T3.1-P37

The Radiological Field Training Simulator (RaFTS)/Spectroscopic Injection Pulser (SIP) For Radiation Detection Training Without Radiation Sources In On-Site Inspection

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LLNL has developed a capability for radiation detection training that enables the use of detection instruments against realistic radiation sources/scenarios of interest to CTBT on site inspection. The sources and scenarios include, for example, short-lived relevant radionuclide radioactivity that is distributed on the surface inside an inspection area or might be contained in samples collected from the same. Our method uses actual operating radiation detection instruments and injects, pulse by pulse, the response into the detectors. Demonstrated on an operational and commercial HPGe detector used for in situ gamma spectroscopy and/or sample measurements in a field laboratory, our approach maintains the full physics fidelity while also maintaining the realities of field operations. This poster describes the current capability and results of some recent demonstrations performed at the Vienna International Centre and also in Washington, DC.

BACKGROUND

- Preparations for CTBT On Site Inspection (OSI) includes training on the use of radiation detection equipment which is used to search the inspection area, identify, and characterize radiation sources for signatures relevant to the treaty
- A real OSI could involve encounters with high-radiation sources, and wide-area contamination
- Training is inadequate because representative radiation sources in realistic configurations can't be used for reasons of cost, radiation dose, etc. (mixed fission product relevant radionuclides in a contamination field, for example)
- These and other scenarios are exactly what inspectors need to prepare to encounter
- LLNL has developed and demonstrated a next-generation training capability that enables operational radiation detection equipment to respond just as they would in the presence of real radioactivity and follows the correct physics of those encounters

GOAL

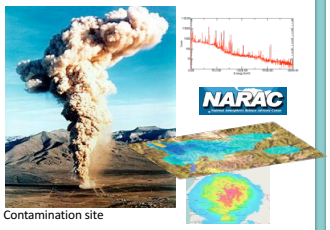
REAL EQUIPMENT

Radiation detection equipment should respond consistent with the instrument type, the strength of the source, the distance to it, and the time measured

Instruments should give consistent responses for the radiation sources across the different types (radiation dosimeter, survey instrument, aerial search, carborne search, backpack, and in situ gamma, even samples measured in the base of operations lab.)

REALISTIC SCENARIOS

For OSI, scenarios should include both location and time-varying source terms of relevant radionuclides deposited on the surface as can be created using tools such as the U.S. National Atmospheric Release Advisory Center (NARAC) and deposition codes such as HOTSPOT



Contamination site

OPERATIONAL CONDITIONS

Distance between the source(s) and detector should control how the individual instrument responds and produce data consistent with the measurement time, distance, and type of detector (scalar, spectral, etc.). Inspectors should be able to train using their instruments in environments representative of a real OSI

CONCEPT OF HARMONIZED INSTRUMENT RESPONSES DEMONSTRATED ON A TABLET PC[1]

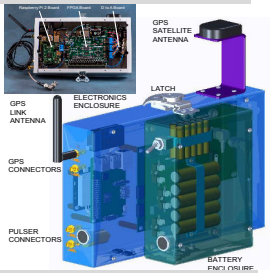
- Multi-detector-type harmonized instrument response demonstrated on a GPS-capable tablet-PC for which the physics of the encounter dictates the response

- Computers don't realistically represent logistical/operational issues experienced by users while using the instruments (examples: How long an inspector measures, instruments get too heavy, can't read the screen in the sun, batteries don't last long enough….)

RADIATION FIELD TRAINING SIMULATOR (RaFTS) SOLUTION[2]

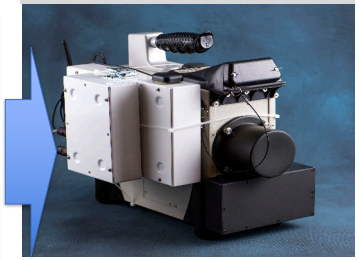
- FPGA, D-to-A converter, integrated GPS, processor and control software draw upon pre-calculated spectral files for the detector type and at the scenario location
- Radiation signatures are fed into the detector at the rate dictated by the location within the scenario

RaFTS Pulser Electronics and Battery Enclosures – Mechanical Design



Each detector has a RaFTS. In principle, could be networked or controlled remotely

RaFTS prototype injects data into a modified commercial HPGe (Ortec Detective in this case)



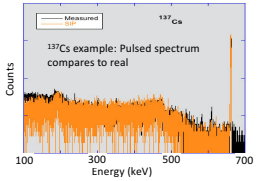
External mount for visual confirmation of training mode, removed when not in use

[1]Kreek et al., 2015 Science and Technology Conference, CTBTO, T2.1-P9 (2015)
[2]Kreek et al., "Incident Exercise in a Virtual Environment," U.S. Pat. App. No. 2016-0203727

RESULTS

- Demonstrated location-controlled pulse production and injection into a HPGe without negatively impacting instrument performance
- Realistic scenarios demonstrated in which a contamination scene of relevant radionuclide shows location-varying deposition concentration

Collected HPGe γ-spectrum is realistic and can be analyzed



Demonstrate walking into simulated ^{137}Cs contamination area in a local parking lot

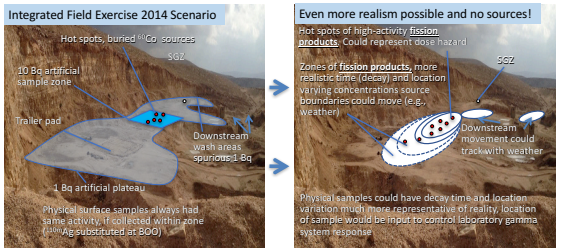
Just like a real source, measurement procedure, time and distance to source control data rate and quality of data collected

CONCLUSIONS

- Tablet-PC concept demonstrated benefit of all instruments responding in a physically consistent manner
- RaFTS prototype connected to a HPGe injects location-based pulses and produces realistic data in a real detector
- Raw data collected is realistic for the detector and can be analyzed
- Eliminates many needs for radioactive sources in training

FUTURE

- Scenarios could be much more realistic, dramatically improve training experience



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