5. Recent Status on Decommissioning and Clearance in Indonesia

5.1 Introduction

The use of nuclear energy in Indonesia to support the national development program shall give due consideration to the safety, security, peace, and health of workers and the public and the protection of the environment, as well as the utmost use for public prosperity. This consideration is stipulated in the Act Number 10 Year 1997 on Nuclear Energy, replacing the Act Number 31 Year 1964 on Basic Stipulation of Atomic Energy.

The nuclear activities in Indonesia were started by the operation of TRIGA MARK II 250 kW at Bandung Nuclear Research Center in 1965. In 1971, the power was upgraded to 1000 kW for routine production of radioisotopes, and then it was upgraded further to 2000 kW on June 24, 2000. In 1979, TRIGA MARK II 250 kW at Yogyakarta Nuclear Research Center was commissioned.

The radioactive waste produced by Bandung and Yogyakarta Nuclear Research Centers is small in quantity with low level activity and mostly contain short-life radionuclides. The treatment of aqueous waste in Bandung and Yogyakarta Nuclear Research Center is simple, i.e., by collection of wastes in the hold-up tank for further decay, down to insignificant activity, then dilute, disperse and discharge in a river. The solid and organic liquid wastes are collected in the containers, kept and stored in storage facilities for radioactivity to decay.

The Serpong Nuclear Research Complex which is comprising some waste generating facilities belonging to the Multipurpose Reactor Center, Nuclear Fuel Technology Center, Radioactive Waste Technology Center, Radioisotopes and Radiopharmaceuticals Center, generates a larger quantity of low and medium level waste. To deal with these wastes, the Centralized Radioactive Waste Management Station (RWMS) was established in Serpong and started its operation in 1989. The RWMS is under the management of the Radioactive Waste Technology Center. This center is assigned responsible for the ultimate management of radioactive waste generated from the whole territory of the Republic of Indonesia.

The radioactive wastes from outside of BATAN premises (i.e. resulting from nuclear applications) are mostly resulting from activities in: nuclear medicine/hospital (spent sources, liquid waste), industrial application (spent sources for radiography, logging and gauging, lightning protection devices, solid waste from gas mantle lamp production), and research institute.

There is no decision yet for the decommissioning of the three research reactors, however sooner or later it will be an object for the near future decommissioning program. Anticipation

for the above situation is necessary. The operator of the reactors assisted by RWTC is now preparing documents of decommissioning program. Until now, the regulation for the decommissioning of research reactor has been available and regulatory has been separated from the executing body. For Indonesian case, an early decommissioning strategy for research reactor and restricted use of the site for other nuclear installation is more favorable, talking into account the high land pricing, the availability of radioactive waste repository, and cost analysis.

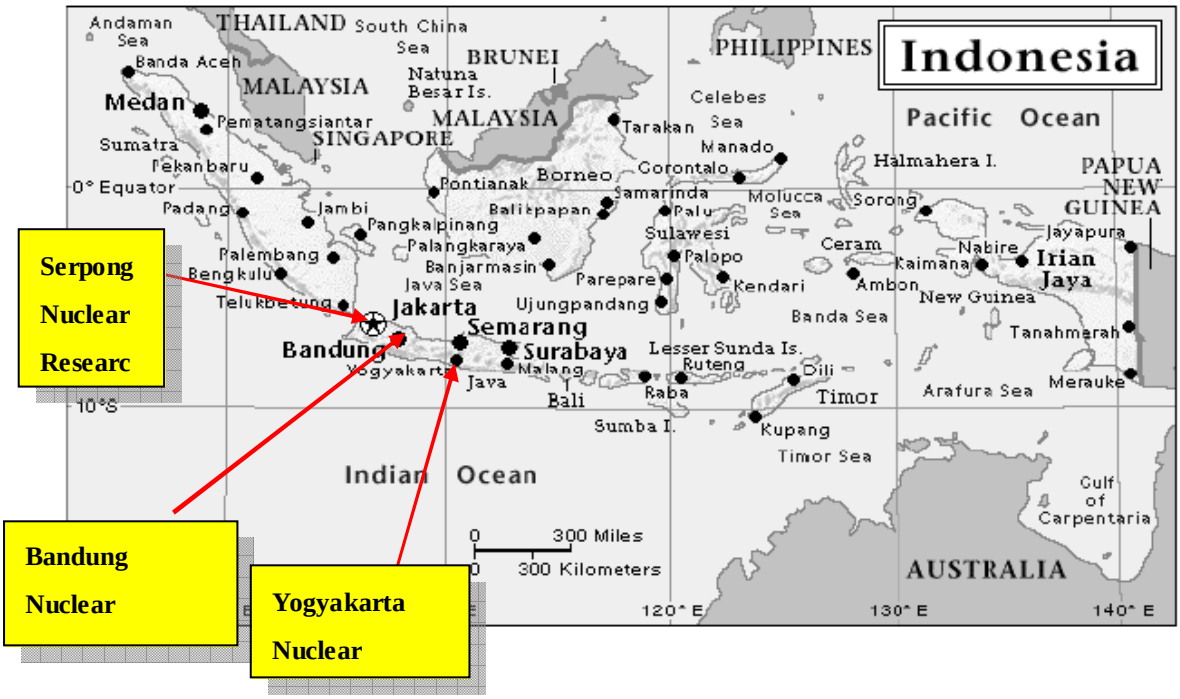

Fig. 1. Map of Indonesia and its nuclear facilities

5.2 Legal and Regulatory Framework for Decommissioning of Research Reactor in Indonesia

Currently, there are three research reactors operating in Indonesia. Those are Bandung Triga 2000 (2000 kW) at Bandung - West Java, Kartini Research Reactor (100 kW) at Yogyakarta – Central Java and Siwabessy Multipurpose Reactor (30 MW) at Serpong – West Java. These reactors are operated by the National Nuclear Energy Agency (BATAN). The age of the three research reactors varies from 20 to 43 years since the reactors reached their first criticality. Detailed data of the reactors are given below.

Regulatory control of the three reactors is conducted by the Nuclear Energy Regulatory Agency (BAPETEN). Controlling the reactors is carried out based on the Act No. 10/1997 on Nuclear Energy, Government Regulations and BAPETEN Chairman Decrees concerning the nuclear safety, security and safeguards. Nevertheless, BAPETEN still lack of the regulation,

especially for controlling the decommissioning project. Therefore, in the near future BAPETEN has to prepare the regulations for decommissioning, particularly to anticipate the decommissioning of the oldest research reactors, which probably will be done in the next ten years.

5.3 Operating Status of the Reactors

All the three reactors are in operation. However, they have different operating experiences, since they were built in different periods. Table 1 shows the data for the three reactors. As from Table 1, Bandung Triga 2000 reactor is the oldest among them.

Bandung Triga 2000 reactor has reached first criticality in year 1964, which meansthat the reactor has been operated about 43 years. Since its first criticality, the reactor has been modified several times. In the first time, the reactor was operated at a power of 250kW. The reactor was then upgraded to 1000 kW power level in 1971, and to 2000 kW in 2000[1]. During the last upgrading project, some important components were replaced or modified. The old core with a circular configuration has been modified to be that with a hexagonal one. In addition, a new aluminum tank was placed as a liner inside the old one. This new liner is then becoming a reference for the period of reactor operability. Referring to the liner, the reactor is predicted to be operable until 2015, after which the reactor shall be decommissioned.

Recently, the reactor operation is limited by the Regulatory Body to about 1250 kW maximum, due to some safety problems relating to heat transfer in the core.

Table 1. Operating data of the research reactors in Indonesia

Reactor	Bandung Triga 2000	Kartini Reactor	GA Siwabessy Reactor
Power [kW]	2000	100	30,000
Type	Triga II	Triga II	MTR
Fuel	UO_2	UO_2	U_3Si_2-Al (plate)
First Critical	Year 1964	Year 1979	Year 1987
Operator	BATAN	BATAN	BATAN
Application	Research, training and isotope production	Research and training	Research, training and isotope production
Location	Bandung, West Java	Yogyakarta, Central Java	Serpong, West Java

5.4 Regulatory Control

According to Act No. 31 Year 1964 on Atomic Energy, promotion and utilization, as well as controlling, of nuclear energy are performed by the National Nuclear Energy Agency (BATAN). Consequently, construction and operation of the reactors in Indonesia were conducted and also controlled by BATAN. However, in 1997 the Act No.31/1964 was amended and replaced by a new one, i.e. Act No. 10/1997 on Nuclear Energy, since then the function of control became independent of BATAN [2]. By the new law on nuclear energy, any activity of research and promotion of utilization of nuclear energy is conducted by BATAN. On the other hand, regulatory control of the nuclear energy utilization is under authority of the Nuclear Energy Regulatory Agency (BAPETEN).

BAPETEN is a national authority on nuclear regulation, which was established in 998 under Presidential Decree No. 76/1998[3]. Based on the Act No. 10/1997 and the nuclear energy, BAPETEN performs regulatory control of the use of nuclear energy, including operation of the three research reactors. For technical aspects, BAPETEN has provided several safety provisions in the form of BAPETEN Chairman Decrees (BDCs) and guidelines. Table 2 indicates the list of regulations relevant to the research reactor construction and operation.

Nevertheless, BAPETEN still lack of the regulation, specifically for controlling the decommissioning activities. In the near future, therefore BAPETEN has to prepare the more detail and specific regulations for decommissioning, particularly to anticipate the decommissioning of the oldest research reactors (Bandung Triga 2000 reactor), which will probably be started in the next ten years.

Table 2. List of regulations relevant to construction and operation of the research reactors

Hirarchy of Regulation	No.	Number/Year of Issue	Topics
Act	1	Act No. 10/1997	Nuclear energy
Governmental Regulation	2	GR No. 63/2000	Safety and health against the utilization of radiation
	3	GR No. 26/2002	Transport safety of radioactive materials
	4	GR No. 27/2002	Radioactive waste management
	5	GR No xx/200x	Licensing on nuclear reactor (final draft)
Pres. Decree	-	-	-
BAPETEN Chairman Decree	6	BCD No. 01/1999	Safety provision on working against radiation
	7	BCD No. 02/1999	Radioactivity limitation in the environment
	8	BCD No. 03/1999	Safety provision on radioactive waste management
	9	BCD No. 04/1999	Safety provision on radioactive transport
	10	BCD No. 05/1999	Safety provision on design of research reactor
	11	BCD No. 07/1999	Quality assurance of nuclear installation
	12	BCD No. 10/1999	Safety provision on operation of research reactor
Guidelines	13	Guide No. 01-P/1999	Safety guide on site evaluation of nuclear reactor
	14	Guide No. 06-P/2000	Safety guide on preparation of safety analysis report for research reactor
	15	Guide No. 04-P/2003	Guide for training the research reactor operator and supervisor
	16	Guide No. 05-P/1999	Guide for emergency response planning

5.5 FNCA Task Group Meeting in Indonesia 2005 - Nuclear Facility Decommissioning and Its Waste Clearance

As the result of Radioactive Waste Management Workshop in Kuala Lumpur Malaysia, held on 27 September to 1 October 2004, Indonesia proposed to joint two sub group activities, and at that workshop it was decided to give a new task group namely: Task Group on Nuclear Facility Decommissioning and Its Waste Clearance. This would give benefit for Indonesia to share experiences from other FNCA member states, since Indonesia has a program to decommission a yellow cake production facility attached to the in the near future. As well, BATAN is also expecting to decommission some other ageing facilities in the future. Besides, Indonesia also requested to receive better first hand information on NORM and their clearance levels, since previously it was not involved in such Task Group. Indonesia intensified its activity to study the cases of NORM although late start as compared to other neighboring countries having similar NORM situation.

The task group meeting was held from 1-5 August 2005, and the task group meeting was focused on the (1) the decommissioning/clearance and (2) NORM. The meeting was hosted jointly by BATAN and BAPETEN, taking place in Jakarta, Serpong and Gresik. There were different parties invited, namely the Ministry of Health, Ministry of Environment, The Gresik Fertilizer Plant, Reactor Operators, the Radioactive Waste Center and the Radiation Safety Center.

The meeting adopted the following topics:

(1) NORM

a) International Trend of Treatment on NORM
b) Recent status of NORM in both countries
c) Outline of NORM guideline/regulation in both countries
d) Guideline categories for NORM in Japan
e) Action steps for NORM issues

(2) Decommissioning/Clearance

a) Recent status of Decommissioning/Clearance in both countries
b) Outline of regulations on Decommissioning/Clearance in both countries
c) Ways of Cooperation on Decommissioning/Clearance within the FNCA framework to provide adequate protection

A one-day visit to the uranium recovery plant at the Gresik Fertilizer plant was made. This plant is located 900 km from Jakarta, and to be decommissioned in the near future. The company had requested BATAN to make a decommissioning program for their facility. This survey in the field showed the whole picture of the plant, and there was a brief discussion about the steps of decommissioning.

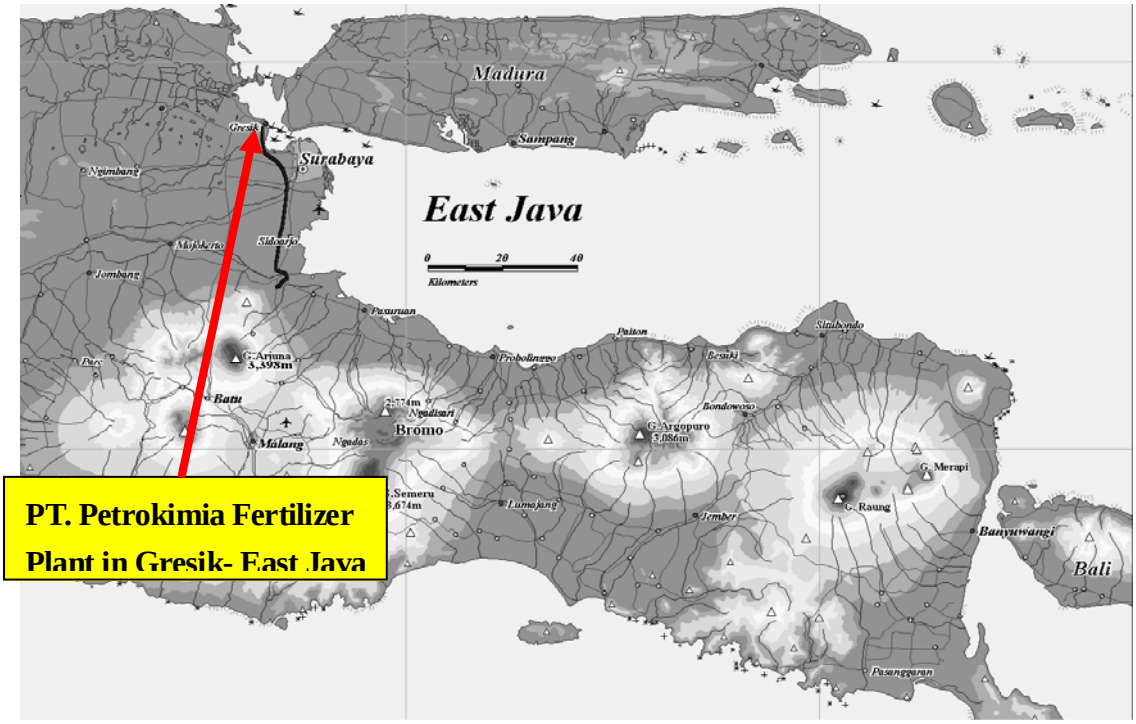

Fig.2. Map of the uranium recovery plant at the Gresik Fertilizer plant-East Java

As a result of this task group meeting, now Indonesia (BATAN and BAPETEN) is intensifying the study on NORM by observing the whole map of potential NORM site in the country, and in progress for the regulations. Beside, financing system is evaluated for decommissioning of uranium recovery plant at the Gresik fertilizer plant, and BAPETEN has established a team to study the clearance.

Figure 3a. Task Group Meeting on Nuclear Facility Decommissioning and Its Waste Clearance in Indonesia (1-5 August 2005).

Figure 3b.
Task Group Meeting on Nuclear Facility Decommissioning and Its Waste Clearance in Indonesia (1-5 August 2005). A one-day visit to the uranium recovery plant at the Gresik Fertilizer

Figure 3c
Task Group Meeting on Nuclear Facility Decommissioning and Its Waste Clearance in Indonesia (1-5 August 2005). A one-day visit to the uranium recovery plant at the Gresik Fertilizer plant

Figure 3d.
Task Group Meeting on Nuclear Facility Decommissioning and Its Waste Clearance in Indonesia (1-5 August 2005). A one-day visit to the uranium recovery plant at the Gresik Fertilizer plant

5.6 Study and Evaluation of Clearance Level

Following the development of clearance, exemption and exclusion concepts, the Nuclear Energy Regulatory Agency (BAPETEN) together with other organizations (including BATAN) evaluated on these concepts. The concepts will affect radioactive waste management in BATAN, i.e. in classifying free release solid waste. Also, this will affect the future decommissioning program of some nuclear facilities by Radioactive Waste Technology Center (RWTC).

Incoming solid waste results from use of radioactive materials in radiation working area is segregated and registered according to its physical and radiological properties, and process knowledge, see Table 1 and 2 below. In principle, this waste can be classified as radioactive waste or free release waste with concentration activity below its clearance level. An alternative of applying clearance levels is given to manage the new incoming waste and the historical waste available in interim storage of RWTC.

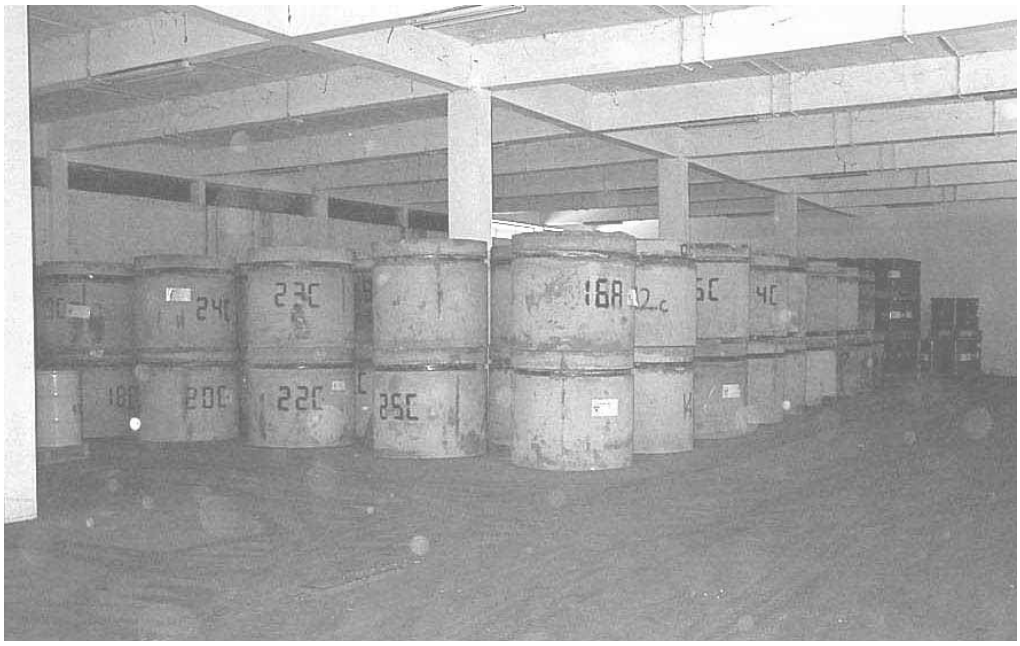

Fig. 2. Inside the Interim Storage Building No.1 RWTC

Table 3. Treated waste in Concrete Shell 950L in RWTC

Origin	Composition	Radionuclides
Research Reactor	Spent Resin	^{14}C, ^{32}P, ^{35}S, ^{54}Mn, ^{56}Mn, ^{60}Co, ^{65}Zn, ^{85}Sr, ^{90}Sr, ^{127m}Tc, ^{123m}Te, ^{137}Cs, ^{176m}La, Th-nat, ^{241}Am
Research Reactor, Radioisotope Laboratories	Concentrate	^{60}Co, ^{65}Zn,^{109}Cd, ^{137}Cs, ^{144}Ce, ^{226}Ra

Tabel 4. Treated waste in Drum 200L in RWTC

Origin	Composition	Predicted radionuclides
BATAN (research activities)	Glove, papers	^{3}H, ^{32}P, ^{45}Ca, ^{65}Zn, ^{75}Se, ^{125}I, ^{131}I, ^{99}Mo dsb.
	Sand, coral rock, ash, cement	^{90}Sr, ^{137}Cs, U-nat, Th-nat
	Carpets	^{238}U
	Ceramics	*unknown*
	HEPA filter	*unknown*
Hospitals	Radium needles	^{226}Ra
	Therapy	^{137}Cs, ^{60}Co
	Laboratories	*unknown*
Industries	Gas mantle	Th-nat, ^{40}K
	Lightning preventer	^{241}Am, ^{226}Ra
	Gauge	^{85}Kr, ^{55}Fe, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{192}Ir dsb.

The application of clearance levels refers to IAEA Safety Guide RS-G-1.7 publication. The clearance technique proposed includes assessment, classification and release of solid waste from BATAN giving emphasis to operational procedures and the available waste inventories in RWTC. Gamma spectroscopy, in conjunction with manual scanning and bulk waste consignment monitoring has fulfilled the requirements for assessment and classification of waste for free release. Gamma spectroscopy provides an overall assessment of total concentration in bulk waste against clearance levels. Vehicle Radiation Monitoring System gives a final assessment of waste released from the initial two processes.