A petty officer assigned to the USS Frank Cable, a submarine tender, uses a RADIAC meter on another officer to monitor possible radiological contamination. (US Navy photo by Petty Officer 1st Class Kim McLendon.)

RADIAC Project Produces State-of-the-Art Simulation Tools to Help Detect Radiological Hazards

Radiological hazards pose serious risks to personnel working in military, medical, industrial, and academic research environments. Yet current training on radiation detection, indication, and computation (RADIAC) instruments often relies on outdated technology and methods. A CTMA project is working to create state-of-the-art RADIAC simulation tools that will enable organizations to improve the performance of their employees in standard work processes and emergencies.

The project—Advanced Radiation Detection Indication and Computation (RADIAC) Technology—brings together four naval shipyards: Puget Sound, Portsmouth, Norfolk, and Pearl Harbor, with industry participant Radiation Safety & Control Services (RSCS), Inc.

The project kicked off in September 2020, when the team was tasked with developing new prototype simulation tools to replace outdated training technology and methods. The team used RSCS's commercially available training system called SIM-Teq® to create RADIAC and dosimetry simulation tools for training and testing with equipment that resembles those currently in use.

Dosimetry is the measurement of the amount or dose of radiation absorbed by a substance or living organism by using a dosimeter, an instrument used to measure ionizing radiation exposure via alpha or beta particles, neutrons, gamma rays, or x-rays. Dosimeters can come in many shapes and sizes, depending on their purpose. Personal dosimeters are small devices that are typically worn on the outside of clothing and are used by personnel working in industries such as nuclear power, military, maritime, construction, nuclear medicine, radiology, oncology, and public safety.

In the United States, 1.5 million radiation workers are occupationally exposed to ionizing radiation each year. Of this number, 300,000 nuclear workers are employed in the commercial nuclear industry.

"The SIM-Teq® product line incorporates 'live' sources that are not radioactive and can be configured through an instructor computer software application called the simulation control center or SCC," said Steve Nester, business development manager, Product Sales, RSCS. "The training instruments auto-respond to the simulated sources much the same as real instruments respond to real radioactive sources, based upon their distance and geometry between one another."

The technology is a portable wireless training network that facilitates communication between all types of simulated

radiation detection equipment, from all the different manufacturers.

"The SIM-Teq system is agnostic to all the instrument manufacturers," said Nester. "Most detection equipment can be modified or replicated, either through a probe or the meter itself, to work within the training platform."

The new simulation tools consist of an executable native simulation control software, optimized for a PC/tablet touch screen, that can be loaded onto a WIN10 and 11 PC/tablet, without using the internet, along with two simulation devices. The first is a Two-Way Ranging (TWR) simulated gamma radiation source. It's a battery-operated portable device that provides an omnidirectional simulated radiation energy field that can be wirelessly configured via the SCC software application to a desired dose rate. The second is a simulated Thermo Fisher Electronic Personal Dosimeter (EPD), another small, battery-operated portable device that operates like currently fielded dosimeters.

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>
> *-Steve Nester, RSCS*

The technology can create complex scenarios, including exposure to extremely small sources of radiation that require close proximity to register on a dosimeter, and exposure to large sources of radiation that can be detected from a distance of over 30 meters.

The project's second phase began in August 2021 and is scheduled to wrap up in February 2024. Phase II added more training instruments. This includes the development of two training probes, simulating a Beta/Gamma probe that will auto-respond to the simulated gamma sources, and a Beta Frisker probe that will auto-respond to pre-programmed radio-frequency identification device (RFID) sources that emulate surface contamination.

These simulation tools are designed to train personnel in the basics of radiation safety: time, distance, and shielding, to help them minimize their dose of radiation during work activities. The tools are easily adjustable by the instructor to simulate standard work processes and emergencies. Moreover, the simulation tools can be used in areas with physical constraints such as tight spaces, high vertical surfaces, and physical barriers.

"I recently supported a NATO exercise in the Czech Republic, where they had a variety of scenarios," said Nester. "One example was an IED explosion with radioactive material that caused a lot of casualties. When the victims were brought into the field hospital, they had to determine what to do with an injured person who had become a high radiation source."

These simulation tools can also be used for many training scenarios such as searching for sources, establishing access boundaries, or surveys of radioactive material in transport.

Above all, the project's prototype simulation tools can train staff in worst-case scenarios safely without exposing them to actual radiological hazards—even to very high, life-threatening levels. If employees are realistically trained and understand how their equipment will respond in a real-world situation, then they can confidently respond as trained and mitigate potential radiological emergencies whenever they may occur.

While these tools were initially designed for personnel at naval shipyards, their use could be transitioned to any Department of Defense (DOD) personnel who generate and handle radioactive material, maintain nuclear systems or equipment, and may be exposed to occupational ionizing radiation. The training tools will improve the performance of chemical, biological, radiological, and nuclear (CBRN) responders in all military branches, and various agencies of the DOD with radiological contamination detection and decontamination methods.

"This technology allows training of not only one specific organization but also larger groups needing to prepare for coordinated responses, such as emergency responders and Homeland Security personnel," said Nester. "It allows each of these groups to come together in a larger drill scenario, and even include fire and police response outside the fence line."

Commercial, state, and federal entities can readily adapt the simulation tools to meet their specific training requirements. These tools can be used for those who work in industries that handle radioactive materials, to ensure their radiation exposure is kept as low as reasonably achievable (ALARA).

These realistic, adaptable simulation tools have the potential to make a global impact on radiological safety for both personnel exposed to radiological hazards and the general public. ■