

# Real-Time Monitoring of Nuclear Cargo Conveyance Using ARG-US TRAVELER

The ARG-US (meaning “Watchful Guardian”) TRAVELER [1] has been developed under the auspices of the U.S. Department of Energy (DOE) Packaging Certification Program, Office of Packaging and Transportation, Office of Environmental Management. It is the latest innovative product in the family of ARG-US remote monitoring systems technology for risk-significant materials in cargo conveyances during transportation by truck, rail, or ship. Risk-significant materials may include nuclear and other radioactive material, radiological sources, and/or hazardous chemicals, for which safety, security, and safeguards are major concerns, because the threats of sabotage and theft are real with very serious potential consequences. The TRAVELER’s modular platform, both in hardware device components and software interface drivers, allows sensors to be added or removed (i.e., customized) with relative ease. For example, the TRAVELER’s modular suite of sensors may include temperature, humidity, and radiation (gamma and neutron) sensors, as well as a 3-axis digital accelerometer, an electronic loop seal, and a digital camera, depending on monitoring needs. The TRAVELER also uses redundant methods (i.e., cellular and satellite) for the transmission of sensor data, alarm annunciation when sensor thresholds are violated, and clearance of alarms remotely from a command center, all dynamically with time stamps and GPS locations. Powered by rechargeable lithium-ion batteries, the TRAVELER in its current configurations can support continuous tracking and monitoring (at 2–5-minute intervals) for up to 6 days.

This paper will describe recent demonstrations of the TRAVELER in a rail and a truck shipment of nuclear cargo conveyance in the United States. We will focus on sensor performance, particularly data analytics and alarms annunciation, after preset sensor thresholds are violated in “staged” incidents during transportation and “simulated” in-transit storage. The staged incidents included temperature alarms, as well as alarms caused by disengaging an electronic loop seal and violation of the invisible geofences. We will also discuss the addition of a digital video camera externally to the TRAVELER (via a USB connection) to enable investigation of incidents (and/or accidents) after their occurrence in the field. Future development of the ARG-US TRAVELER system may include (1) addition of dynamic weather maps for the web application user interface; (2) addition of a geographic information system (GIS) to enhance emergency response and enable users to access lists of key resources, including all emergency medical service stations, fire stations, hospitals, local law enforcement, and state emergency operations center within a user-defined region surrounding the incident/accident; and (3) deployment of a self-forming, wireless sensor network (WSN) of TRAVELER and blink sensors by the emergency responders to gain situational awareness near real-time and actionable information in the field.

Reference:

1. Y.Y. Liu, B. Craig, and J. Shuler, “ARG-US Remote Monitoring Systems for Enhancing Security of Radioactive Material,” IAEA International Conference on the Security of Radioactive Material: The Way Forward for Prevention and Detection, Vienna, Austria, Dec. 3–7, 2018.

## Gender

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**Track Classification:** PP: Transport of nuclear and other radioactive material: practices, challenges and regulatory issues