



**ATOMIC ENERGY LICENSING BOARD**  
MINISTRY OF ENERGY, SCIENCE, TECHNOLOGY,  
ENVIRONMENT AND CLIMATE CHANGE

# Naturally Occurring Radioactive Materials (NORM) Waste Management

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**MALAYSIA**

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# INTRODUCTION

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Atomic Energy Licensing Board (AELB) was established under Section 3 of the Atomic Energy Licensing Act 1984 (Act 304) on 1 February 1985.

AELB is responsible to control and supervise the radioactive waste management in Malaysia, including the potential radioactivity harm to human and the environment

Minister of Science had given the power to appoint the member of the Board based on the specific requirements under the Act.



# INTRODUCTION

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Naturally Occurring Radioactive Materials (NORM) is control as radioactive materials in Malaysia.

The control limit is 1Bq/g for radionuclide of U-238 and Th-232 and 10 Bq/g for the K-40.

Any material contain NORM exceed these limit is considered as radioactive materials.

The rare earth that industries using NORM materials as input in chemical process to produce rare earth elements and also generated NORM residues or wastes.

# LEGAL SYSTEM

## Hierarchy of Malaysian Legal System

Atomic  
Energy  
Licensing  
Act (1984)  
(ACT304)

- Act provides for the basic law for regulation and control of atomic energy, for establishment of standards on liability for nuclear damage and for matters connected therewith or related thereto.

Regulations

- Regulations provide more detailed provisions entrusted by the Act.

**Orders and  
Conditions of License**

- Provides additional requirements which are not stated in the regulations or special matters related to provisions entrusted by the Act

**Guidelines, Codes  
and Standards**

- Provides guides, codes and standards to comply with and achieve goals imposed in regulations

# Legislative Framework in Malaysia

## 1. Main Legislation

- **Atomic Energy Licensing Act 1984 (Act 304)**

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  - To provide for the **regulation and control of atomic energy**
  - For the establishment of **standards on liability for nuclear damage**; and
  - For **matters connected therewith or related thereto**

## 2. Regulations

- I. Radiation Protection (Licensing) Regulations 1986
- II. Radiation Protection (Appeal) Regulations 1990
- III. Atomic Energy Licensing (Radioactive Waste Management) 2011
- IV. Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010

## 3. Orders

- I. Atomic Energy Licensing (Small Amang Factory) (Exemption) Orders 1994*
- II. Atomic Energy Licensing (Lighting Arrestors) (Exemption) Orders 1991*
- III. Atomic Energy Licensing (Smoke Detectors) (Exemption) Orders 1991*
- IV. Atomic Energy Licensing (Scanning Electron Microscope) (Exemption) Orders 2002*

# CONTROL LIMIT FOR NORM WASTES

Control limit (licensing) for the activity concentration of raw material and waste containing NORM

Radionuclide	Activity Concentration (Bq g <sup>-1</sup> )
<sup>40</sup> K	10
Each radionuclide in the chain of Uranium and Thorium decay	1

For the disposal of NORM waste, there are options used such as:

- a. Near surface disposal facility – for NORM waste from monazite cracking, rare earth extraction etc
- b. Landfill - for oil and gas sludge and NORM wastes from ilmenite processing
- c. Incineration for higher activity of oil and gas sludge – concentrated ash will be dispose in secured landfill

# MILLING OF MINERALS CONTAINING NORM

The wastes generated from mining industries and mineral processing plants were in a large amount and normally contain low level of naturally occurring radionuclides.

The whole process for milling of mineral containing NORM involve the importation/ mining of raw material, transportation to the plant, storage of the raw material, processing of the raw material to produce products and generate by-products (waste).

Some of the by-products are potentially reuse and recycle to another material used in another industry, but some are dispose of as a radioactive waste.

The treatment of the by-products containing activity concentration of Uranium and Thorium to below permissible limit is required before the by-products can be reused and recycled.

# Rare Earth Extraction Plant

In Malaysia, the rare earth extraction activities starting in 1980s. As Malaysia formerly is one of the largest tin mining industry, the raw materials came from the local mine.

But nowadays, most of the natural resources already finished, the rare earth extraction plant in operation using raw material that imported from overseas such as Australia.

Under the Act 304, the licence for rare earth extraction activities are divided into 3 phases;

- Siting Licence phase
- Construction Licence phase
- Operating Licence phase

The Operating License phase are divided into 2 stages, which is Temporary Operating Licence and Full Operating Licence

# Rare Earth Extraction Plant



One rare earth extraction plant in operation, using lanthanide concentrate from Western Australia as input material.

The raw material contains of Th-232 of 6 Bq/g which is exceed the control limit of 1 Bq/g under the Act 304, therefore this activity is licenced by the regulator.

Three (3) types of residues generated by the rare earth production plant from the processing of lanthanide ore namely:

- ❖ Water Leached Purification (WLP) – NORM wastes
- ❖ Neutralised Underflow (NUF) and
- ❖ Flue Gas Desulfurization (FGD).



# Rare Earth Extraction Plant

The main issue that the industry is facing is to manage the waste generated from the rare earth production. As huge amount of very low level waste (about 6 Bq/g) containing NORM generated during the operational of the plant)

Currently the waste generated is stored in the plant facilities and the huge amount occupied a large area of the plant.

The industry is studying to recycle and reuse the residues in other commercial products.

Research and development (R&D) is being carried out in collaboration with local research centre and higher education institutions.

# NORM WASTE MANAGEMENT



Waste management covers the whole process of waste handling starting from collection and transfer, waste treatment, waste storage and finally waste disposal.

Disposal is the final part of radioactive waste management process and is considered when there is no intention to recycle or reuse the radioactive material (waste) in the future.

Three (3) basic principles of radioactive waste disposal as stipulated in the IAEA GSR Part 5 (2009) are:

- delay and decay,
- dilute and disperse and
- concentrate and contain.

# NORM WASTE MANAGEMENT



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However, there is not clear that, whether the dilution principle is allowed in management the NORM waste generated from the rare earth industry.

International best practices to manage the waste generated from rare earth industry and international guidance or standards are required.

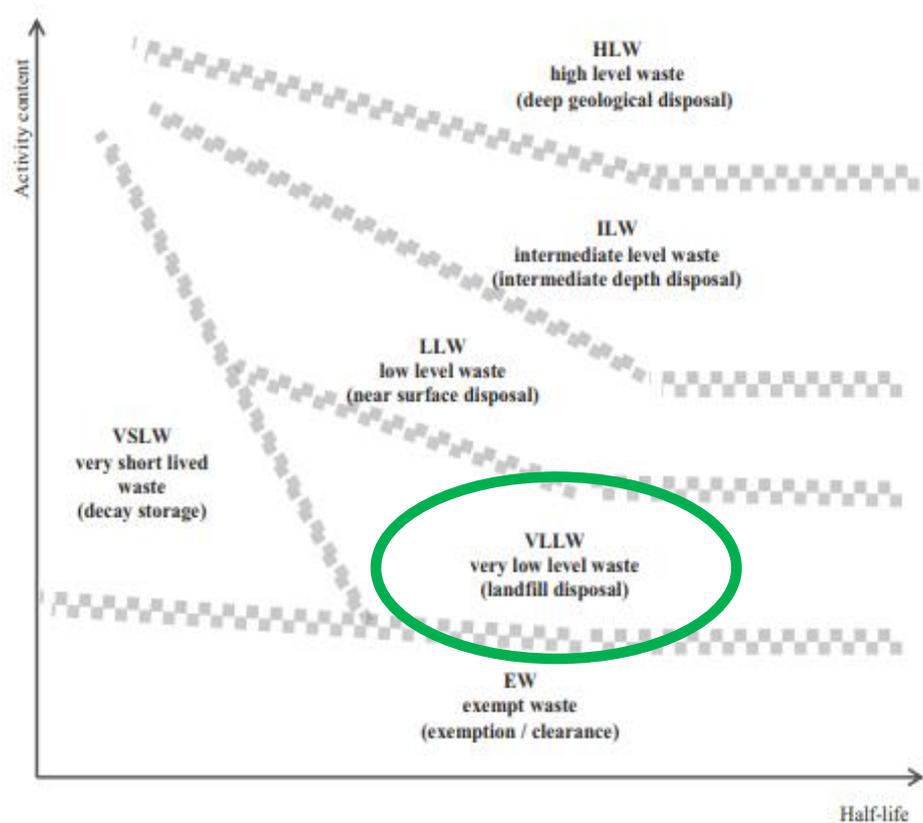
NORM wastes also contain minerals such as, Magnesium that is valuable for agriculture. Study had been carried out to re-use this NORM wastes as soil conditioner.

By mixing with the normal soil to the WLP (concentration of Th-232 is 6 Bq/g) with the ratio of 1: 9 for WLP: Soil, the WLP was diluted 10 times and the concentration of Th-232 in the dilution material was analyzed and confirmed below the control limit (1 Bq/g).

# INTERNATIONAL STANDARD

## IAEA Guide:

- GSG -1 (2009): Classification of radioactive waste
- GSR Part 5 (2009): Predisposal of radioactive waste
  - Delay and decay
  - Dilute and disperse
  - Concentrate and contain



- Classification of radioactive waste IAEA (2009)

# NORM Waste Disposal Facility

One monazite cracking plant to extract rare earth elements operating since 1982 generated the by-product or waste as a result of the operation were thorium hydroxide.

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The plant had ceased its operation in January 1994. The waste was temporarily stored at the Long Term Storage Facility (LTSF), about 85,000 drums (size of 200L) of waste containing thorium hydroxide and contaminated materials.

The activity concentration of Th-232 in the thorium hydroxide were more than 200 Bq/g.

The plant decommissioning and decontamination (D&D) activities had been commenced in September 2003. This D&D project completed in 2015.



# CONCLUSION

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NORM wastes generated from the rare earth industry is huge amount.

Referring to the IAEA waste classification of radioactive waste which consider NORM wastes as Very Low Level Waste (VLLW), the reference level for the reuse and recycle or disposal of NORM waste should be established within the VLLW classification.

The dilution process should be considered provided that the reference level is not exceeded.

Above the reference level, this NORM waste are recommended to be disposed of in the landfill type disposal facility.

# POINTS TO DISCUSS

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## GUIDANCE REQUIRED IN:

- ✓ ESTABLISHING A REFERENCE LEVEL FOR RE-USE & RE-CYCLE OF NORM WASTES
- ✓ DILUTE & DISPERSE (BLENDING) IS CONSIDERED AS OPTIONS FOR THE NORM WASTE MANAGEMENT



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*Thank you*

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<http://www.aelb.gov.my>