National Centre for Nuclear Security and Non-Proliferation

CASE STUDY: NUCLEAR SECURITY

Stand-Off Alpha Radiation Detection Under Daylight Conditions

The National Nuclear Laboratory (NNL) and the Atomic Weapons Establishment (AWE) plc have been collaborating to seek solutions that could enable the stand-off detection and identification of radiologically hazardous sources of alpha radiation and provide an accurate assessment of their location.

Accurate mapping

As a time-critical component of emergency responses, there is a need to map radiological contamination more accurately and rapidly. Commercial off-the-shelf (COTS) hand-held alpha radiation monitoring equipment requires close proximity sweeps of the surfaces of potential source materials. This is time consuming, labour intensive and may not even be possible in some situations due to safety restrictions.

Novel systems are sought that can operate from a distance of up to, several metres under a range of illuminated conditions, including daylight.

Collaboration between NNL and AWE has identified research into a possible solution to the remote detection of alpha emitters. This may be achieved by measuring the secondary radioluminescence light (air fluorescence) that is induced by alpha particles when absorbed in air.

Alfa Rift Oy has used a telescope to collect the radioluminescence photons connected to a photomultiplier tube. Matching of the photocathode response and filter pass-band allows the sensing of a faint emission in a brightly illuminated environment. Alpha activity of 4 kBq was acquired at 1 metre using a 10 second acquisition time, when ultraviolet-free lighting is present, and also, 800 kBq under bright fluorescent lighting.

In-situ analysis

The detection principle is a scanning imager for the detection of alpha contamination with the primary operation mode being a point scan with a motorized tripod. Using real-world samples,

being supplied by NNL, to perform in-situ analysis to increase the Technology Readiness Level (TRL) to realise a deployable instrument.

NNL working in collaboration with AWE allows a strong joint security application to address the challenge of detecting alpha radiation under daylight at a distance. The experience gained and added value of this cross-over of defence and civil nuclear interaction.

This allows new contacts and capability interactions to aid global nuclear enterprise especially in operations and decommissioning.

Moreover, the value of the open innovation arrangements attracts and supports small to medium enterprises (SME's), such as Alfa Rift Oy, to develop novel technology for the nuclear industry to support Nuclear Security, Emergency Preparedness and Non-Proliferation.

For everyday use in condition monitoring and inspection of laboratory environment operations and furthermore decommissioning activities.

The challenges in the security & safety of the UK society where crime scene investigations and screening of widespread alpha contamination can be an extensive task (e.g., Litvinenko case). Being prepared for emergency situations of deliberate dispersion of alpha emitters or accidents with alpha emitting materials, utilising new technologies such as this will reduce the time and cost and increasing safety of the investigating resources.

The decommissioning challenge of nuclear installations being the radiological characterization, this is the central part of the process, alpha emitters have specific challenges, workers needing to wear protective suits, slowing down the process of decommissioning and the cost and complexity of these operations is high.

Using the detection principle of a scanning imager for the detection of alpha contamination will help speed up the process, while keeping the operators safe by remotely, controlling a motorized tripod to identify areas of interest for further investigation.

More Information

Game Changer Challenge GC_597

Stand-Off Radioluminescence Mapping of Alpha Emitters Under Bright Lighting - Scientific Journal IEEE Transactions on Nuclear Science Volume: 63 Issue: 3