

Development of Decommissioning Plan in Indonesia

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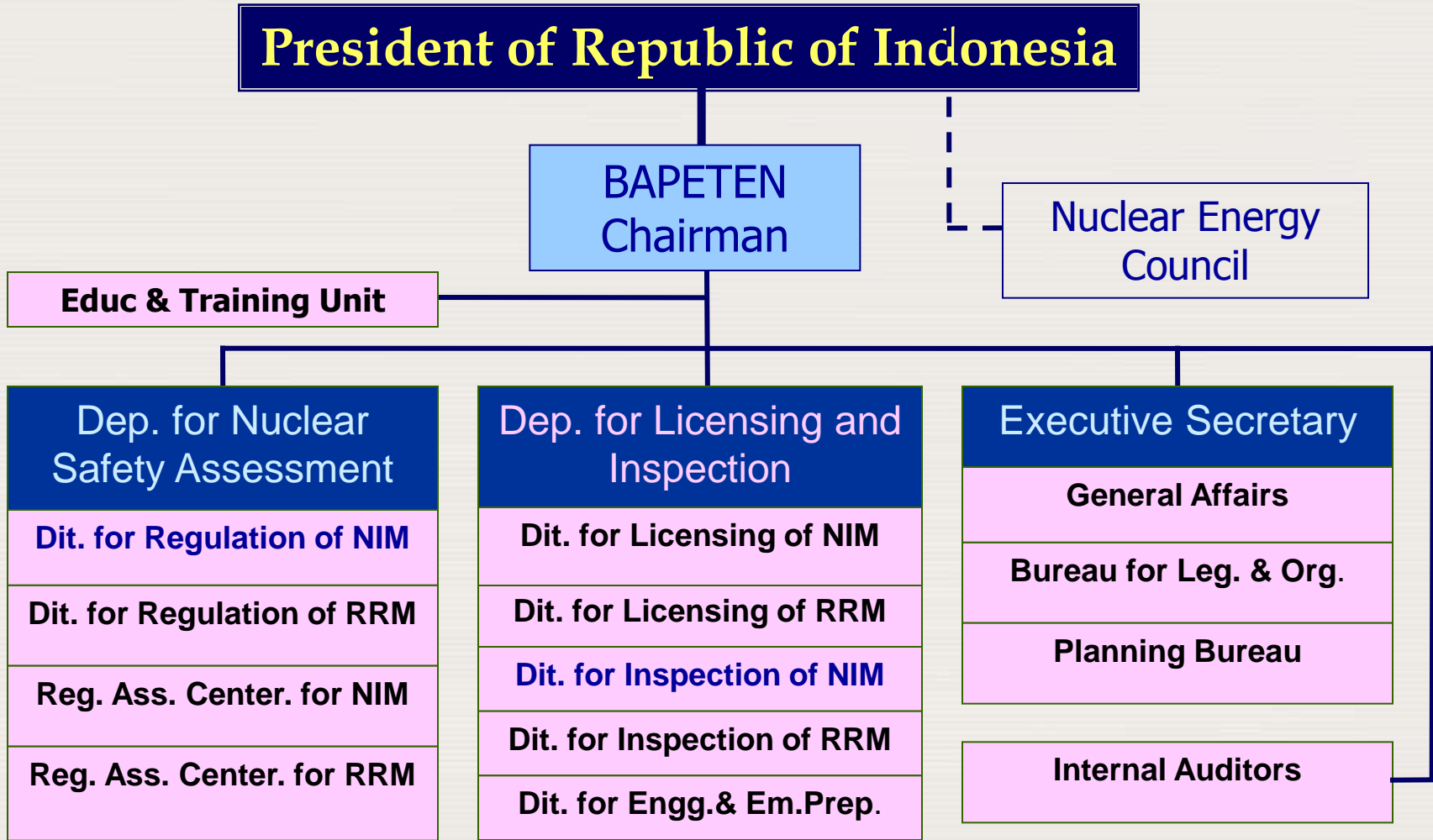
IAEA

International Atomic Energy Agency

Legal and Regulatory Framework (1)

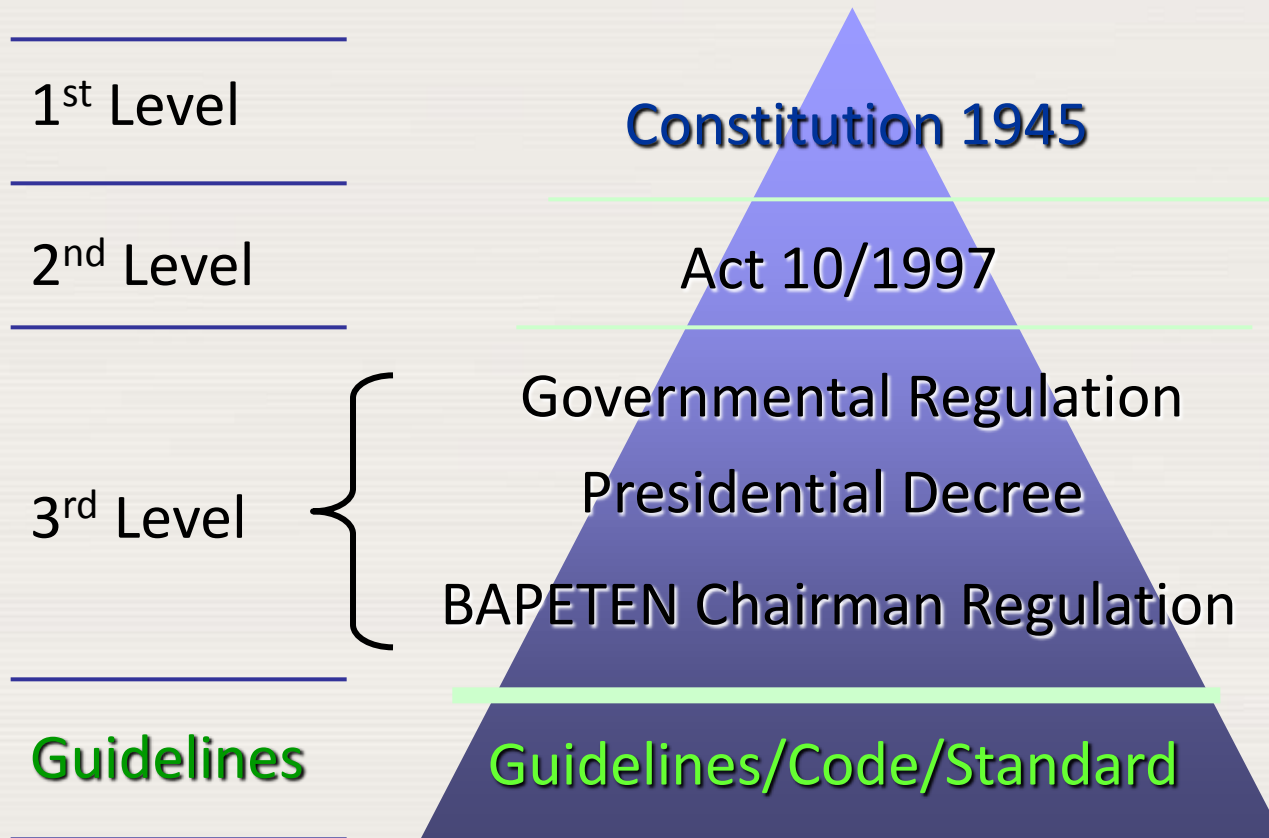
- Act no 10 year 1997 on Nuclear Energy is a basic law for nuclear activities in Indonesia.
- Nuclear Energy Regulatory Agency (BAPETEN) which was established in 1998 based on the Act, is an independent regulatory body.
- BAPETEN is chaired by a Chairman who reports directly to the President of Rep. of Indonesia.
- The main task of BAPETEN is to control all nuclear activities through 3 regulatory functions: (1) set up regulation, (2) conduct licensing, and (3) perform inspection.

Legal and Regulatory Framework (2)



Legal and Regulatory Framework (3)

HIERARCHY OF NUCLEAR LAW



Legal and Regulatory Framework (4)

- Provisions on decommissioning of nuclear reactor are included in:
 - Act No. 10/1997 on Nuclear Energy;
 - Government Regulation No. 43/2006 on Reactor Licensing; and
 - BAPETEN Chairman Regulation No. 4/2009 on 'Decommissioning of Nuclear Reactor' (detailed/technical provisions).

License / Authorisation

- **There are 3 research reactors in Indonesia:**
 - Triga-2000 (2 MW) Reactor, Bandung
 - first criticality 1964 and operated at 750 kW,
 - upgraded to 1 MW (in 1971), and upgraded to 2 MW (in 2000)
 - Kartini Reactor (100 kW), Yogyakarta – first critical 1979
 - MPR-30 (30 MW), Serpong – first criticality 1987
- All the reactors in are licensed by BAPETEN.
- The validity of each license is as follows:
 - Triga-2000, Bandung :2016
 - MPR-30, Serpong :2020
 - Kartini Reactor, Yogya :2011

Basics of Decommissioning

- Some issues below may be considered as basics of decommissioning (**for Triga-2000 Reactor Bandung**):
 - Regulations (provisions on decommissioning);
 - Ageing of facilities:
 - Triga-2000 Reactor Bandung has been operated for more than 40 years.
 - Some technical problems such as:
 - Core bubbling, that has been occurred since 2004
 - Detection of fission products in cooling water.

Transition from operation to decommissioning

- Triga-2000 Reactor has an authorization for operation until year 2016. However, the reactor has been shutdown since several years ago due to some technical problems. While the operators are striving to accomplish the problems, the management are discussing about the decision on decommissioning.
- In the transition period, the management of Triga-2000 Reactor Bandung has initiated some preparations:
 - Development of decommissioning plan (draft)
 - Setting up an organization special for running the decommissioning plan;
 - Identification of decommissioning tasks and equipments/tools required;
 - Preparing procedures and working instructions;
 - Developing training programme for workers; etc.

Characterization Survey

- In order to map the potential hazard inside and surrounding the reactor, characterization survey are important task.
- The survey has not been done yet, but according to their decommissioning plan, the following surveys are planned to be done:
 - Surface gamma radiation using GM Counter
 - Surface contamination using smear test
 - Airborne contamination by air sampling
- The survey will be performed at several locations that are considered to be representing the whole picture of radiation hazards.

Cost Estimates

- Cost estimates is one of important steps that is enabling management to estimates the decommissioning cost and is easing them to plan the budget required.
- In the case of Triga-2000 Bandung, however, since the decommissioning plan is still at the early stage, and its decision is still under discussion, the cost estimates of the decommissioning has not been carried out yet.
- Based on the plan, the decommissioning activities will be funded from the national budget (annual bases).

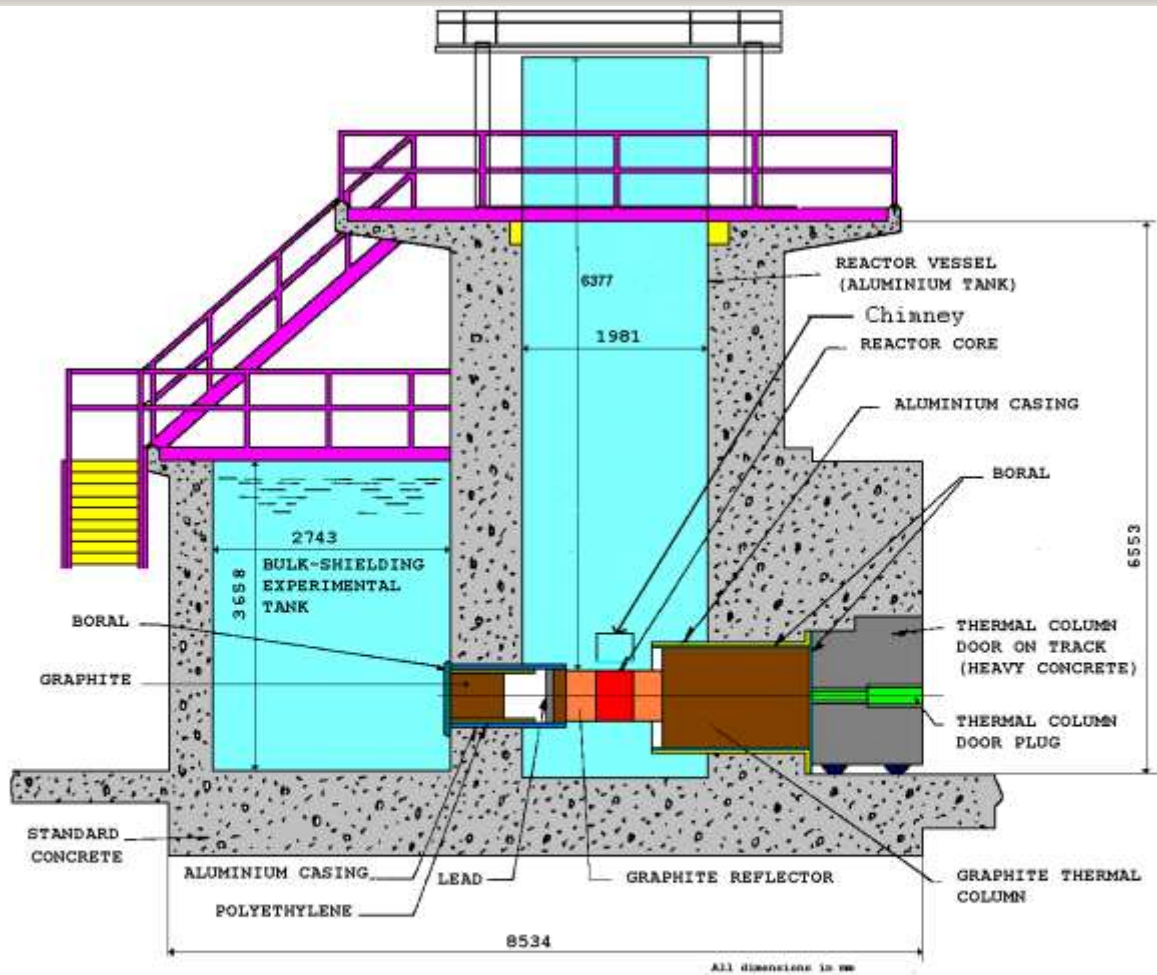
Decommissioning Technologies

- The decommissioning technologies are not mentioned in the draft of decommissioning plan, but following tools will be applied (as the draft mentions):
 - Shears (manual and remote handling): for cutting metal and dismantling concrete;
 - Power nibblers (manual and remote handling): for cutting stainless steel and softer metals;
 - Mechanical saws;
 - Orbital cutter: for cutting an object by circling outer parts of the object;
 - Abrasive Cutting Wheels; etc.

BATAN-Bandung Facilities:

- ◆ **TRIGA 2000 Reactor;**
- ◆ **Metallurgy Lab;**
- ◆ **X-ray and SEM Machines;**
- ◆ **NILO-I Engineering Loop;**
- ◆ **Prompt Gamma Spectrometry and Neutron Diffractometry Facility;**
- ◆ **Neutron Radiography Facility;**
- ◆ **Neutron Activation Analysis Lab;**
- ◆ **Radioisotopes Processing Lab;**
- ◆ **Labeled Compound Synthesis Lab;**
- ◆ **Biodynamic and Biosynthesis Lab;**
- ◆ **Hot Cell;**
- ◆ **Radiation Measurement and Calibration Lab;**
- ◆ **Radioactive Waste Processing Facility;**
- ◆ **Medical Service Unit;**
- ◆ **Mechanical Workshop.**

Vertical Cross Section of Bandung TRIGA 2000 Reactor



VERTICAL SECTION REACTOR TRIGA-MARK-II

Technical Specification of TRIGA 2000 Reactor-Bandung

Items	Specification
Maximum Power (thermal)	2000 kW
Moderator	Light Water, Graphite Reflector
Coolant	Light Water
Fuel Material	U-ZrH_{1.6}, SS-Cladded
U-235 Enrichment	20 %
Weight of U-235 per FE (grams)	38, 55, 98
Thermal Neutron Flux at Center Thimble	5.7e13 n/cm²-s
Thermal Neutron Flux at Pneumatic Transfer Tube	2.1e13 n/cm²-s

Brief History:

- **Bandung TRIGA Mark II Reactor** went first criticality on **October 10, 1964** and since then it was operated at power level of **250 kW**;
- **The facility has been operated for research, production of radioisotopes and training;**
- **In 1971, the reactor was upgraded from 250 kW to 1000 kW; The reactor was operated safely at various level of power until February 1996.**
- **Starting from April 1996, the second upgrading activities began.**
- **Went critical at 2000 kW in May 2000;**
- **Inaugurated by Vice President Republic of Indonesia on June 24, 2006 and renamed Bandung TRIGA 2000 Reactor.**
- **Since 2008 has been operating under limited condition, due to FFCR and fision products problem, and decommissioning option has been proposed.**

Decommissioning Plan

- After Chairman of BAPETEN Decree No.4/2009 about Nuclear Reactor Decommissioning, BATAN-Bandung has been preparing a decommissioning plan document to meet the BAPETEN requirements.
- The Decommissioning Plan document compile by a team with lack of personnel, that make the progress in preparing documentation is slowly
- In the next year, a reactor decommissioning management legally will be under Reactor Division in organization structure of BATAN-Bandung, with a personnel focused on reactor decommissioning program.

Draft Content of TRIGA 2000 Reactor-Bandung Decommissioning Plan (Based on Chairman of BAPETEN Decree No.4/2009)

- Decommissioning Organization
- Facility Description
- Decommissioning Strategy
- Characterization survey plan
- Cost Estimate
- Safety Analysis
- Environmental Assessment
- Radiation protection program
- Nuclear Security and Safeguar
- Nuclear Emergency Program
- Radioaktif Waste Management
- Decommissioning Activities
- Surveillance and Maintenance
- Final Radiation Survey