NATIONAL REPORT
ON COMPLIANCE TO
CONVENTION ON NUCLEAR SAFETY

INDONESIA
2010

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FOREWORDS

The Republic of Indonesia is a contracting party to the Convention on Nuclear Safety since 2004. For the purpose of the Third Review Meeting in 2005, Indonesia has submitted its first national report in 2004. This is the third report that was prepared and based on the IAEA guideline No. INFCIRC/572/Rev. 2 (2002) on National Reports Under the Convention on Nuclear Safety and through a self assessment on the implementation of the nuclear safety of the nuclear facilities in Indonesia. Several parts of the previous report of 2007 will be included in this report, provided that they remain relevant and necessary to report.

Even though to date there is no formal political decision to "go nuclear", yet Indonesia continues to develop its nuclear infrastructure, especially in sthrenghtening its regulatory infrastructure by improving its regulations, licensing and inspection system and enhancing its human resources. For the purpose of strengthening its regulatory infrastructure, Indonesia is currently in the process of ratifying Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and finalising several draft regulations on the construction and operation of nuclear power plants (NPP).

I. INTRODUCTION

1.1. National Policy on Nuclear Energy Programme

Until now , Indonesia has not established any NPP yet, as it is intended by this convention. However, as it has been reported previously the Government has announced the national policy on NPP and the related safety regulation.

Presidential Regulation (PR) No. 5/2006 on National Energy Policy and Decree of Ministry of Energy and Mineral Resources No. 2270/2006 on General Plan of National Electricity are used by the Government of Indonesia as the guidance in managing national energy. Based on these regulations, new and renewable energy, especially biomass, nuclear, hydro, solar and wind energy, are expected to contribute to national energy generation as much as 5 % (five percent) in 2025. The first NPP in Indonesia is planned to operate in 2017 and is expected to contribute electricity around 4000 MWe in 2025, or about 2% of total electricity generated. This plan is supported with the establishment of Act No. 17/2007 on National Long-Term Development Plan for 2005-2025.

In order to provide a strong basis for the introduction of NPP to the national electricity system, a comprehensive and deep feasibility study has been performed in 1991-1996, namely “Feasibility Study on the Site and the Environment for the First NPP in Indonesia.” In 2000-2002, the study was renewed, especially on the issue of national energy supply and demand, including environmental assessment under a TC Project entitled “The Comprehensive Assessment of Different Energy Sources for Electricity Generation in Indonesia (CADES)”. The final report of this study was submitted by the DG of the IAEA to the President of Republic of Indonesia in August 2003. Its result, along with other studies related to the scenario of mixed energy for Indonesia, was used by Technical Committee on Energy (PTE) and National Energy Coordinating Agency (BAKOREN) in order to anticipate energy problem, both in national and global scale. Some additional studies have been prepared to complete the previous study as it was recommended by the IAEA on its expert mission in February 2006.

Several measures in accordance with the preparation of NPP introduction have been adopted for instance:

- site and environmental study of NPP;
- the preparation of Bid Invitation Specification (BIS);

- the preparation of User Requirements Document (URD); and
- regular dialogue with the Parliament, as well as the provision of public information and pubic education programme.

In regard to the sthrengthening of regulatory infrastructure, the Government of Indonesia has stipulated several government regulations, such as Government Regulation (GR) No. 46/2009 on the Nuclear Liability, and PR No. 46/2009 on the Ratification of the Amendment to The Convention on The Physical Protection of Nuclear Material, as well as Nuclear Energy Regulatory Agency (BAPETEN) Chairman Regulations related to site evaluation and design of NPPs. In addition, the Government is in the process of drafting a regulation to ratify Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

In regard to the development of governmental infrastructure for nuclear power, the Government of Indonesia received IAEA's Integrated Nuclear Infrastructure Review (INIR) mission in 2009. From the INIR mission, it can be concluded that Indonesia has completed the necessary requirements for the phase 1 (Considerations before a decision to launch a nuclear power programme is taken) and ready to commence to the phase 2 (Preparatory work for the construction of an NPP after a policy decision has been taken). It is important to note that, based on this review mission, our regulatory framework is considered adequate to license and control the first nuclear power plant in Indonesia.

1.2. Nuclear installation safety issue

Indonesia currently operates three research reactors that have average age of more than 20 years. Hence, ageing is an important issue for all reactors.

1.3. Summary of important changes to the last report

Some important changes in this National Report on Nuclear Safety Convention compared to the second one (2007) are as follows:

1. the enactment of GR No. 29/2008 on the Licensing of Ionising Radiation Sources and Nuclear Material;
2. the enactment of GR No. 46/2009 on the Nuclear Liability;
3. the enactment of PR No. 46/2009 on the Ratification of the Amendment to The Convention on The Physical Protection of Nuclear Material;
4. the enactment of various BAPETEN Chairman Regulations as listed in the Annex 4; and
5. various preparatory programme for NPP development in Indonesia.

II. ARTICLE BY ARTICLE ASSESSMENT

A. GENERAL PROVISION

Article 6 – Existing Nuclear Installation

6.1. List of Nuclear Installation

As it was reported previously, Indonesia at the moment is not operating any NPP yet and just operating three research reactors, i.e.: (1) Multipurpose Reactor (MPR) GA Siwabessy, Serpong; (2) TRIGA 2000 Reactor, Bandung; and Kartini Reactor, Yogyakarta. This article will briefly describe the current status of these three research reactors which are operated by the National Nuclear Energy Agency (BATAN).

(1) MPR GA Siwabessy

The MPR GA Siwabessy, with 30 MWt maximum power, is a pool type reactor using H_2O both as the moderator and coolant. The fuel is Uranium Silicide with 19.75 % enrichment and the reflector is Berylium. The reactor has been operated since 1987 for the purpose of material testing and analysis, radioisotope production, research etc. The reactor is operated four cycles a year and 45 days a cycle. (See Annex-1 for details)

(2) TRIGA 2000 Reactor

The TRIGA 2000 is a pool (TRIGA MARK II) type reactor using H_2O both as the moderator and coolant. The fuel is U-ZrH with 19.75 % enrichment and the reflector is graphite. When it was first operated in 1965, the power was 250 kWt. It was upgraded to 1000 kWt in 1971, and upgraded again lastly to 2000 kWt in 2000. The reactor is operated with operation mode of 3 days per week and 24 hours per operating day for the purpose of material analysis, radioisotope production, research etc. (See Annex-2 for details)

(3) Kartini Reactor

Kartini Reactor is also a pool (TRIGA MARK II) type reactor which has 100 kWt power and the enrichment of U-ZrH fuel is 19.75 %. It utilises graphite as the reflector and uses H_2O both as the moderator and coolant. The reactor was first operated in 1979, and now ~~it~~ is operated five times a week the purpose of material analysis, research, education etc. (See Annex-3 for details)

6.2. Main Safety Issues of Research Reactor

6.2.1. Ageing of Research Reactors and Human Resources

Major issues in nuclear safety in Indonesia remain similar to those outlined in the previous report, namely ageing of facilities and manpower. Ageing and obselete technology is the main problem for all three research reactors in Indonesia, as their age is now more than 20. On the other side, 70 % of the reactor operators and supervisors are close to their retirement time, while there is a limitation to recruit new employees for reactor operator position.

6.3. Efforts to enhance the safety of Research Reactor

6.3.1 Ageing

6.3.1.1. Structure System and Component

An ageing analysis for Kartini reactor has been performed since 2000 until currently with measurement of its tank thickness and visual verification by the use of underwater camera. Corrosion progress is restrained by maintaining the pH of reactor water coolant to make it not too corrosive for the aluminum tank.

Ageing analysis of TRIGA 2000 reactor tank was performed in 2006 with the assistance of the IAEA expert mission programme. Everest VIT colour videoscope with image capture dan Rees monochrome nuclear camera with axial and radial viewing capability with focus and zoom and adjustable lighting was used for visual verification. Corrosion of reactor tank is restrained by maintaining the quality of the reactor water coolant in accordance with the SAR.

In order to improve the reliability of reactor system in enhancing the safety in the GAS reactor, a refurbishment programme for some aged and obsolete systems and components has been done since 2005. The programme has been applied to some electrical, mechanical and I&C systems, i.e.:

- Electrical: switch gear, panel, UPS, battery and electric motor.
- Mechanical system: Cooling tower, secondary pump; cleaning the heat exchanger, ventilation and demineraliser of water supply.
- I&C: PLC, data acquisition and radiation monitoring system.

6.3.1.2. Human resource

In the near future, most of reactor operators and supervisors will enter their retirement time. In order to maintain the continuity of reactor operation, BATAN organises coaching programme for junior reactor operators or supervisors from their seniors. The coaching programme is somewhat different from the regular training and uses practical method more frequently. It is applied more specifically to particular equipment or operation mode. The schedule is arranged in accordance with the reactor condition. The coaching programme has been performed intensively in the last two years.

Other important action taken is managing documentation and records related to construction, commissioning and operational experiences, both for normal and emergency situation. This is very important for the future decommissioning programme, since most of senior operators and supervisors will not be available for work in the future.

Other related programme is to employ junior personnel together with their seniors in revising operating and maintenance procedures of research reactors. This is important for effective transfer of knowledge. Even the number of junior personnel is very limited depending on the current Government policy, recruitment of fresh graduate is still continued. The new employees will very soon have to take radiation protection training and an introductory course on the operation of research reactor.

B. Legislation and Regulation
Article 7 - Legislative and regulatory Framework

7.1. Nuclear Legislation

There is no change in nuclear legislation system in Indonesia.

7.2 Nuclear Regulation

In order to implement the Act No. 10/1997 on Nuclear Energy, the government of The Republic of Indonesia has enacted several government regulations and presidential regulations. The government regulations which have been enacted since 2008 are GR No. 29/2008 on the Licensing of Ionising Radiation Sources and Nuclear Material; GR No. 46/2009 on the Nuclear Liability; PR No. 46/2009 on the Ratification of the Amendment to The Convention on The Physical Protection of Nuclear Material; and several BAPETEN Chairman Regulations.

Currently, Indonesia is finalising the draft Regulation on Ratification of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Some drafts regulations in the form of BAPETEN Chairman Regulation are also being finalised. Applicable regulations on the safety of nuclear installations are listed on Annex 4.

7.2.1 Licensing System of Nuclear Reactors

The licensing system of nuclear reactors follows the provisions and requirements stated by the GR No. 43/2006. The GR states that the future NPPs in Indonesia shall be land-based and use proven technology. Basically, it utilises multi step licensing system. However, for modular-designed nuclear reactors which have been granted a design certification by the regulatory body of the supplier's country, it could follow combined licensing system.

7.2.2 Regulatory Inspection

Regulatory inspections for verifying the compliance to licence conditions and regulatory requirements are performed by inspectors who were appointed by the Chairman of BAPETEN. GR No. 43/2006 provides the authorities of inspectors in more detail. For example:

- To gain entry to nuclear reactor area and facilities during the construction, commissioning, operation and decommissioning stages;

- To instruct the operators to take necessary measures for protecting the safety and health of the workers, the public and the environment;
- In emergency situation, to temporarily terminate any commissioning, operation or decommissioning activities of a nuclear reactor which potentially leads to radiological hazard to the workers, the public and the environment. This action can only be executed after consultation with the chairman of BAPETEN.

7.2.3 Enforcement

The law enforcement to any violation of licence conditions or regulatory requirements could be performed by means of the following actions:

a. Warning note,
b. Licence suspension,
c. Licence revocation,
d. Penal provision for nuclear energy utilisation without authorisation.

Article 8 – Regulatory Body

As an independent regulatory body, BAPETEN needs sufficient number of human resources who are qualified and have the necessary competencies relevant to their tasks. Currently, BAPETEN is developing the blue print of human resources development plan, especially in anticipating the introduction of NPPs.

In the human resources development framework, BAPETEN has initiated cooperation with several countries, such as Japan, South Korea, Australia, China, Canada and the United States of America.

In order to accomplish its regulatory function, BAPETEN has established centers for assessment of nuclear safety and radiation safety as the internal technical supporting units. These units may outsource their duties to both domestic or foreign experts and consultants.

Financial resources of BAPETEN come from the government funding in accordance with the annual budget plan which is approved by National Development Planning Agency and the Minister of Finance. Licensing fees obtained by BAPETEN go to the government.

Article 9 – Responsibility of the Licence Holder

BAPETEN Nuclear Safety Policy states that the main responsibility of the safety in the nuclear energy utilisation lies on the licence holder, and this responsibility cannot be delegated.

Article 6 of GR No. 33/2007 states that the licence holders bear the prime responsibilities on the safety of the workers and the public in and around the installations under their authority. The licence holders shall provide BAPETEN inspectors–access to their facilities to perform regulatory inspections, with or without prior notification.

C. General Safety Consideration

Article 10 - Safety Priorities

10.1. Nuclear Safety Policy

As the licence holder, the operators establishes nuclear safety policy in order to maintain the safety level of their nuclear reactors, i.e.:

a. To operate the facility in compliance with the requirements stated in the **licence** conditions established by BAPETEN;
b. To operate and maintain the facility according to operation and maintenance procedures;
c. To implement safety culture;
d. To implement quality assurance program**me** in the management of the facility.

Article 11 - Financial and Human Resources

11.1. Financial Resources

The three research reactors operated by BATAN are supported by the government funding. The maintenance and repair during their lifetime and the decommissioning of the reactors are guaranteed by the government. The responsibility for radioactive waste management lies on BATAN in accordance with the Act No. 10/1997. In the case of nuclear power plants, the licen**c**e applicant is responsible for providing the proof of financial capabilities for its construction, operation, and decommissioning, as well as for nuclear liability in the case of nuclear accident as stated in GR No. 43/2006.

11.2. Human Resources

The preparation of the human resources in nuclear area, for both BAPETEN or BATAN, is managed by dispatching staffs to attend training courses or workshops in either domestic or foreign countries and by having cooperation with universities and relevant institutions.

Article 19 of Act No. 10/1997 states that all employees operating a nuclear reactor and certain employees in other nuclear installations shall be subjected to working permit. BCR No 10/2008 on the Working Permits for Personnel of Nuclear Installation and Materials further regulates the mechanism of obtaining the working permit through qualifying examination and certification. The employees in nuclear installations subject to

working permit are reactor operators and supervisors, radiation protection officers, and maintenance and repair officers. To maintain their competency, those employees shall be trained and retrained regularly.

Article 12- Human Factors

To prevent human error, research reactors in Indonesia shall be operated:

- by a team which consists of at least 2 operators, 1 supervisor, and 1 radiation protection officer;
- with one working shift of 8 hours;
- implementing qualification and requalification system (see point 11.2.); and
- implementing quality assurance programme and safety culture.

Article 13 – Quality Assurance

Based on GR 43/2006, quality assurance programme which shall be implemented by nuclear installation is comprised of:

- safety culture, grading, and documentation;
- management responsibilities;
- resource management;
- process implementation
- measurement, assessment and improvement.

Currently, all nuclear installations have established and implemented the quality assurance programs and have carried out periodic internal audit based on the IAEA SS 50-C/SG-Q. BAPETEN has the authority in conducting quality assurance audit for nuclear installation licensee and supplier having the activities and supplying the safety related system, structures and components.

Article 14- Assessment and Verification of Safety

GR No. 43/2006 stipulates requirements for the systematic and comprehensive safety assessments prior to nuclear reactor construction, commissioning and operation. Currently, BAPETEN is drafting a guidance on power reactor safety assessment and

verification. For research reactor, the licensees have implemented deterministic safety analysis which is reported in the Safety Analysis Reports. BAPETEN evaluates the implementation of licensee's Reports through verifications and inspections.

Article 15 – Radiation Protection

The GR No. 33/2007 has adopted some significant principles from IAEA BSS-115, i.e.: defense in depth, good engineered practices, safety verification, intervention and security of radioactive sources. It also adopts the basic concepts of justification, limitation and optimisation, through dose constraint and guidance level in medical exposures.

For nuclear installations, this GR governs that the licensee shall continuously, periodically and/or incidentally monitor the environmental radioactivity. The level of environmental radioactivity shall not exceed the limit of environmental radioactivity established by BAPETEN. Besides that, the GR No. 43/2006 requires the licensing applicant to submit the report of environmental management and environmental monitoring programme.

BAPETEN assesses the radiation worker dose and environmental monitoring programme. The results of those assessments for three research reactors during 2005-2007 show that the radiation exposure on radiation workers is below the dose limit established by BAPETEN.

Article 16 – Emergency Preparedness

GR No. 43/2006 stipulates that the applicant shall apply for commissioning licence to BAPETEN, inter alia, by submitting the emergency preparedness programme. In addition, GR No. 33/2007 governs that the licensees are responsible and shall have their own capability for emergency response based on their emergency preparedness programme.

Based on Act No. 24/2007 on the Response of National Disaster, all kind of national disaster response, including nuclear accident, shall be carried out by the National Disaster Management Agency (BNPB).

At the moment, BAPETEN is preparing a draft GR on National System for Nuclear Emergency Preparedness which is expected to be a national platform in preparing and responding nuclear emergency situation, and integrating all organisation involved.

As a contracting party, the Government of Indonesia took some actions in regard to Early Notification of a Nuclear Accident and Assistance in the Case of a Nuclear Accidents or Radiological Emergency conventions, such as:

- Providing and operating National Competent Authority-Abroad (NCA-A) that is the Chairman of BAPETEN; National Competent Authority-Domestic (NCA-D) that is the Deputy of Chairman of BAPETEN for Licensing and Inspection; and, National Warning Point (NWP) that is the Director of Nuclear Engineering Support and Emergency Preparedness, BAPETEN.
- Participating in International Convention Exercise (CONVEX) and Field Exercise.

In implementing the BAPETEN Chairman Regulation (BCR) No. 1/2010 on the Nuclear Emergency Preparedness and Response, three research reactors conduct nuclear emergency exercise annually based on their nuclear emergency programme.

D. Safety of Installations

Article 17 – Siting

The Government of Indonesia takes necessary efforts to ensure that the future NPP site will comply with established requirements for site safety.

Article 9 of GR No. 43/2006 BAPETEN establishes the requirements for site licensing of nuclear reactor. The applicant shall carry out the site evaluation. In the licensing process, the application shall submit:

1. Site Evaluation Report;
2. Description of nuclear reactors;
3. Preliminary Design Information Questionnaire (DIQ); and
4. QA records on the site evaluation process.

For implementing the above GR, BAPETEN has issued several BCRs in more detail related to Siting (see Annex 4), in addition to the BCR No. 05/2007 on the Safety Provisions on Site Evaluation of Nuclear Reactor.

Article 18 – Design and Construction

The construction licensing process has been stipulated in the Article 12 of the GR No. 43/2006. The construction licence application shall be submitted together with of administrative and technical documents, such as:

1. Preliminary Safety Analysis Report;
2. A detailed design of the nuclear reactor;
3. Probabilistic Safety Analysis Report for commercial power reactors;
4. Construction Programme;
5. Design Information Questionaire;
6. The Preliminary Nuclear Security System describing Physical Protection Programme for the facilities;
7. Quality Assurance Programme for construction phase;
8. A recommendation from the competent authority on the environmental impact analysis; and
9. Legal documents of financial ability to ensure the implementation of construction.

If necessary, the construction licence can be renewed by submitting the following documents:

a. progress report of construction activities; and
b. new construction programme and schedule.

The applicant shall apply the construction licensing application at least 4 years since the site licence has been issued. The licensee shall commence the construction activities at most one year since the construction licence has been granted. If the licensee has not completed the construction activities for the determined period, the licensee shall apply for renewal of the construction licence at least 6 months before the construction licence expired.

Implementing GR No. 43/2006 in this issue, BAPETEN has finished several drafts BCR on the Safety Provisions of NPPs design and construction, reffering to the IAEA NS-R-1.

Article 19 – Operation

Commissioning and operation licensing process are stipulated in the Article 15-18 of GR No. 43/2006. The application of commissioning licence shall be submitted together with of administrative and technical documents, such as:

a. Commissioning Programme;
b. Construction activities report, including the report on functional testing of the structure, system and components of the nuclear reactor;
c. as-built technical drawing of nuclear reactor;
d. Safeguards and Nuclear Security Systems;
e. Nuclear Emergency Preparedness Programme;
f. Quality Assurance Programme for commissioning phase;
g. The report on the implementation of Environmental Management and Monitoring Plan;
h. Legal documents of financial guarantee for nuclear liability; and
i. Legal documents of financial guarantee for the future implementation of decommissioning activities of nuclear reactor.

The application of operation licence shall be submitted together with of administrative and technical documents, such as:

a Final Safety Analysis Report which contains the operational limit and condition, and decommissioning programme.
b Facility Attachment (safeguards);
c The report on the implementation of Environmental Management and Monitoring Plan during commissioning;
d Quality Assurance Programme for operation phase; and
e Legal documents of financial guarantee to operate nuclear reactors.

Currently, BAPETEN is preparing the draft BCRs on the Safety Provisions of NPP Operation, with reference to the IAEA NS-R-2.

Radioactive waste produced in operating phase shall fulfill all requirements stated in GR No. 27/2002 on Radioactive Waste Management, which is currently under revision. In the current situation, radioactive waste from research reactors is stored in the Center of Radioactive Waste Management in BATAN facility in Serpong. Spent fuel of the fuel produced in the USA, is re-exported back to the USA based on the agreement between Indonesian and the US Government.

III. Summary

1. The National Energy Policy as stipulated in the Presidential Decree No. 5/2006 stated that the first NPP in Indonesia will operate in 2017, and will contribute 4,000 MWe in 2025 or 2% of national energy generation.
2. Nuclear Energy Regulatory Agency (BAPETEN) is strengthening the regulatory infrastructures of NPP, including regulation, licensing and inspection as well as human resources development.
3. GR No. 43/2006 on the Licensing of Nuclear Reactor established that NPP ~~to built~~ shall be land-based and of proven technology.
4. BATAN facilities have established nuclear safety policy, which states that the safety is the highest priority in the utilisation of nuclear energy. There were some activities which have been executed to improve and promote nuclear safety culture.
5. The Government of Indonesia enacted GR No. 29/2008 on the Licensing of Ionising Radiation Sources and Nuclear Material; GR No. 46/2009 on the Nuclear Liability; PR No. 46/2009 on the Ratification of the Amendment to The Convention on The Physical Protection of Nuclear Material; and several BAPETEN Chairman Regulations.
6. The Government of Indonesia has finalised the draft regulation of Ratification of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Annex 1: RSG-GAS Reactor

Facility Name	RSG-GA Siwabessy Reactor
Location	Serpong, Indonesia
Owner	National Nuclear Energy Agency (BATAN)
Operator	Center for Multi Purpose Reactor (PRSG)
Licensing Authority	Nuclear Energy Regulatory Agency (BAPETEN)
Construction started	01/01/1983
First criticality	29/07/1987
Status	Operation
Reactor Type	Tank Pool Research Reactor
Fuel Type	MTR (Material Testing Reactor)
Material	Uranium Silicide (U_3Si_2Al)
Number of Elements	40 FE (Fuel Elements) and 8 CE (Control Elements)
Removal rate	20,5 / 615
Total weight U-235	8,00 – 8,625kg
Enrichment	19,75 %
Peak neutron flux	2 X 10^{14} n/cm^2/s
Thermal Power	30 MW
Moderator	Light Water
Primary Coolant	Light Water (H_2O)
Flow rate	3150 m^3/h (two pump)
Inlet temperature	40 ^{0}C
Outlet temperature	49 ^{0}C
Secondary Coolant	Light Water (H_2O)
Flow rate	2 x 2000 m^3/h
Inner Reflector	Beryllium
Outer reflector	Beryllium
Control system	8 fork type absorber Absorbing material : Ag In Cd Cladding material : Stainless Steel
Operating Staff	1 Supervisor 4 operators 1 radiation protection officer
Exclusion boundary	0,5 km
Utilisation	R&D, Radioisotope production, material testing

Annex 2: TRIGA 2000 Reactor

Facility Name	TRIGA 2000 reactor
Location	Bandung
Owner	National Nuclear Energy Agency
Operator	Center for Nuclear Technology of Material and Radiometry (PTNBR)
Licensing Authority	Nuclear Energy Regulatory Agency (BAPETEN)
Construction started	01/01/1961
First criticality	19/10/1964
Status	Operational
Reactor Type	Triga Mark II
Thermal Power	2000 kW
Moderator	H_2O, ZrH
Coolant	Light Water
Reflector	Graphite, H_2O
Fuel Element	U_{235} (38,55 and 99 gr) per element 111 element
Control rod	B_4C, 5 FFCR (Follower Fuel Control Rod)
enrichment	19,75%
neutron Flux maximum	CT (A-1) : $5{,}18 \times 10^{13}$ neutron cm^{-2} sec^{-1} E-8 : $2{,}57 \times 10^{13}$ neutron cm^{-2} sec^{-1} E-15 : $3{,}40 \times 10^{13}$ neutron cm^{-2} sec^{-1} E-23 : $2{,}56 \times 10^{13}$ neutron cm^{-2} sec^{1} Pnematic : $2{,}46 \times 10^{13}$ neutron cm^{-2} sec^{-1} Lazy Suzan : $8{,}34 \times 10^{12}$ neutron cm^{-2} sec^{-1}
Flow rate of Primary Coolant	$\leq$ 600 gpm
Inlet Temperature of primary Coolant	$\leq 40^0$C
Outlet Temperature of primary Coolant	$\leq 49^0$C
Utilisation	radioisotopes production, R&D and training

Annex 3: Kartini Reactor

Reactor Type	TRIGA Mark II
Maximum reactor power	250 kWt
Location	Babarsari, Yogyakarta.
Owner dan operator	National Nuclear Energy Agency (BATAN) Center for Technology of Accelerator and Material Process (PTAPB)
Contractor	GAMA Research Center
Design	General Atomic Division, General Dynamics Corporation
Status, constraction and operation	- Start built : April 1975 - First Criticality : Januari 1979 - Operation : Maret 1979
Avaerage neutron energy	0,21 eV
Effective prompt neutron lifetime	$6x10^{-5}$sec
Delayed neutron fraction (β_{eff})	0,007 (a value used for control tod calibration)
Thermal neutron flux	average $1,2x10^{12}$ neutron cm^{-2} sec^{-1} maks $2,0x10^{12}$ neutron cm^{-2} sec^{-1}
Prompt neutron flux	average $2,3x10^{12}$ neutron cm^{-2} sec^{-1} maks $4,0x10^{12}$ neutron cm^{-2} sec^{-1}
Core size	cilinder diameter, 45 cm, high 56 cm
Critis mass	2,40 kg U^{235}
Core	2,62 kg U^{235} (~69 fuel element)
Average heat flux	3,25 W/ cm^2
Fuel element	U_{235}
Control Rod	B_4C
enrichment	19,75%
Fuel Temperature	~ 143^0C
Pool reactor Temperature	surface water maximum ~49^0C
temperature reactivity coefficient	Prompt ~ 1,2 x 10^{-4} δk/k per ^{0} C delayed ~ 3 x 10^{-5} δk/k per ^{0} C
Utilisation	Reactor physic research, activation analysis, training

Annex 4 List of Regulations for Nuclear Installation

A. Regulations enacted before 2008

No.	Title
1	Nuclear Energy Act No. 10/1997 on Nuclear Energy
2	Government Regulation (GR) No 43/2006 on Licensing of Nuclear Reactors
3	GR No. 33/2007 on the Ionising Radiation Safety and Security of Radioactive Sources which is the amendment of GR No.63/2000 on the Safety and Health on the Ionising Radiation Utilisation
4	BAPETEN Chairman Regulation (BCR) No 5/2007 on the Safety Provisions for Siting of Nuclear Reactors
5	GR No. 43/2006 on the Licensing of Nuclear Reactor
6	GR No. 26/2002 on the Safety of Radioactive Material Transportation
7	GR No. 27/2002 on the Radioactive Waste Management
8	BAPETEN Chairman Decree No. 05-P/Ka-BAPETEN/I-03 on the Guidance on the Emergency Response and Preparedness Programme
9	BAPETEN Chairman Decree No. 04-P/Ka-BAPETEN/I-03 on the Guidance on Nuclear Reactor Operator and Supervisor Training
10	BAPETEN Chairman Decree No. 05-P/Ka-BAPETEN/VII-00 on the Guidance on the Requirements of Radioactive Material Safe Transport
11	BAPETEN Chairman Decree No. 10/Ka-BAPETEN/VI-99 on the Safety Provision on Research Reactor Operation.
12	BAPETEN Chairman Decree No. 07/Ka-BAPETEN/V-99 on Quality Assurance of Nuclear Installation
13	BAPETEN Chairman Decree No. 05/Ka-BAPETEN/V-99 on the Safety Provisions on Research Reactor Design
14	BAPETEN Chairman Decree No. 04/Ka-BAPETEN/V-99 on the Safety Provisions on the Transportation of Radioactive Materials
15	BAPETEN Chairman Decree No. 04-P/Ka-BAPETEN/VI-99 on the Technical Guidance of the Format and Content of Environmental Impact Analysis Report Construction and Operation of Nuclear Installation and other Installations.
16	BAPETEN Chairman Decree No. 03/Ka-BAPETEN/V-99 on the Safety Provisions on Radioactive Waste Management
17	BAPETEN Chairman Decree No. 03-P/Ka-BAPETEN/VI-99 on the Technical Guidance of the Format and Content of Environmental Impact Analysis Report Construction and Operation of Nuclear Installation.
18	BAPETEN Chairman Decree No. 01/Ka-BAPETEN/V-99 on the Safety Provisions on Radiation Safety
19	BAPETEN Chairman Decree No. 01-P/Ka-BAPETEN/VI-99 on the Siting of NPP

B. Regulations enacted after 2008

No.	Title
1	GR No. 29/2008 on the Licensing of Ionising Radiation Sources and Nuclear Material
2	GR No. 46/2009 on the Nuclear Damage Liability
3	Presidential Regulation No. 46/2009 on the Ratification of the Amendment to The Convention on The Physical Protection of Nuclear Material

4	Draft regulation of Ratification of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
5	BAPETEN Chairman Regulation (BCR) No. 1/2010 on the Nuclear Emergency Preparedness and Response
6	BCR No. 3/2010 on the Design of Handling and Storage System for Nuclear Fuels of Power Reactors
7	BCR No. 1/2009 on the Provision for Physical Protection System of Nuclear Instalation and Materials
8	BCR No. 2/2009 on the Establishment of Design Information Questionnaire
9	BCR No. 3/2009 on the Operational Limit and Condition and Prosedures for Power Reactors
10	BCR No 4/2009 on the Decommissioning of Nuclear Reactors
11	BCR No 1/2008 on the Site Evaluation of Power Reactor: Aspect of Seismicity
12	BCR No 2/2008 on the Site Evaluation of Power Reactor: Aspect of Volcano
13	BCR No 3/2008 on the Site Evaluation of Power Reactor: Aspect of Determination of Dispersion of Radioactive Material in the Air, and Considerations of Population Distribution in the Site Area
14	BCR No 4/2008 on the Site Evaluation of Power Reactor: Aspect of Geotechnics and Foundation
15	BCR No 5/2008 on the Site Evaluation of Power Reactor: Aspect of Meteorology
16	BCR No 6/2008 on the Site Evaluation of Power Reactor: Aspect of External Human Induced Events
17	BCR No 8/2008 on the Safety Provision of Ageing of Non Power Reactors
18	BCR No 9/2008 on the Format for the Declaration of Additional Protocol in Accountancy and Control System of Nuclear Materials
19	BCR No 10/2008 on the Working Permits for Personnel of Nuclear Installation and Materials

C. Draft Regulations

No.	**Title**
1	Draft Regulation of Ratification of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
2	Draft ~~of~~ Revision of GR No. 26/2002 on the Safety of Radioactive Material Transportation
3	Draft ~~of~~ Revision of GR No. 27/2002 on the Radioactive Waste Management
4	Draft ~~of~~ GR on Safety and Security of Nuclear Installation and Materials
5	Several drafts BAPETEN Chairman Regulations.