SYNOPSES

THE ELDORADO-8 RE-SOURCE: MASTERING SAFETY, SECURITY, AND LOGISTICS IN THE TRANSPORT AND INSTALLATION OF A HIGH ACTIVITY COBALT-60 SOURCE

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1. Introduction

The safe and secure transport of high-activity Category I radioactive sources, such as Cobalt-60 (Co-60) used in teletherapy, presents complex challenges requiring meticulous planning, regulatory adherence, and robust logistics. This paper details the comprehensive safety and security framework implemented for the replacement of a Co-60 source in the Eldorado-8 teletherapy calibration machine located at the Secondary Standard Dosimetry Laboratory (SSDL) of Malaysian Nuclear Agency (NUKLEAR Malaysia). The operation involved the transport and installation of a new 2,188 Ci source, transported using a Type B(U) package over a 50 km inland distance following its arrival by air freight at Kuala Lumpur International Airport (KLIA) Cargo Hub.

2. Objective

The primary objective of this paper is to share a successful, real-world case study, highlighting the integrated protocols developed to meet both IAEA Regulations for the Safe Transport of Radioactive Material (SSR-6) and national regulatory requirements by the Department of Atomic Energy, Malaysia (ATOM Malaysia) for safety and physical security, especially the transport of Dangerous Goods Cargo.

3. Integrated Safety and Security Methodology

The entire operation from import approval to final source installation was meticulously segmented into three critical phases, designed and executed under the supervision of the Radiation Protection Supervisor (RPS) of NUKLEAR Malaysia.

3.1 Pre-Transport Planning and Licensing

Prior to movement, an exhaustive licensing and logistical phase was executed. This included:

- **Regulatory Compliance:** Securing approvals from ATOM Malaysia for the import, ownership, and transport of the Category 1 source. This process was critical for the new source, which was sourced from the Institute of Isotopes Co. Ltd., Hungary.
- **Transport Risk Assessment and Planning:** A detailed Work Implementation Plan was submitted to ATOM Malaysia, which included identifying three potential routes, from KLIA Cargo Hub NUKLEAR Malaysia Bangi Complex, a distance of approximately 50 km. The plan meticulously documented potential height limitations on the route to prevent vehicular accident or delay.
- **Physical Security Plan:** The Category I source mandated enhanced security. The security plan detailed the use of **Armed Guard,** who were equipped and authorized to provide armed escort throughout the transport journey. Personnel involved in the transport and installation were vetted for reliability.

3.2 Transportation Phase: Safety and Security in Transit

The road transport phase was executed under strict physical security and radiation protection controls.

Key Implementation Details (December 2022):

- **Armed Escort:** Transport was conducted during the night (6:00 PM – 09:00 PM) and was protected by a convoy that included the Armed Guards, RPS from NUKLEAR Malaysia and the contractor. The transport vehicle must be accompanied by a minimum of two personnel and must never be left unattended.
- **Package Verification:** Upon arrival at the KLIA Cargo Hub and before onward transport, the Type B(U) flask inside the truck was meticulously verified for document conformity, physical integrity, and correct labelling (UN 2916).
- **Radiological Safety and Control:** Mandatory Leak Testing was performed on the package before shipment and upon arrival to confirm source containment integrity. The transport was continuously escorted by RPS to ensure radiological safety protocols (ALARA) were maintained, including dose rate monitoring and erection of safety barriers at the KLIA Hub.

3.3 On-Site Movement and Installation Phase (Delayed Execution, January 2023)

The final stage of source replacement, initially planned for **16 January 2023**, involved manoeuvring the heavy flask and performing the source exchange in the SSDL Bunker (Blok 32). The entire process was ultimately completed on **18 January 2023** due to unforeseen technical complications.

- **Logistical Challenges (Bunker Dilemma and Technical Delay):** The flask had to be transferred from the transport vehicle to the Eldorado-8 machine head inside the bunker. Initial site constraints included narrow corridors, ramp gradients, and a raised threshold (about 15 cm) at the bunker entrance necessitated the deployment of specialized lifting and movement equipment (ramps, rubber mats, lifter units, portable gantry). A critical technical challenge emerged during the operation: the holes on the Eldorado-8 machine head did not align correctly with the transfer tool

used to remove the old source and place it into an old teletherapy head for temporary storage, which required additional time and specialized effort to resolve, delaying the completion of the project.

- **Radiological Safety during Source Change:** The source exchange operation was performed remotely by specialized installer engineers (Foss Therapy Services Inc.). Site setup included pre-marked exclusion zones, continuous radiation monitoring by Health Physics Group personnel, and temporary physical security monitoring by the Physical Security Unit of NUKLEAR Malaysia. Direct supervision by the RPS ensured dose limits were maintained **As Low As Reasonably Achievable (ALARA)**.
- **Source Accountability and Disposal:** Post-installation, the old, depleted source (estimated 81 Ci at replacement) was safely removed, repackaged, and transferred to NUKLEAR Malaysia's waste storage facility, ensuring full chain of custody and accountability, as required by the regulatory body.

4. Conclusion

The successful transport and installation of the high-activity Co-60 source, though encountering delays and technical challenges, demonstrated the effective integration of international transport regulations (IAEA SSR-6) with stringent national physical security and radiological safety requirements. The experience highlights the critical role of the Radiation Protection Supervisor in managing complex, multi-agency operations (regulator, logistics, technical installers) and executing tailored solutions for both predictable site-specific logistical issues and unexpected technical failures, thereby guaranteeing the integrity and safety and of Category I radioactive source. The management of security during high-visibility transport offers valuable insights for maintaining public safety and international non-proliferation standards.

References:

1. IAEA Safety Standards Series No. SSR-6, Regulations for the Safe Transport of Radioactive Material (2018 Edition).
2. Malaysia Atomic Energy Licensing Act 1984 (Act 304), Radiation Protection (Transport) Regulation 1988.