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Testing facility for the qualification of measurement devices suitable for detecting nuclear and radioactive material

Fraunhofer INT has a profound long-lasting experience in the assessment of measurement devices for the detection of nuclear and radioactive material. This includes searching and identifying radioactive and nuclear material with hand-held and portable gamma and neutron measuring devices including electrically cooled germanium detectors. For example, the latter were investigated concerning the outcome of the implemented analysis routines and the obtained spectra which were examined using different further analysis tools.
Due to this long-lasting experience some researchers of the working group have been invited to participate as experts in the Illicit Trafficking Radiation Assessment Program (ITRAP+10). ITRAP+10 was a program initiated by the European Union and the United States to evaluate the performance of available commercial radiation detection equipment against consensus standards.
The ITRAP+10 effort accentuated the need to have accredited testing laboratories in the EU to perform testing against the consensus standards in order to have reproducible test results, independent of testing location. Therefore the next step is to enable laboratories to work as such testing locations. Initiated by the EU, this was carried out in ITRAP+10 Phase II in work package 2. Fraunhofer INT has conceived and built a test environment to perform the corresponding dynamic and static test measurements using neutron and gamma sources. This testing facility can be used to qualify new devices as well as to test already deployed ones. Therefore a reliable comparison between different devices is possible. This could be helpful for the procurement of additional components when the presently used version is no longer available or a replacement with new equipment has to be done.
The system for static measurements consists of a central cube for placing the radioactive sources. While not needed for the measurement, the source is moved down and shielded with a combination of lead and polyethylene, both borated and normal. Polyethylene is inserted for neutron sources used. A maximum shielding with a thickness of 15 cm and a height of 30 cm can generally be placed around the source using 5 cm x 10 cm x 20 cm bricks. If other thicknesses are needed, individual solutions can be realized.
Guide rails can be attached to the central cube, each of which has a roller carriage placed on it and can hold a measurement device. Their height can be adjusted which enables us to bring the center of the detectors to the same height as the center of the source. The roller carriages are fully adjustable via setting wheels. The roller carriages and the guide rails are equipped with scales for measuring distances. We have four guide rails which can each be placed on the sides of the cube or can be placed in a row in order to enlarge the distance from the source. The length of each guide rail is 1.5 m.
In order to measure the time behavior e.g. time to alarm or time to stabilize a measurement value, it is necessary to have a short lift up time for the radioactive sources. Intended times are below 0.5 s. Therefore a lift-up mechanism based on compressed air was chosen for the lifting device. The resulting lift uptime is about 0.35 s.
The tests performed at the static measurement system may include tests of general requirements, radiological tests, and radionuclide identification tests. The tests of general requirements in general involve tests of the user interface, battery requirements, and documentation of audible and vibrational alarms. The radiological tests comprise, for example, tests concerning false identification rate, time to alarm, accuracy tests for photons, and over-range and gamma response of a neutron detector. The quality of the nuclide identification results is part of the radionuclide tests.
The system for dynamic measurements consists of a roller carriage running on guide rails. The radioactive or nuclear material required for performance tests are positioned on the roller carriage at a variable height. This system is especially suitable for the qualification of portal monitors. The material in question passes by the monitor at a well-defined distance and height. Due to limitations of lab space, portal monitors for pedestrians are best suited to be qualified by the system. Possible aspects of qualification measurements include the behavior of the monitor's occupancy systems, false alarm tests, response to gamma and neutron radiation, neutron indication in the presence of photons, over-range tests, and the determination of the vertical profile of the monitor.
Both systems of the testing facility and their options for qualification measurements will be presented.

State

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