

Experimental Testing and MCNP Modelling of Spectroscopic Radiation Portal Monitors to detect Illicit Trafficking of Nuclear Material

The threat of criminal or unauthorized acts involving nuclear and radioactive material has grown since the early 1990s. Each year IAEA reports loss, theft or out of regulatory control discovery of radioactive materials. Most incidents are minor, but material is potentially available for criminal acts. Illicit trafficking and theft of nuclear material can lead to nuclear proliferation and the possible construction of improvised nuclear devices or radiological dispersal and exposure devices. Measures to reduce the radiological and nuclear threat are many-faceted. An important component is the ability to detect illicit transport of radioactive and nuclear material. Fixed installed pedestrian Spectroscopic Radiation Portal Monitors are designed to be used at checkpoints such as those at road and rail border crossings, airports or maritime ports, to detect the presence of radiation in order to alert of the presence of nuclear or radioactive material. A combination of experimental data and simulations is a good way to study the performance of Spectroscopic Radiation Portal Monitors in realistic conditions. The paper presents a process to evaluate the performances of a portal, based on a combination of experimental data and MCNP simulations to calculate the detection probability and the false alarm rate for different measurement scenarios. IRSN developed platforms for testing Spectroscopic Radiation Portal Monitors for pedestrian control and collected experimental data from two Spectroscopic Radiation Portal Monitors, the first one is an available commercial radiation detection equipment and the second tested portal dates from the 80th but still present in nuclear facilities. Many scenarios were tested with different sources using realistic setups and many experimental data were collected using radioactive and nuclear material available in IRSN nuclear security laboratory. The tested equipment were simulated with MCNP based on the data provided in the user manual and the standards found in the industry. The MCNP model of the portal and its surroundings was adjusted to be as realistic as possible based on measurements performed with americium, cesium, cobalt, barium and europium sources. To get a realistic idea of the uncertainty, all the variables inherent in the measurement were considered. Their relative contributions were identified and quantified, then propagated to predict an overall uncertainty. The combination of experimental data, numerical simulations and uncertainty evaluation showed good agreement with experimental assays. The results were then used to test the sensitivity of Spectroscopic Radiation Portal Monitors to special nuclear materials for different alarm thresholds. This process applied to different scenarios according to defined targets should help in the selection of operating characteristics of the portal.

Gender

Male

State

France

Author: DEYGLUN, Clement (IRSN)

Presenter: DEYGLUN, Clement (IRSN)

Track Classification: MORC: Detection technology development and performance testing