

DECOMMISSIONING OF MINERAL PROCESSING PLANT AND REMEDIATION OF NORM CONTAMINATED SITES

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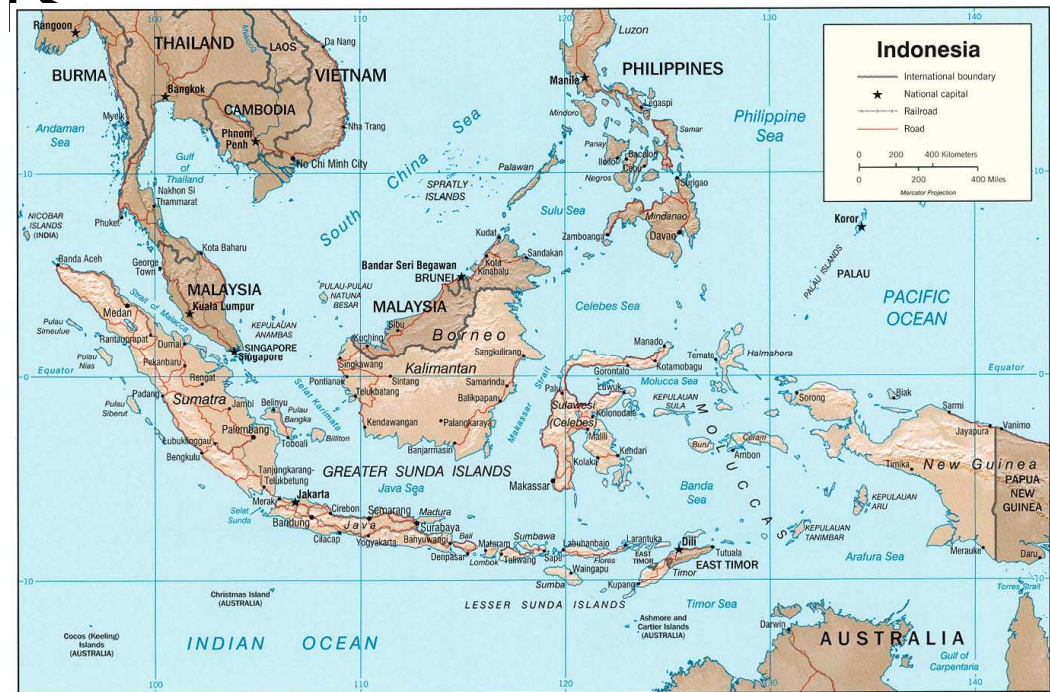
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CONTENT



- INTRODUCTION
- REGULATORY BODY
- NORM
- LEGAL REQUIREMENTS



Base: 802899AI (C00429) 11-02



REGULATORY BODY

- Atomic Energy Licensing Board (Board) was established under Section 3 of the Act 304 on 1 February 1985.
- The Board consists of five (5) Board's Members including the Chairman, all of whom have scientific or technical qualifications relevant to atomic energy or other disciplines.
- Minister of Science had given the power to appoint the member of the Board based on the specific requirements under the Act.
- The appointment of the members and the Chairman are for every 3 years period of cycle where the Minister can continue or withdraw the appointment.
- AELB is responsible to control and supervise the radioactive waste management in Malaysia, including the potential radioactivity harm to human and the environment

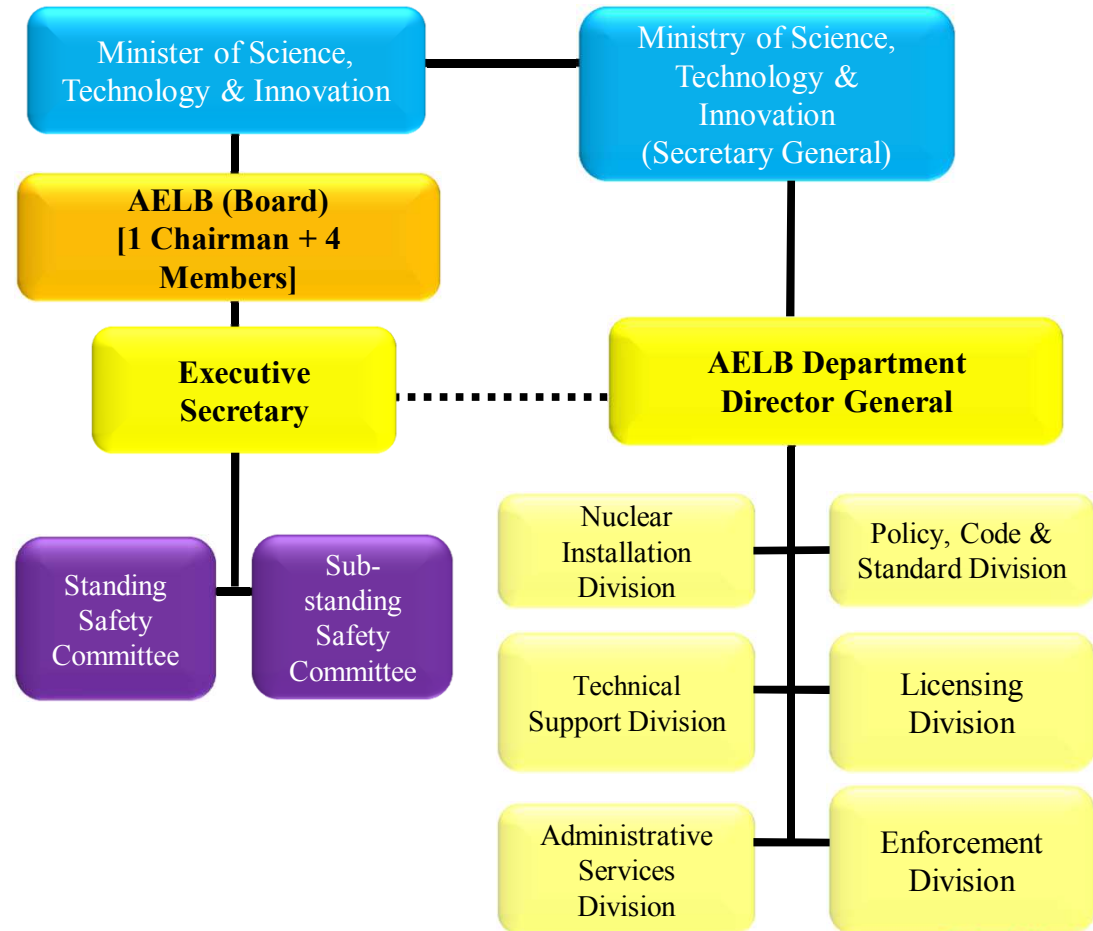
AELB

The Department

The Board

Atomic Energy
Licensing Act
1984 (Act 304)

- Atomic Energy Licensing Board (AELB) was established under Section 3 of the Act 304.
- Ensuring safety, security and safeguarding peaceful Nuclear Activities
- For the establishment of standards on liability for nuclear damage.



LEGAL REQUIREMENTS



Licensing, reporting, inspection, safety assessment are major measures to implementing the legislative requirements.

Legislative in Malaysia is composed of 4 hierarchy:
Act,
Regulations,
Orders; and
technical guidelines



LEGAL REQUIREMENTS

1. Main Legislation

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

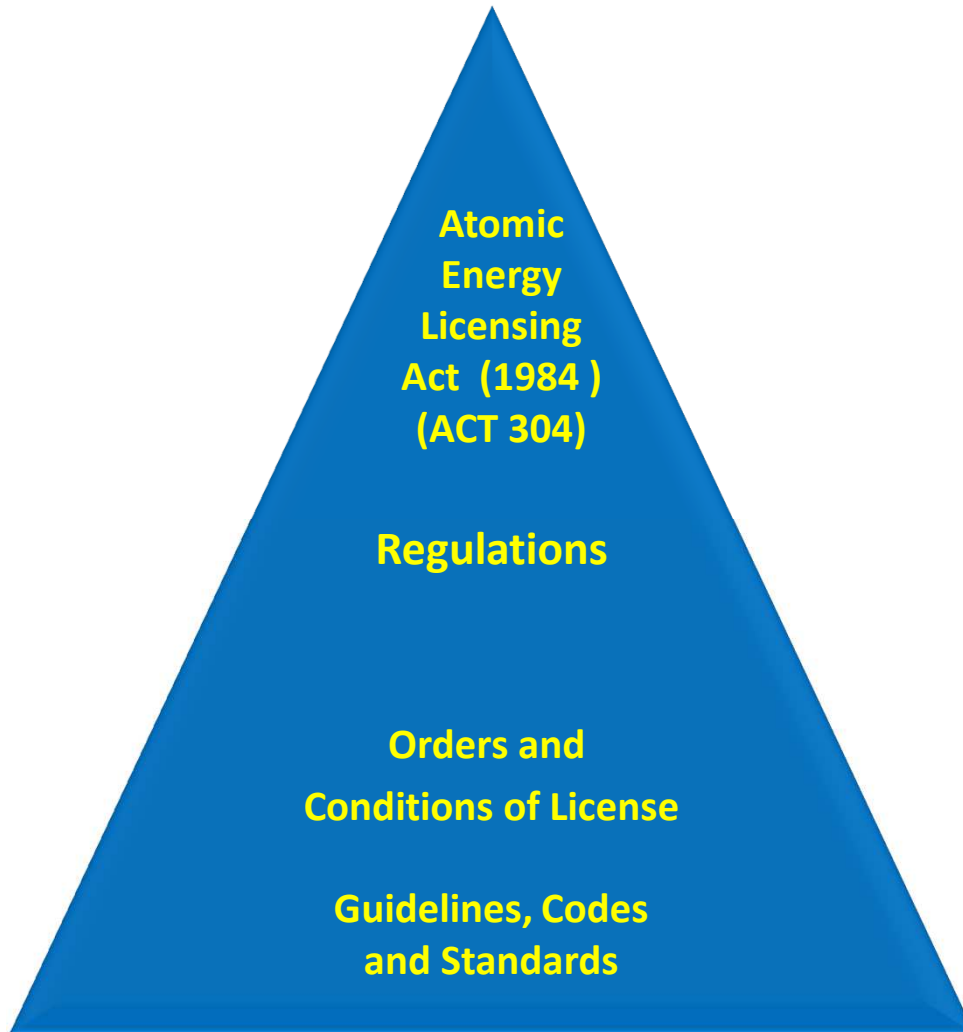
2. Regulations

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

3. Guidelines

- I. Draft Regulatory Requirement for Radioactive Waste Disposal Facility “Borehole Disposal Concept” Guideline (2013)
- II. Draft Basic Technical Criteria for Radioactive Waste Disposal Facility “Borehole Disposal Concept” Guideline (2013)

Hierarchy of Malaysian Legal System



- **Act:** provides the basic law concerning the development and utilization of atomic energy and safety regulations

-
- **Regulations** provide more detailed provisions entrusted by the Act.

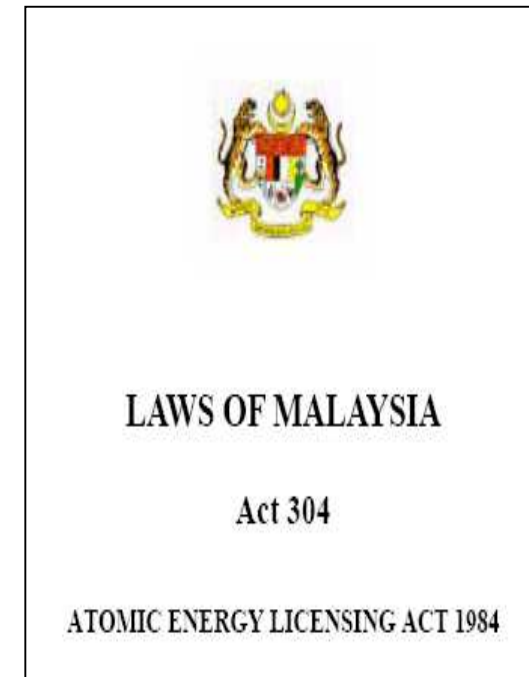
-
- **Provides additional requirements** which are not stated in the regulations or special matters related to provisions entrusted by the Act

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

Atomic Energy Licensing Act 1984

☀ **Scope of the Act 304**

- ◆ To control any :
 - ◆ radioactive materials,
 - ◆ nuclear materials,
 - ◆ prescribed substances, or
 - ◆ irradiating apparatus in medical and non-medical application.



Ionizing radiation application

NON MEDICAL ACTIVITIES

- Gamma sterilization
- Non Destructive Testing
- Gauging
- Oil Logging
- NORM/ TENORM
- Research
- Archeology



ATOMIC ENERGY LICENSING (RADIOACTIVE WASTE MANAGEMENT) REGULATIONS 2011

ATOMIC ENERGY LICENSING (RADIOACTIVE WASTE MANAGEMENT) REGULATIONS 2011

[Free download
www.aelb.gov.my](http://www.aelb.gov.my)



ATOMIC ENERGY LICENSING (RADIOACTIVE WASTE MANAGEMENT) REGULATIONS 2011

5) The outline of the content of the draft are as follows:-

Part I – Preliminary

Part II – License To Dispose

Part III – Responsibilities Of Licensee

Part IV – Radioactive Waste Management Officer

Part V – Control of Radioactive Waste Generation

Part VI – Reuse and Recycle of Radioactive Materials

Part VII – Management of Sealed Source

Part VIII – Discharge and Disposal of Radioactive Waste

Part IX – Management of Radioactive Waste

Part X – Transport of Radioactive Waste

Part XI – Quality Assurance

Part XII – Physical Protection and Security

Part XIII – Records and Reports

Part XIV – Emergency Plan and Procedures

Part XV – Cessation of Operations, Decommissioning or Abandonment of Licensed Facilities

NORM



- In Malaysia, Naturally Occurring Radioactive Materials (NORM) are mainly found in scales and sludges from the oil and gas industries, thorium hydroxide from the processing of xenotime and monazite, and iron oxide and red gypsum from the processing of ilmenite.
- Other NORM are tin slag produced from the smelting of tin, and ilmenite, zircon, and monazite produced from the processing of tin tailing (generically termed amang)



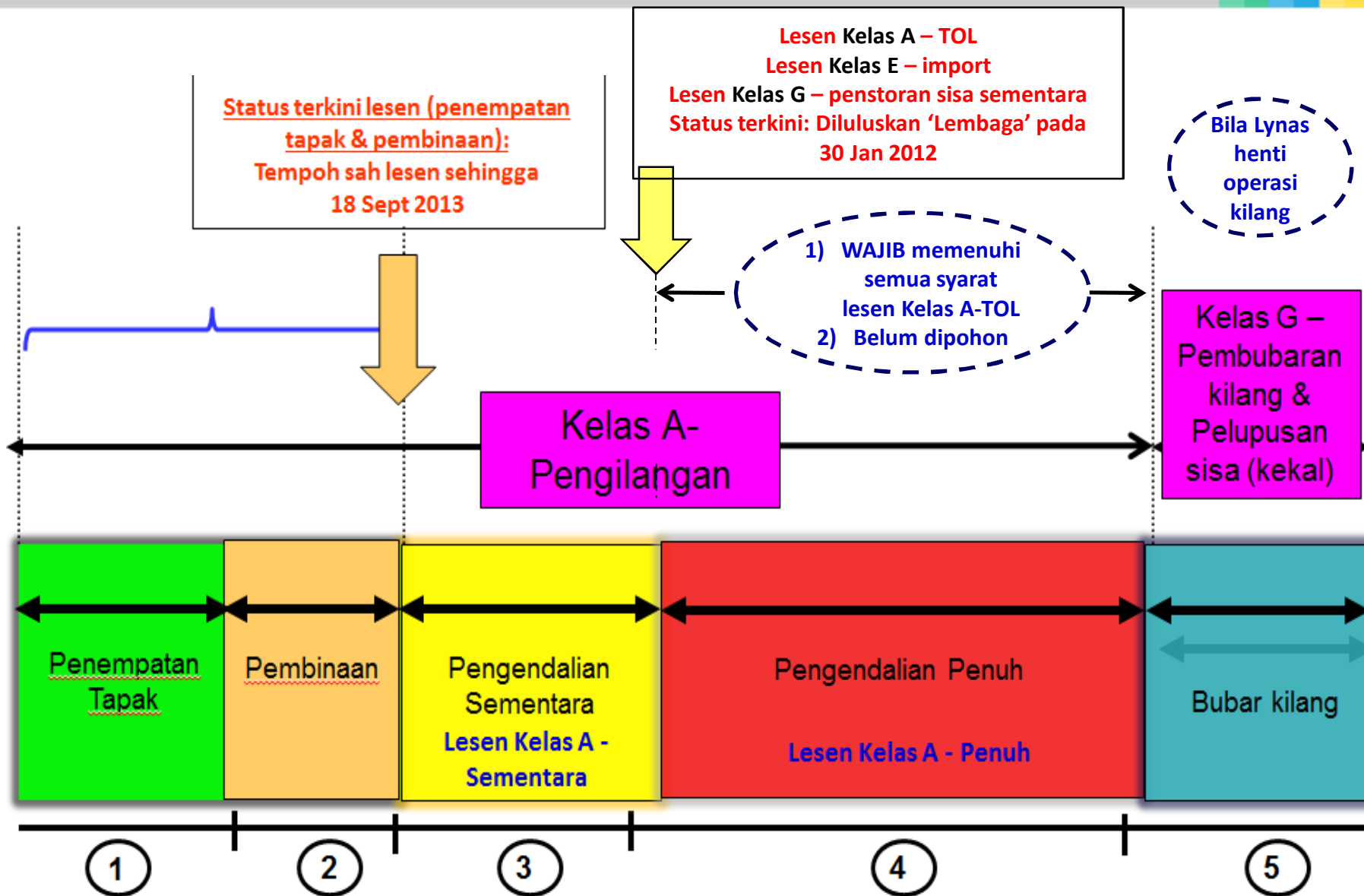
NORM



- These unwanted materials containing NORM have subsequently been called NORM wastes.
- These activities are regulated and controlled by the Atomic Energy Licensing Act, 1984 (Act 304). The licensing authority of the Act 304 is the Atomic Energy Licensing Board (AELB).
- AELB enforces the NORM activities including oil and gas industries, milling activity involving minerals containing NORM and its waste management through its licensing procedure and conditions of license issued to the licensees.

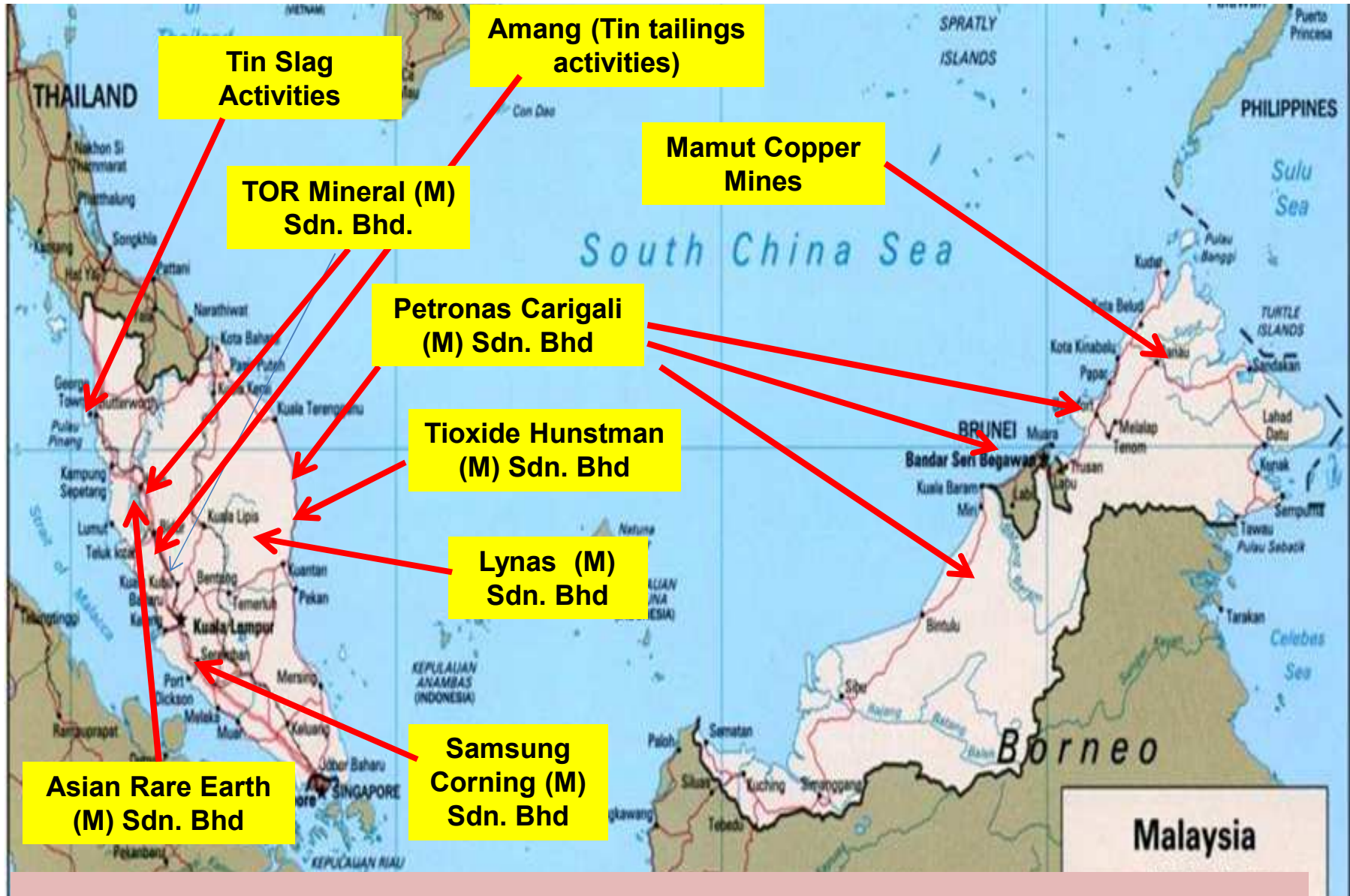


LICENSING



Milling of minerals containing NORM

- The main issues occur from NORM activities is the waste management.
- The wastes generated from mining industries and mineral processing plants were in a large amount and normally contain low level of naturally occurring radionuclides.
- Malaysia implemented 1 Bq g^{-1} as the clearance limit for naturally occurring radionuclides from series of uranium and thorium, as stipulated in the Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011.



CONTROL OVER MINERAL CONTAINING NORM AND RARE EARTH ACTIVITIES IN MALAYSIA

EXAMPLE OF RESIDUES CONTAINING NORM IN MALAYSIA

GYPSUM:

^{226}Ra :77, ^{228}Ra :688 Bq/kg



IRON OXIDE:

^{226}Ra :4970, ^{228}Ra :2010 Bq/kg



OIL SLUDGE/ SCALES:

^{226}Ra : 286, ^{228}Ra :278 Bq/kg



TIN TAILING (MONAZITE)

^{232}Th : 328,000Bq/kg



TIN SLAG:

^{238}U :1122, ^{232}Th :834 Bq/kg



RAD WASTE MANAGEMENT



- For the disposal of NORM waste, there are options used such as:
 - Landfilling for oil and gas sludge
 - Incineration for higher activity of oil and gas sludge – concentrated ash will be dispose in secured landfill
 - Near surface disposal facility – for NORM waste from monazite cracking

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

Radionuclide	Activity Concentration (Bq g ⁻¹)
⁴⁰ K	10
Each radionuclide in the chain of Uranium and Thorium decay	1



Decommissioning and Decontamination (D&D)



- One monazite cracking plant to extract rare earth elements operating since 1982 is situated in the northern part of Malaysia. The by-product or waste as a result of the operation was thorium and radium sludge, thorium contaminated equipment and the processing plants.
- The company 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 plant decommissioning and decontamination (D&D) activities had been commenced in September 2003. This D&D project was divided into 2 phases.



MONAZITE CRACKING PLANT



PLANT SITE



STORAGE SITE

- 23 Nov 1979-Establishment of Asian Rare Earth (ARE) company – a joint venture between the Japanese and Malaysian investors to process monazite for recovering rare earths
- April 1982 - The ARE started its operation
- 16 Jan 1987 - AELB issued a Class A license (interim operation) to the ARE to process monazite.
- 4 Dec 1987 - The construction of Long Term Storage Facility (LTSF) begun.
- 24 Jan 1989 - Completion of the LTSF
- 13 Feb 1989 - Thorium wastes were transferred to the LTSF.

D&D

PHASE 1

- Remediation of plants site contaminated with the radioactive materials
- Management of contaminated materials generated from the D&D activities
- Transportation of contaminated materials to the disposal facility in Bukit Kledang, Mukim Belanja (Disposal in Engineered Cell 1)

D&D

PHASE 2

- Transfer the thorium waste (radioactive wastes) and contaminated materials from the LTSF to the disposal facility Bukit Kledang, Mukim Belanja (Disposal in Engineered Cell 2)

D&D PHASE 1

Plant Site Decommissioning & Decontamination



BEFORE D&D (Plant Operation)
0.65 $\mu\text{Sv/hr}$

CONTROLLED AREA



AFTER D&D
0.17 $\mu\text{Sv/hr}$
CLEAN AREA



Radiation level back to normal (background)

- Started work May 2003
- Declared as clean and decontaminated area by AELB 2006
- Scope



- ❖ demolition of all structures and equipment
- ❖ excavation of contaminated soils
- ❖ construction of Engineered Cell (EC-1)
- ❖ disposal of materials into EC-1



D&D AND WASTE DISPOSAL

DISMANTLING



CONT SOIL EXCAVATION



CONT MATERIALS

DECONTAMINATION



DISPOSAL



BACKFILLING



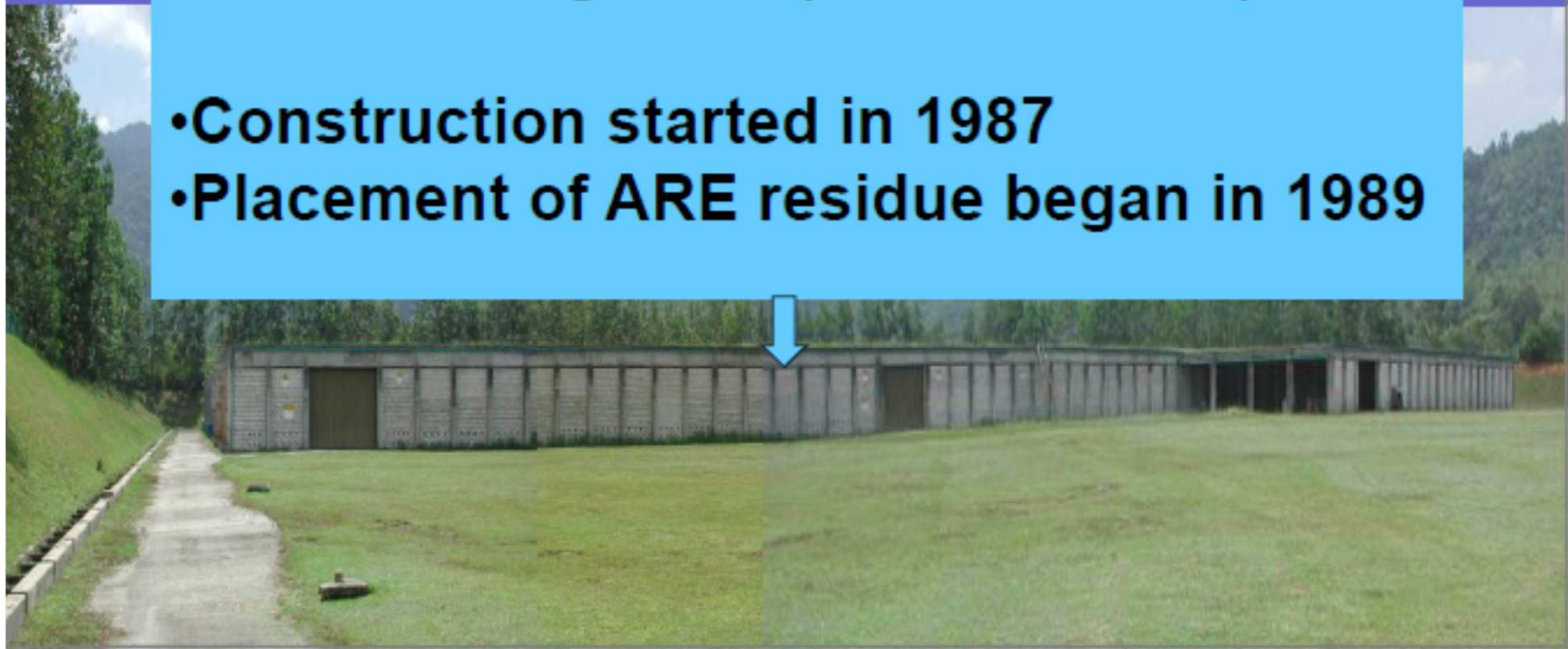
D&D PHASE 2

LTSF Decommissioning & Disposal

Phase 2: LTSF D&D

Existing LTSF (BEFORE D&D)

- Construction started in 1987
- Placement of ARE residue began in 1989



PROJECT BACKGROUND

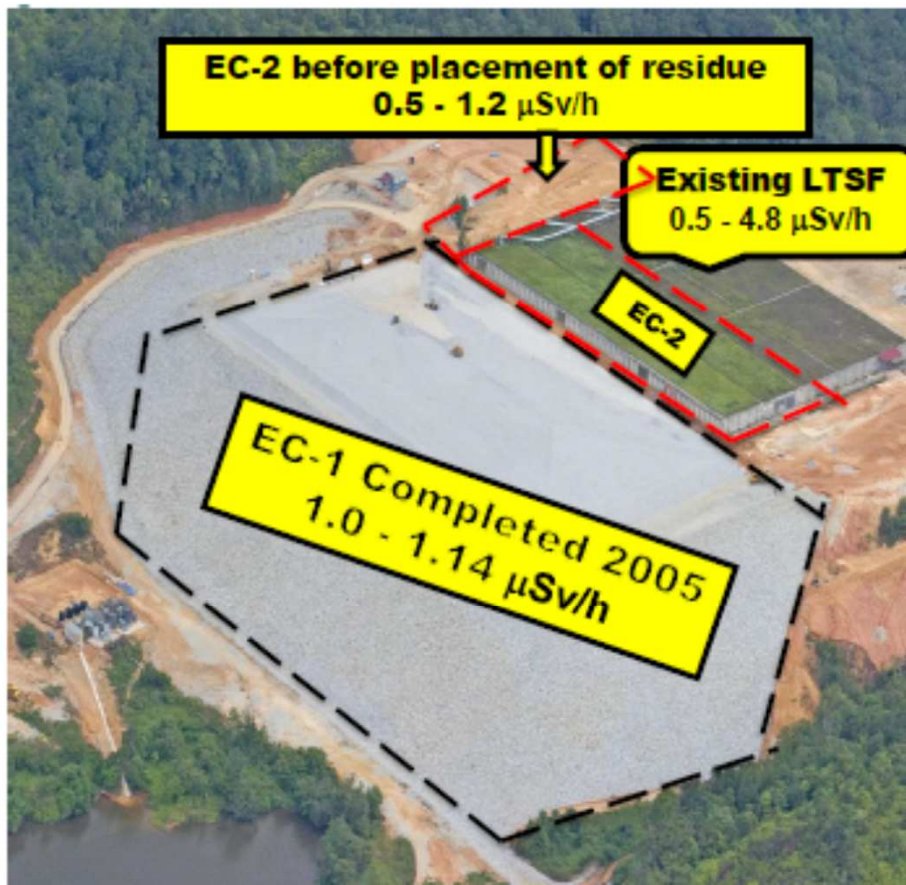


LTSF Content

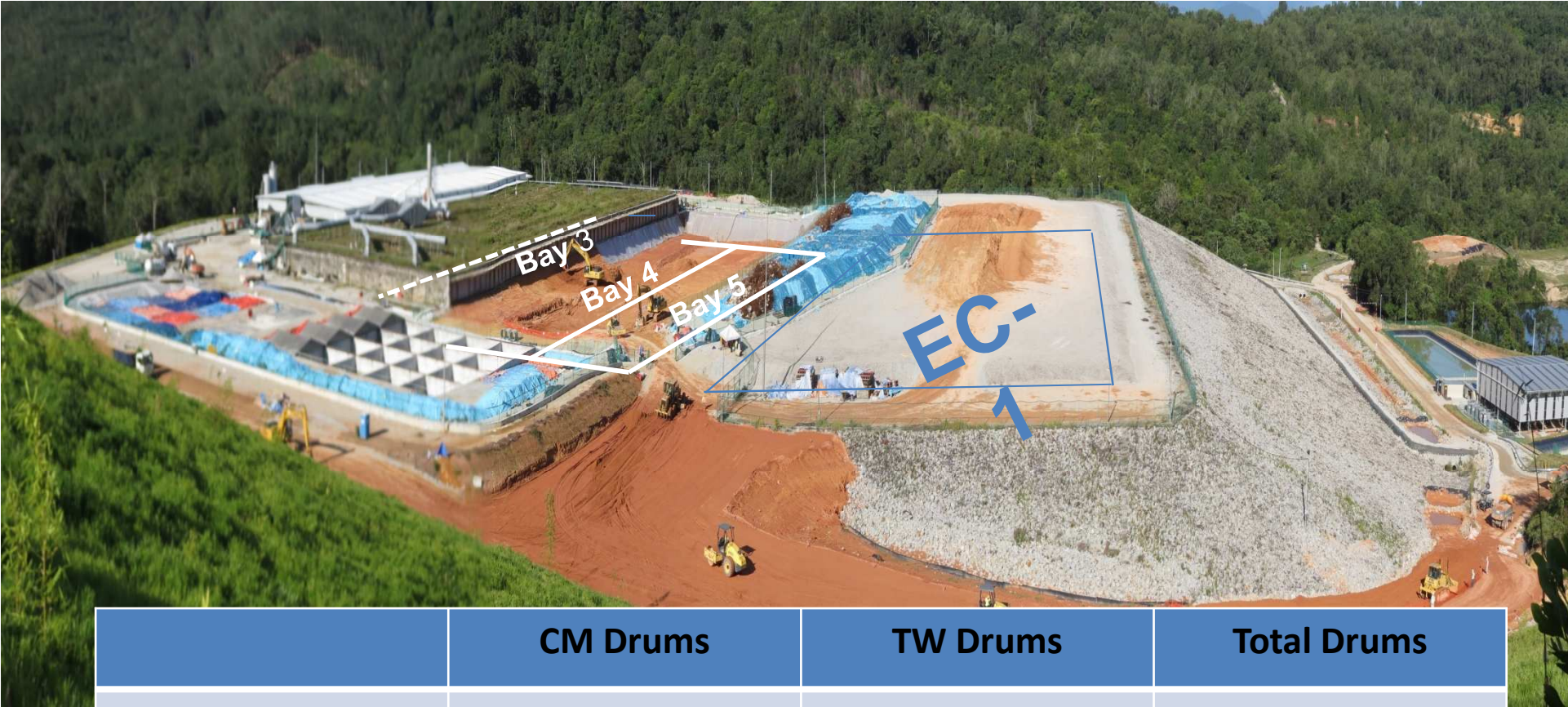
- Waste material is stored in the LTSF in drums and packages and classified as LILW-LL (Low Intermediate Level Waste – Low Level).
- The primary radioactive material in the LTSF include Th-232, U-238, and their decay product.
- Contains 84,822 drums and 4,657 packages
- Majority drums and packages are located in Bays 1 through 4
- 52,650 drums contain Thorium Waste (TW)
- 32,172 drums contain Contaminated Material (CM)



EC 2 construction



PHASE 2 (LTSF D&D)



	CM Drums	TW Drums	Total Drums
LTSF Total	32,172	52,650	84,822

KEM MIN:	Drum Category	Average Activity Concentration (Bq/g)	
		Th - 232	U - 238
	CM	25	7
	TW	384	73



DRUMS CONDITION IN LTSF



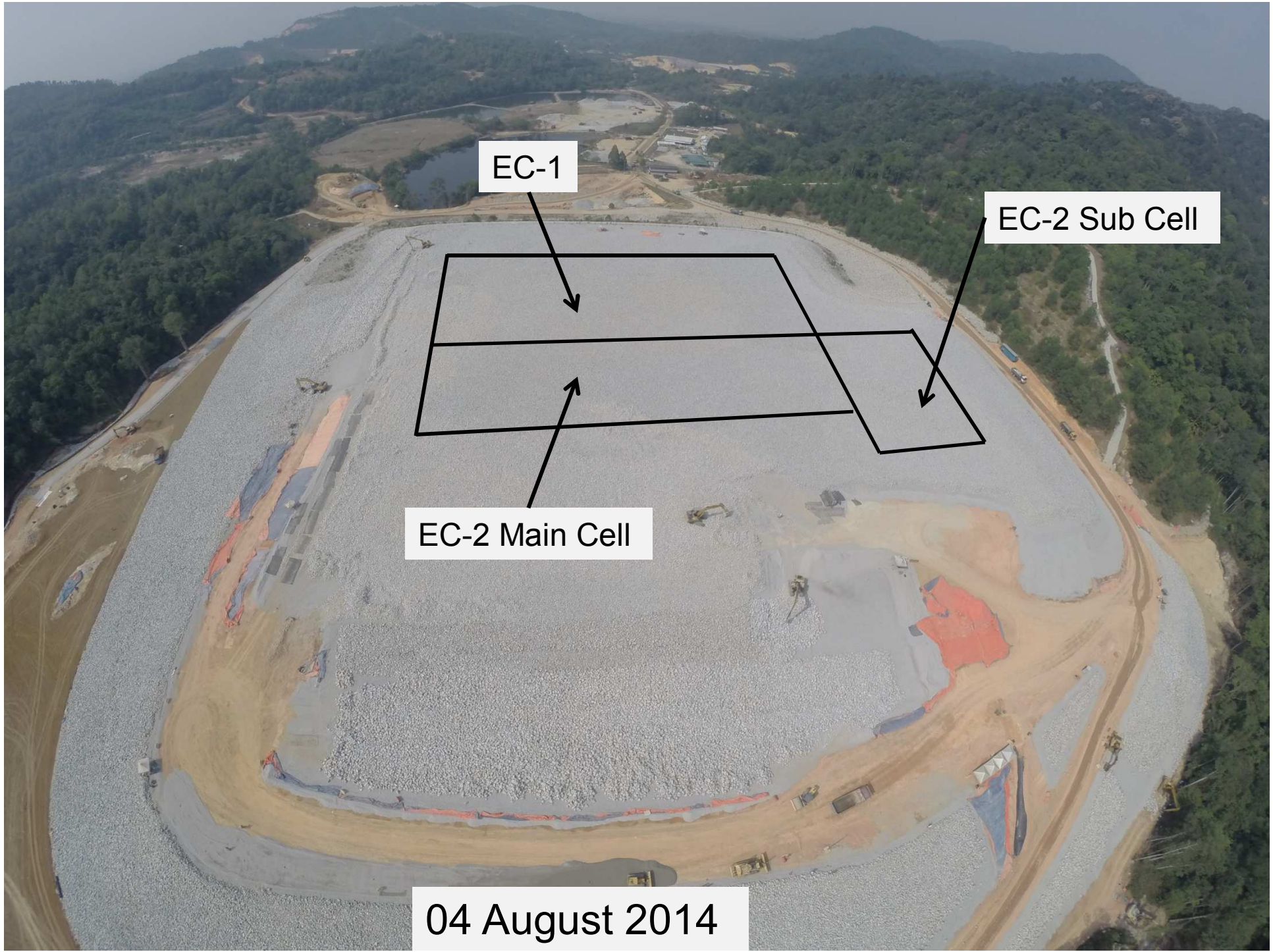
DISPOSAL FACILITY



- The capacity of the EC 1 is about 85,000 m³ and the capacity for EC 2 is approximately 55,000 m³

D&D project	Waste	Volume (m ³)
Phase 1 (Plant D&D)	Contaminated soil excavated	66,000
	Contaminated concrete & rubble	6,330
	Contaminated material	2,000
Phase 2 (LTSF D&D)	Thorium waste	16,200
	Contaminated material	10,000
	Rubble & others	20,200





EC-1

EC-2 Sub Cell

EC-2 Main Cell

04 August 2014



Patrol Road Footpath

EC-1 Slope

Access Road

04 August 2014

REMEDIATION OF PLANT SITE



Plant site Soil excavation



WWTS soil excavation



Plant site remediation (excavation & backfilling)



Backfilling



Plant site after D&D

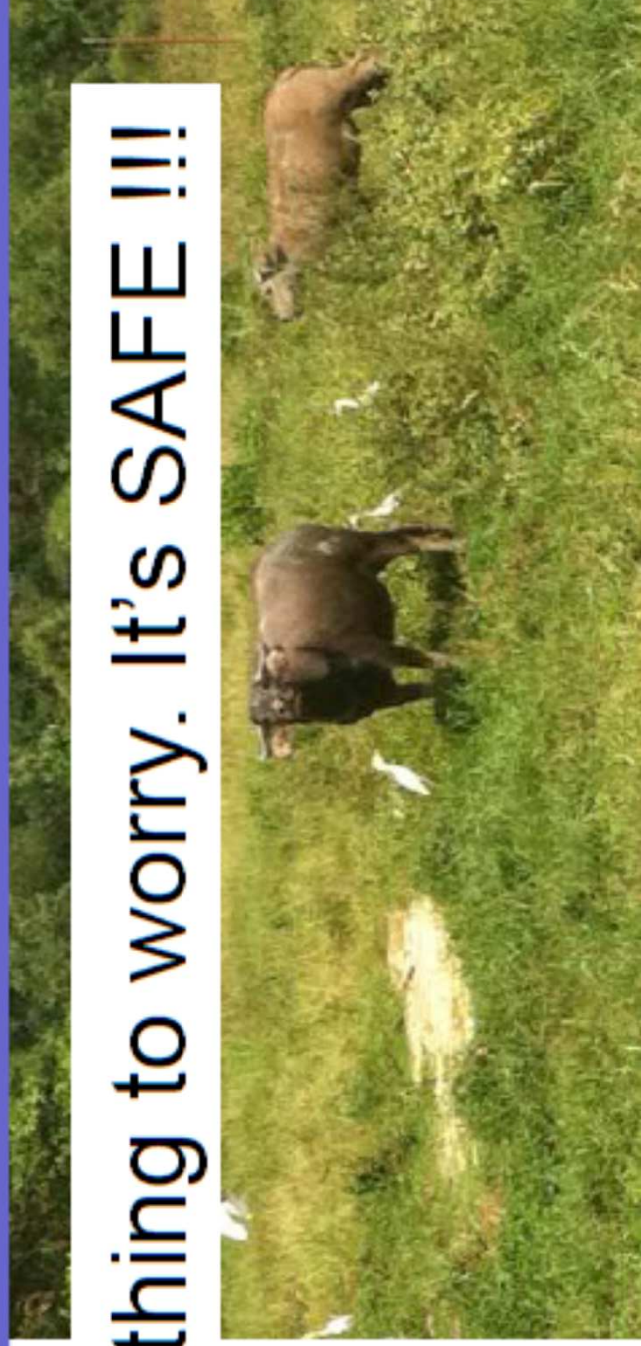
Mother Jones: Will Malaysians Get Cancer for Your iPhone or Prius?

I went to the site of a notorious rare-earth refinery—and investigated plans for a new one—to find out.

—By [Kiera Butler](#)

| Mon Feb. 13, 2012 3:00 AM PST

Nothing to worry. It's SAFE !!!



[Quote] I'm not sure what I was expecting to see—maybe some creepy factory ruins or at least a few "No Trespassing" signs. Instead, we found a very normal looking field. [Unquote]

Monitoring result on-site

Parameter	Result on site	Limit	Regulation
External radiation (mSv yr ⁻¹)	0.4 - 0.5	1.0	Act 304
Soil: Activity concentration of Ra-226 (Bq kg ⁻¹)	90	<100	Normal soil in Malaysia (reported by UNSCEAR 2000)

Sampling	Parameter	Method	Frequency of monitoring
External radiation	External Radiation	TLD	Monthly
Soil	Ra-226/ R-228	Gamma Spectrometer	Monthly
Water	Ra-226/ Ra-228	Liquid Scintillator	Monthly
Air	Activity concentration of the radon and thoron progenies	Radon/thoron detector	monthly

CONCLUSION

- Post closure monitoring will be carried out for 2 years starting from the closure of the engineered cell.
- The institutional control for the final disposal facility will be for at least 300 years.



THANK YOU

