Title: Testing and Certification of Packaging for the Safe Transport of Monazite According to IAEA SSR-6 from Brazil to Canada.

Authors and Affiliation: A, Nathalia**,** H, Steven, TAM International LP.

Introduction: Monazite is a rare earth phosphate mineral that contains significant concentrations of thorium, a radioactive element, in addition to uranium. Due to the presence of these radionuclides, it is classified as NORM, Naturally Occurring Radioactive Material. The thorium content in Monazite may range from 5% to 12% by mass, with an average of approximately 7%[1]. For transport purposes, however, the classification of monazite as radioactive material depends not only on the mass fraction of uranium and thorium, but also on the activity concentration (Bq/g). According to the IAEA's SSR-6, naturally occurring materials and ores containing radionuclides are exempt from regulatory control provided that their activity concentration does not exceed ten times the exemption values established in paragraph 401(b).[2]

In Canada, when the uranium or thorium content exceed 3% by mass, it can no longer classified as Low Specific Activity-I (LSA-I), but as LSA-II. In such cases, the SSR-6 requires the use of Industrial Package Type 2 (IP-2). Canadian national regulations also require LSA material to be transported in Type IP-3 packages unless they can be (1) transported in conveyances that are not carrying passengers; (2) are transported in conveyances or freight containers from one consignor only; and (3) are only loaded at the consignor's location and unloaded at the consignee's location[3]. For ocean transport, where the containers are loaded into a freight container, this is possible and then the IP-2 package can be used for monazite transport. For an air shipment, this is not possible due to the multiple loading and unloading operations and therefore the Type IP-3 package is needed.

Section VI of SSR-6 establishes requirements for the testing of packaging intended for the transport and storage of NORM. The prescribed tests include free drop, penetration, water spray, stacking, and, additionally, the internal pressure test of 95 kPa for air transport.

Objectives: This study aims to evaluate the certification and transport of industrial packages containing NORM, highlighting the differences between Canadian and Brazilian regulatory frameworks. Despite existing regulations, many operators remain unaware of specific national requirements, which can lead to improper handling and transportation of radioactive materials. In Brazil, there are currently no local suppliers of packages fully compliant with SSR-6 specifications. Consequently, TAM International, the company responsible for NORM logistics between Brazil and Canada, submitted domestically manufactured packages to qualification testing to ensure transport safety. These tests were conducted by the Nuclear Technology

[1] https://world-nuclear.org/information-library/appendices/mineral-sands-appendix-to-norm-information-paper?utm_source=chatgpt.com

[2] https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1798_web.pdf?utm_source=chatgpt.com

[3] https://laws-lois.justice.gc.ca/eng/acts/N-28.3/

Development Center (CDTN/CNEN), a Brazilian reference institution in applied research and specialized services in nuclear safety.

Methodology / Tests: Performance tests for the certification of Industrial Package Types IP-2 and IP-3 were conducted in accordance with IAEA SSR-6 requirements, evaluating two package types based on their intended transport modes: flexible intermediate bulk containers (FIBCs) for ocean and ground transport, and metal drums for air transport.
The 80 × 80 × 65 cm FIBC was fully filled with a non-radioactive surrogate simulating monazite sand (density 5,000 kg/m³; total mass ~2,000 kg) and subjected to stacking and penetration tests to verify compliance under simulated operational conditions for IP-2.
The 50-liter cylindrical steel drum (384 mm diameter, 595 mm height; net weight 6.3 kg; maximum gross mass 180 kg) with a removable lid and lever-type locking ring was filled with a surrogate simulating monazite (density 2,300 kg/m³; mass ~115 kg) and underwent drop, penetration, and stacking tests to ensure IP-3 compliance, complementing previous water spray and internal pressure assessments.
These procedures allowed verification of both package types under realistic transport scenarios while ensuring adherence to regulatory requirements.

Results: The successful performance of the Type IP-3 drum and Type IP-2 FIBCs tests demonstrates that the package meets IAEA SSR-6 requirements for transport of NORM, ensuring safe and compliant shipment of monazite from Brazil to Canada.

Conclusion: A preliminary and critical step in radioactive material transportation is the comprehensive evaluation of the material type, the packaging design, and the regulatory frameworks of all transit and destination countries. This study underscores the importance of understanding and complying with both national and international regulations, particularly given the differences between Brazil and Canada discussed in this paper. However, in practice, the lack of fully compliant packaging providers in certain countries creates regulatory gaps that may result in non-compliant transport practices. The results further highlight the relevance of domestic qualification testing to ensure transport safety and regulatory compliance.

References

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