

# **Safety-Security Interface in Madagascar: Experience, Challenges, and Opportunities with Transport of NORM**

*by Dr J.L.R. Zafimanjato  
MSc N. Zafimanjato  
National Institute for Nuclear Sciences and  
Techniques  
PO BOX 3907, 101 Antananarivo, Madagascar  
Dr C. Massey  
International Atomic Energy Agency  
PO BOX 100, 1400 Vienna, Austria*

- Location: East Africa, Indian Ocean
- Area: 592 000 km<sup>2</sup>
- Population: 23 millions



# Industry sectors identified

- (01) Extraction of rare earth elements;
- (01) Mining of ores other than uranium ore;
- (02) Oil drilling;
- (01) Production of cobalt and nickel;
- (01) Manufacture of titanium dioxide pigments;
- (01) Extraction of zircon;
- (01) Extraction of chromium;
- (01) Production of iron.

# Transport of radioactive minerals



## IAEA Safety Standards

for protecting people and the environment

### Regulations for the Safe Transport of Radioactive Material 2018 Edition

Specific Safety Requirements  
No. SSR-6 (Rev. 1)



# Transport of radioactive minerals

## Relevant exposure scenarios:

- Exposure to gamma radiation
- Dust (only when mineral transported in bulk)
- Radon (sometimes in storage areas, cargo holds of ships and containers)

# Transport of radioactive minerals

**Separation of monazite from other minerals and transport**



# Transport of radioactive minerals

## Separation of monazite from other minerals and transport



# Transport of radioactive minerals

## **Detection of radioactivity and dose rate measurements from NORM before transport and shipment are required:**

Even if a material is exempt from the Regulations and the associated signposting, the concentrations of radionuclides may cause gamma radiation levels outside the packages (e.g. sea containers) that are easily detectable by the equipment that is commonly used in ports.

Transport documentation needs to contain detailed information about the concentrations of naturally occurring radionuclides, irrespective of its classification. All necessary information may be provided in the document that is accompanying every material shipment.

The inclusion of the gamma-spectrum for a particular material is highly advisable. Whilst not absolutely necessary, this information would assist in the process of clearing a particular NORM through the radiation detection equipment at seaport.

# Transport of radioactive minerals

Monazite transported by truck from mining separation to seaport for shipment

**August 2018**

**No of containers : 144**

	Dose rate in contact with the container (mSv.h <sup>-1</sup> )	Dose rate at 1m from the container (mSv.h <sup>-1</sup> )	IT
Max	80	38	11.4
Min	23	9	2.7
Average	40.6	19.5	5.8

**March 2019**

**No of containers: 98**

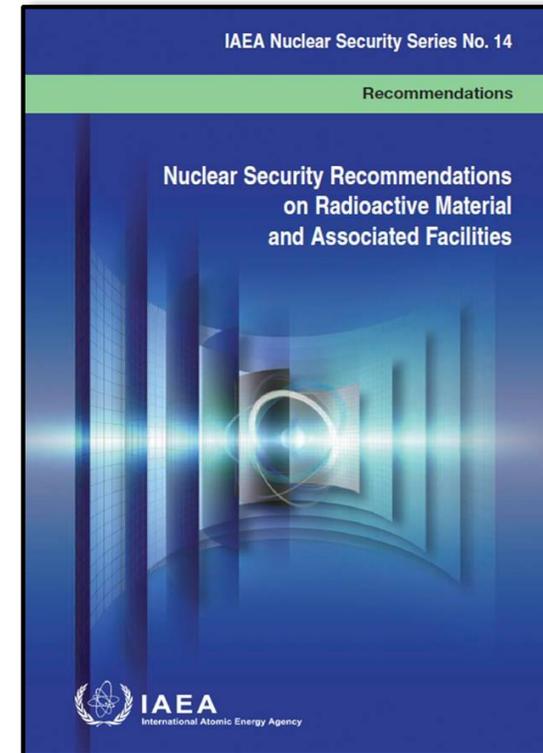
	Dose rate in contact with the container (mSv.h <sup>-1</sup> )	Dose rate at 1m from the container (mSv.h <sup>-1</sup> )	IT
Max	33	17.5	5.3
Min	12	6	1.8
Average	19.5	12.2	3.1

**Reference:** IAEA Safety Standards N° SSR 6 [§ 523, (a), (b) and Table 7.]

# Security measures

## NSS 14 specifies in para. 4.36 that:

when establishing security measures to protect against a *malicious act* particularly *sabotage*, the safety features of the design of the transport package, container and conveyance should be taken into account



# Detection

**In cooperation with Customs Department and Border Polices, at the international airports and seaports.**



# Detection



# Detection

## **NSDA**

**Strategy development**

**Implementation**

**Assessment**

**Site Information and Design Document (SIDD)**

# Detection

## Implementation

In the implementation of the NSDA in Madagascar, radiation detection instruments have been deployed to support the detection and identification of possible illicit trafficking in nuclear and other radioactive materials.

### IAEA to donate the following:

- 16 PRDs (Rad Eye PRD-ER)
- 2 RIDs (FLIR identiFINDER 2 ULK NG gamma only)
- 4 PRD software packages (one per organization- Police, Customs, Gendarmerie, and INSTN)
- USB cable for data communications.



**Pager (PRD)**



**Identifinder (RID)**

# Challenges

## Legislation and Regulation

- Adoption of Nuclear National Policy and Strategies.
- Promulgation of a comprehensive Nuclear Law (*Safety - Security - Safeguards*).
- Revision of Regulations for transport of radioactive materials.

## Regulatory body

- Establishment of an independent and sustainable Regulatory Body.

## Detection and Identification

- Deployment of equipment to identify isotopes such as uranium-235, uranium-238 and thorium-232 at the border.
- Establishment of Site Information and Design Document (SIDD) for the main seaports of Madagascar concerned with NORM shipments.
- Compilation of data to support the development of guidelines and tools to determine with high confidence if an alarming container has only NORM content and if the proper labeling/packaging had been used.
- Help Customs Officers in Madagascar to make more efficient and high confidence decisions regarding alarm assessments to ensure safety and security.