

Integrating Safety and Security by Design for Transportation Packagings of Nuclear and Other Radioactive Material

In a resolution at the International Atomic Energy Agency (IAEA) 2002 General Conference, the IAEA adopted an integrated approach that includes physical protection and material accounting for transport of radioactive material and nuclear material and recommends that security system designers consult with safety experts. [1] In this paper, we present examples of the integration of safety and security by design for two transportation packagings of nuclear and other radioactive material: “smart drum” technology and a new compact Type B packaging design.

The “smart drum” technology, described in reference [2], is the coupling between (1) a robust drum-type transportation packaging that meets all regulatory requirements and safety standards for nuclear and other radioactive material and (2) the ARG US radio frequency identification (RFID) system with multiple sensors that enables remote tracking and monitoring of the packages in real time, with automatic alert/alarm capabilities, to enhance security during transportation and in-transit storage. The ARG-US—meaning “watchful guardian”—RFID system was developed by Argonne National Laboratory (Argonne) for the U.S Department of Energy (DOE) Packaging Certification Program, Office of Packaging and Transportation, Office of Environmental Management. The system consists of RFID tags, readers, and software for local and web-based applications that can continuously monitor and track tagged packages during storage, processing, transportation, and disposal. Demonstrations and field-testing of the ARG-US RFID systems for drum-type packages during storage and transportation have been conducted at selected DOE sites, including Argonne, Savannah River National Laboratory, and the Nevada National Security Site. Development, testing, and integration of radiation sensors (gamma and neutron), tactile and electronic loop seals, readers and multiple communication platforms, secured servers, and web application user interfaces have also continued over the last ten years. The patented RFID surveillance tag was licensed to Evigia Systems, Inc., in 2014. The system is commercially available and meets U.S. export control requirements.

The other transportation packaging is a new compact Type B packaging design [3] for storage, transport, and disposal of disused radiological sources. Results of engineering analyses showed that the compact Type B packaging design could accommodate up to seven disused CsCl capsules, with a total heat dissipation capability of up to 1,000 W. The all-stainless-steel packaging design provides excellent structural, thermal, and shielding performance under normal conditions of transport (NCT) and hypothetical accident conditions (HAC), as specified in the U.S. Title 10 of Code of Federal Regulations, Part 71 (10 CFR 71) Packaging and Transportation of Radioactive Material. The stainless-steel structure components also provide excellent long-term performance against general corrosion and stress corrosion cracking during extended dry storage, thus enabling subsequent transportation (without repackaging of the disused CsCl capsules) to a geological repository or deep borehole for final disposal. The compact Type B packaging design also enables the use of ARG-US remote monitoring systems to enhance safety and security during extended storage, transportation, and disposal. In this paper, we will provide case studies of these two transportation packagings, illustrating the integration of safety and security by design.

References:

1. IAEA Nuclear Security Series No. 11, Security of Radioactive Sources, Implementing Guide, 2009.
2. Y.Y. Liu, H. Lee, B. Craig, and J.M. Shuler, “Smart Drum Technology for Radioactive and Other Hazardous Materials,” Waste Management Symposia, Phoenix, AZ, USA, March 18–22, 2018.
3. Z.H. Han, J. Li, D. Kontogeorgakos, Y.Y. Liu and J. M. Shuler, “A New Type B Packaging Design for Disused Radiological Sources,” INMM 59th Meeting, Baltimore, Maryland, USA, July 22–26, 2018.

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