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Advancing Safety and Security by Design through the Development of RadSecure Mover for the Transport of Radioactive Material in Indonesia

Indonesia's nuclear programme is entering a decisive stage with the planned commissioning of its first nuclear power plant (NPP) by 2032. This milestone will significantly increase the demand for the safe and secure transport of radioactive materials, spanning medical isotopes, research reactor fuel, radioactive sources, and ultimately nuclear fuel cycle materials. Transport is widely recognized as one of the most sensitive links in the nuclear infrastructure chain, where both safety risks—such as accidents, radiation exposure, and environmental contamination—and security threats—such as theft, sabotage, or malicious acts—must be managed in an integrated manner. To address Indonesia's lack of purpose-built transport vehicles, this research introduces the RadSecure Mover, the country's first dedicated design for radioactive material transport, formally registered as industrial design intellectual property. Unlike modified commercial trucks, the RadSecure Mover integrates safety-by-design and security-by-design principles into a single platform. Key features include multilayer shielding for gamma and neutron emitters, reinforced aerodynamic cabin functioning as a command-and-control centre, controlled access doors for inspection and secure loading, an integrated hydraulic crane, and internationally compliant hazard communication elements. Beyond static design, the project advances into simulation-based validation to ensure regulatory compliance and operational credibility. Shielding effectiveness will be quantified using PHITS, while accident and sabotage release scenarios will be modelled with ALOHA. Outputs will be combined with QGIS geospatial mapping to overlay dispersion pathways with real transport routes, population density, and emergency response nodes. Finally, discrete-event simulations using SimPy will test response performance, measuring time-to-safe-state and cumulative dose under different operational scenarios. The RadSecure Mover thus bridges a critical infrastructure gap ahead of NPP deployment, establishing a replicable model for newcomer states. By embedding safety and security functions from the outset, it strengthens resilience, compliance, and public confidence in radioactive material transport, supporting IAEA goals of innovation and preparedness in nuclear infrastructure.

Country or International Organization

Instructions

Author: Mr JUNIANTO, Irvan Dwi (National Research and Innovation Agency of Indonesia)

Presenter: Mr JUNIANTO, Irvan Dwi (National Research and Innovation Agency of Indonesia)

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