Contribution ID: **33** Type: **Oral presentation**

#08-33 Novel thermometry approaches to facilitate safe and effective monitoring of nuclear material containers

Wednesday, June 23, 2021 11:20 AM (20 minutes)

Many established nuclear power producing countries are currently decommissioning first and increasingly second-generation power producing plants and fuel processing facilities. This has led to a growing inventory of different containers and packages containing radioactive waste and other nuclear materials, as well as storage of spent fuel. Here we describe establishment of in-situ yet remote health monitoring techniques based on novel temperature measurement methods for different containers and stores used to hold different radioactive waste forms, such as intermediate level waste (ILW), special nuclear materials (SNM) and spent fuel.

ILW and SNMs are usually held in high quality stainless steel containers. In the case of the containers used by Sellafield Ltd the ILW suspended in cementitious grout and held in 500 litre containers (drums), whilst in the future heterogenous ILW will be stored wet in approximately 3 m3 packages (i.e. covered with water inside the container). SNMs are generally held in nested stainless-steel containers. Advanced gas cooled reactor (AGR) spent fuel will be held in ponds awaiting final disposal.

Each of these container waste forms and spent fuel storage has particular monitoring challenges to ensure the on-going integrity of the storage. Particular challenges are; the high level of gamma radiation emitted by the ILW and spent fuel, the gamma and neutrons emitted by the SNM, and the general inaccessibility of the store and pond configurations.

Here we report the use of quantitative remote temperature measurement techniques to assess the condition of waste package or temperature of spent fuel racks. Specifically the following measurement requirements are addressed; ILW container health and internal temperatures, determination of the surface temperature of SNM containers in-situ with the future prospect of identifying surface and sub-surface defects, development of surface thermometry approaches for a new long term storage container of SNM, development of a method to determine the temperature of racks holding spent AGR fuel and a remote thermal method to identify anomalously high temperature 3 m3 packages in stores.

Key to the success of this work is that the thermometry approaches, where needed, are traceable to the current temperature scale the International Temperature Scale of 1990 (ITS-90). Robust traceability to ITS-90 gives a stable baseline against which to compare all subsequent measurements and confidence in the actual measured temperatures. Temperature measurement uncertainties are evaluated according to the internationally accepted Guide to the Expression of Uncertainties (GUM).

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Session Classification: 08 Decommissioning, Dismantling and Remote Handling

Track Classification: 08 Decommissioning, Dismantling and Remote Handling