

Nuclear Program in Indonesia

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Haryo Seno, Indah Kusmartini, Afida Ikawati, etc

Center for Applied Nuclear Science & Technology

National Nuclear Energy Agency (BATAN)

BATAN

Badan Tenaga Nuklir Nasional

VISION :

Realization of safe and reliable application of nuclear science and technology to actuate and accelerate the pursuit of prosperity

MISSION:

- To perform research, development and engineering of nuclear science and technology for energy and non energy
- To disseminate proven result of research and development in nuclear science and technology
- To ensure total quality management for the satisfaction of all stakeholders



*National Nuclear Energy Agency
Indonesia*



NUCLEAR RESEARCH AREA



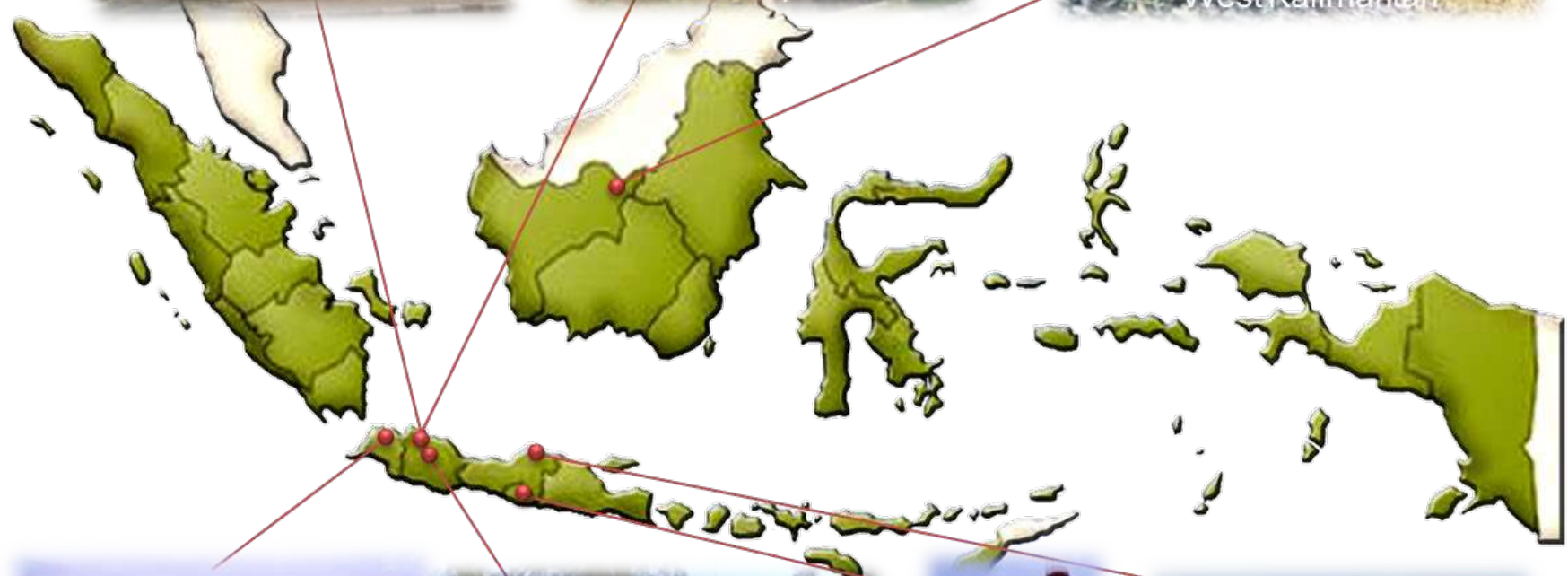
The Head Office, Jakarta



The Pasar Jumat Nuclear Complex



Exploration area and uranium test mining Kalan-West Kalimantan



The Serpong Nuclear Complex



The Bandung Nuclear Complex

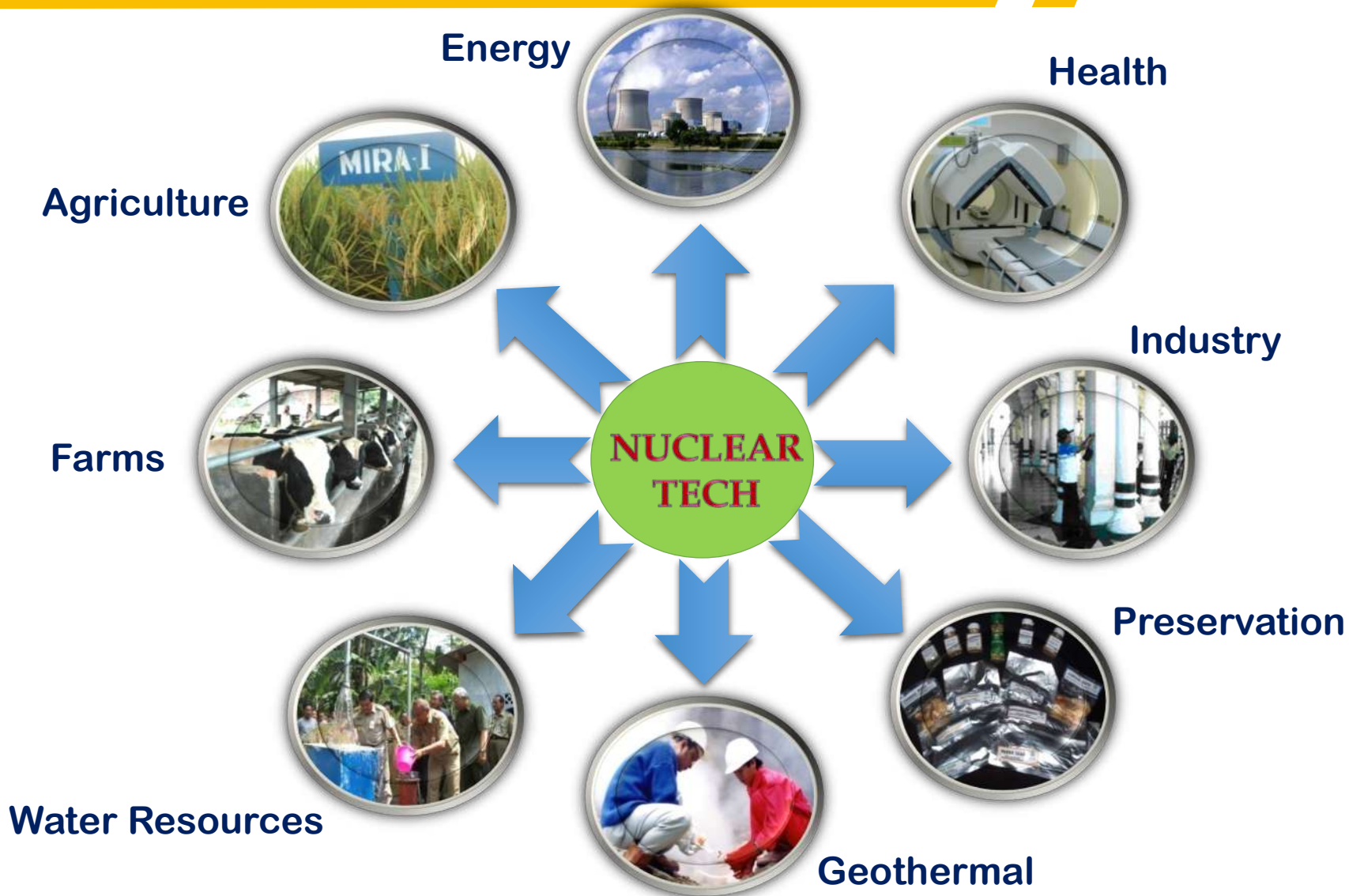


The Yogyakarta Nuclear Complex



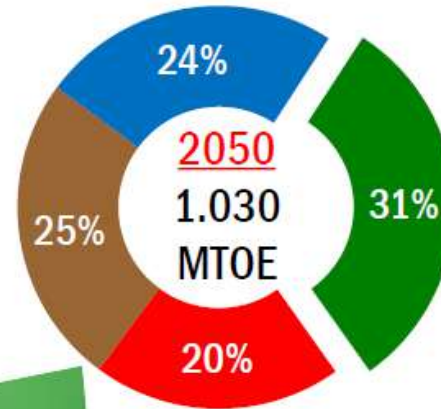
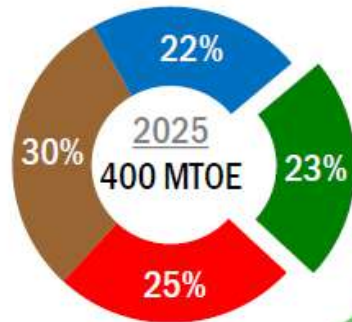
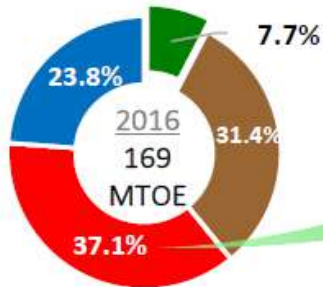
Prospective nuclear power plant site Bangka Belitung

Nuclear Research & Technology Focus



Target of Energy Mix

PRESENT CONDITION



- New and renewable
- Coal
- Oil
- Gas

	2016	2025	2050
Role of energy	Commodity	As development capital	
Renewable mix	7.7%	23%	31%
Energy supply	169 MTOE	400 MTOE	1.021 MTOE
Power plant Capacity	59 GW (EBT 8 GW)	136 GW (EBT > 45 GW)	443 GW (EBT > 167 GW)
Energy elasticity	1	< 1	< 1
Electricity /capita/year	865 kWh	2.500 kWh	7.000 kWh
Electrification Ratio	88%	~100%	~100%

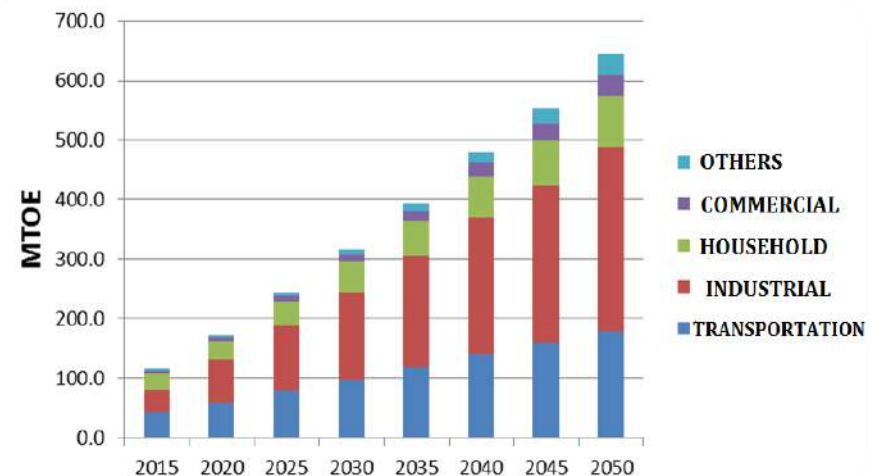
Nuclear for Energy



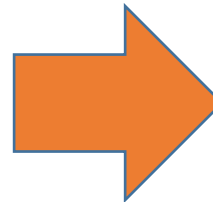
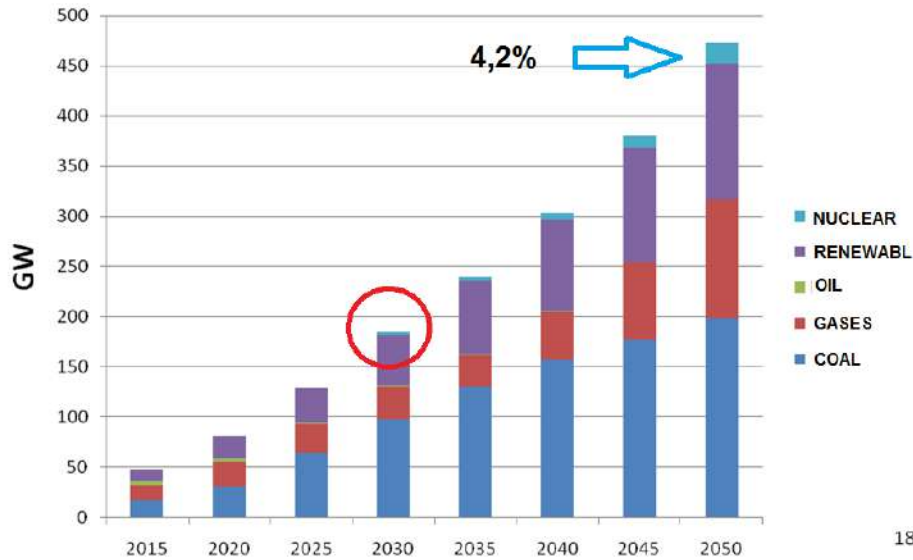
Nuclear energy as new energy in Indonesia, why?

- Fourth most populous country in the world, 223 million people (2006), 1.49% growth rate
- An average of 7% per year will be hard to come by depending only on fossil materials.
- Reserves of fossil energy is limited
- Subsidy of Energy Continues to Increase every year
- Lack of Energy Infrastructure Development
- Carbon emission issue

Energy Need Projection in
Indonesia

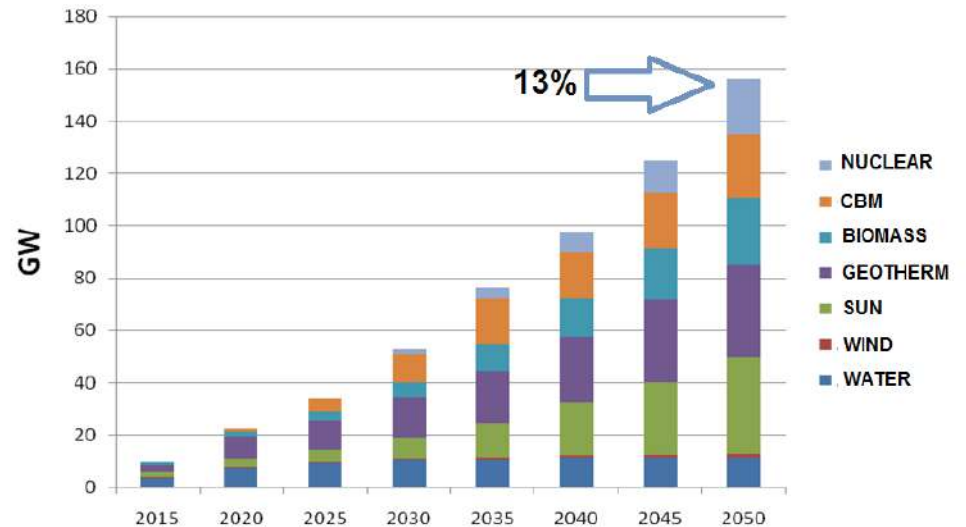


Nuclear for Energy



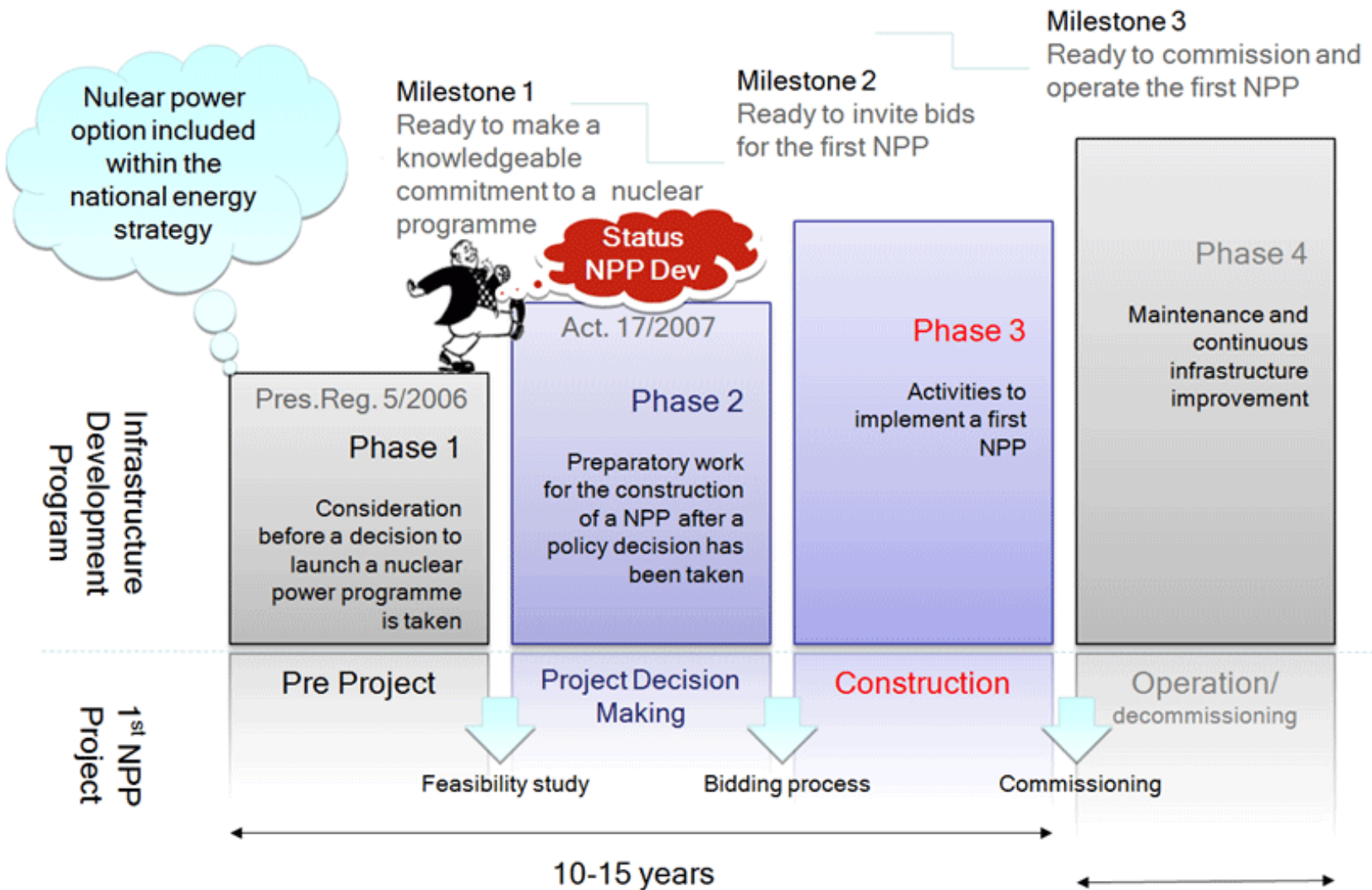
Total Projected Capacity of Electric Plant

Capacity of Electric Plant from New & Renewable Energy



- BATAN requested the IAEA to perform an **Integrated Nuclear Infrastructure Review (INIR) Mission** under the framework of TC programme (INS/4/037) in a letter dated on 5 August 2009.
- An INIR mission provides an **external peer reviews conducted by the IAEA** in November 23 – 27, 2009
- INIR mission shows that **Indonesia has done extensive preparatory work on most infrastructure issues** that would allow the country to make decision to further consider introduction of nuclear power, i.e. to go from phase 1 to phase 2 in Milestone methodology.

STATUS OF NPP INFRASTRUCTURE DEVELOPMENT



STATUS OF NPP INFRASTRUCTURE DEVELOPMENT



No.	INFRASTRUCTURE ISSUES	PHASE 1, STATUS
1.	National position	Red
2.	Nuclear Safety	Green
3.	Management	Red
4.	Funding and Financing	Yellow
5.	Legislative Framework	Yellow
6.	Safeguards	Green
7.	Regulatory Framework	Green
8.	Radiation protection	Green
9.	Electrical Grid	Green
10.	Human resources	Green
11.	Stakeholder involvement	Red
12.	Site and supporting facilities	Yellow
13.	Environmental protection	Green
14.	Emergency planning	Green
15.	Security	Green
16.	Nuclear fuel cycle	Green
17.	Radioactive waste	Green
18.	Industrial Involvement	Yellow
19.	Procurement	Green



To be prepared, not available



To be updated/improved



Functional, being implemented, available

*** IAEA INIR Mission**

Integrated Nuclear Infrastructure Review

Nuclear for Energy (Plan)



Experimental Power Reactor (EPR) → HTGR



Nuclear Power Plant (NPP) → PWR or SMR

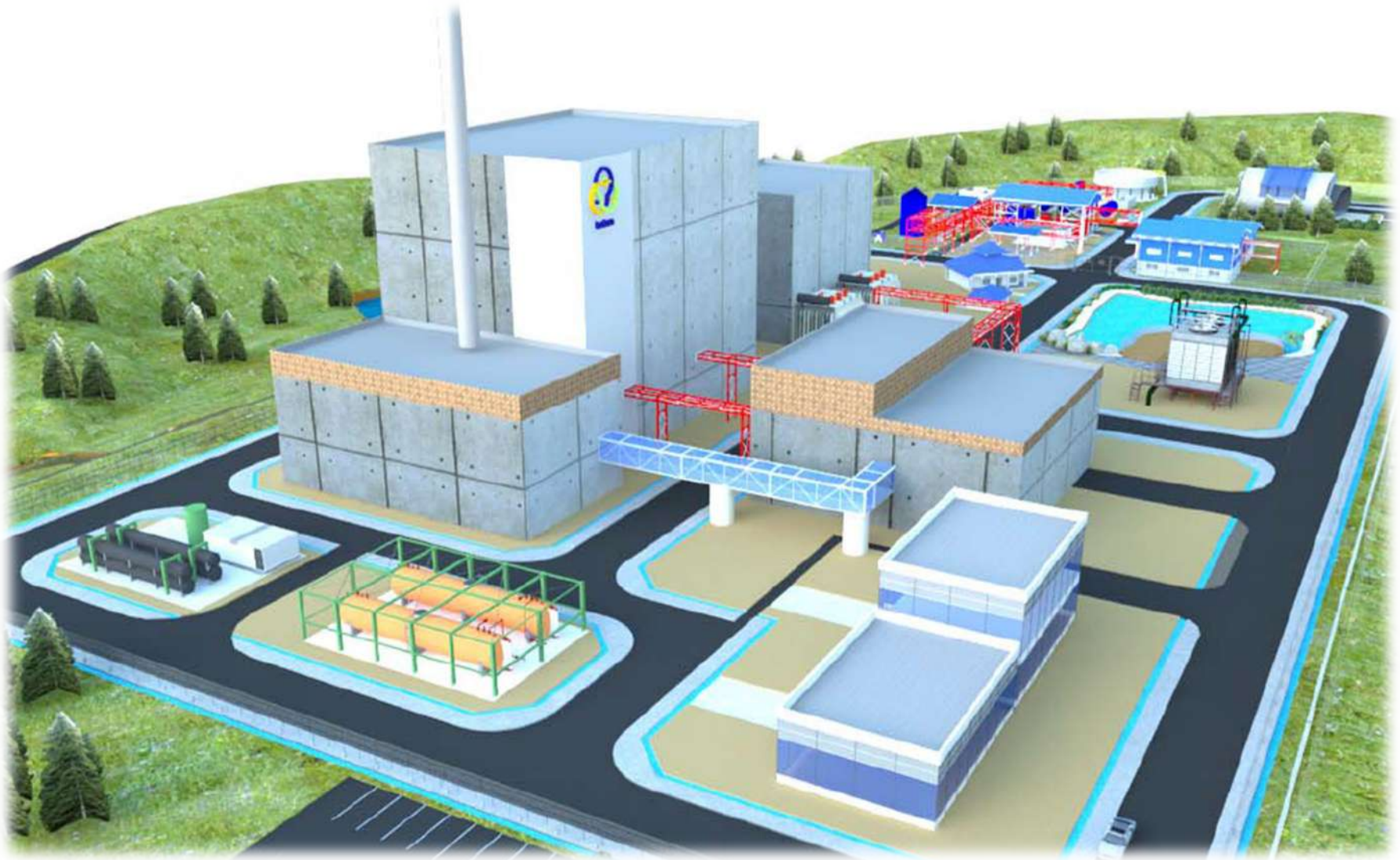


Why Experimental (non-commercial) Power Reactor?



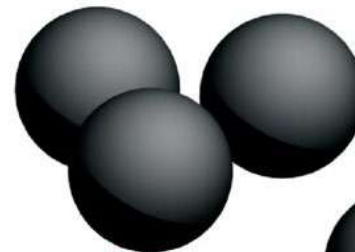
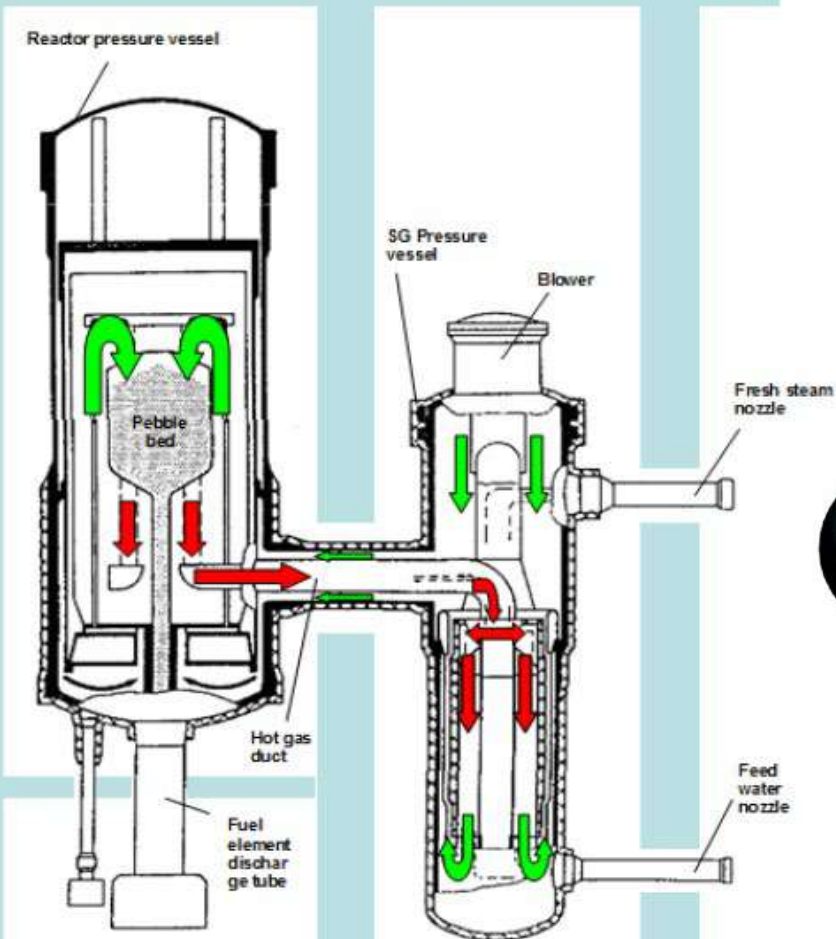
- The development of a **national nuclear power plants** with the aim to improve the Nation's ability to provide electricity, particularly with the nuclear option
- To improve the public perception of nuclear power plants with the aim of strengthening the Public Acceptance and Stakeholder Participation
- Based on the regulations, BATAN can do the construction and operation of non-commercial/experiments / research power reactors, with funding come from the government with a relatively small budget
- The development of non-commercial reactors will be a basis for the development of nuclear power plants in Indonesia, that are should be competitive compared to non-nuclear energy
- To demonstrate the operation of the reactor that can generate electricity, operate safely, and the development of cogeneration
- To improve the ability to master technology of nuclear power plants for deployment of commercial NPP in the future. EPR can be a miniature of nuclear power plant which in the future could be applied to regions which do not need a large power source, especially in the Central and Eastern parts of Indonesia
- Development of R&D for Power Reactor and its supporting
- **Current status:** The detailed engineering design has been completed, however the continuation of this project is now on hold, due to national policy dynamics

EPR Plant Illustration

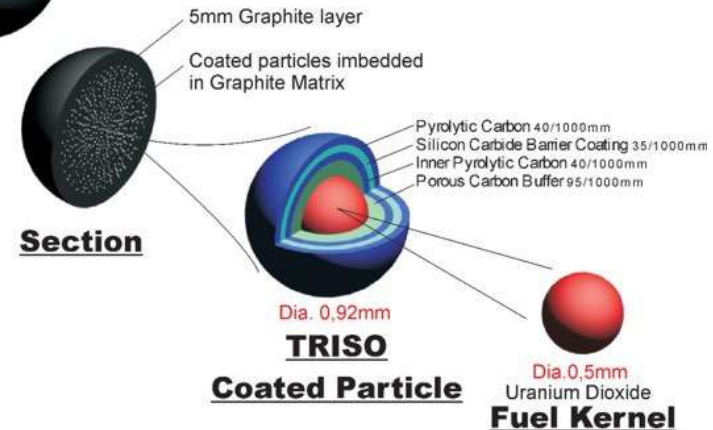


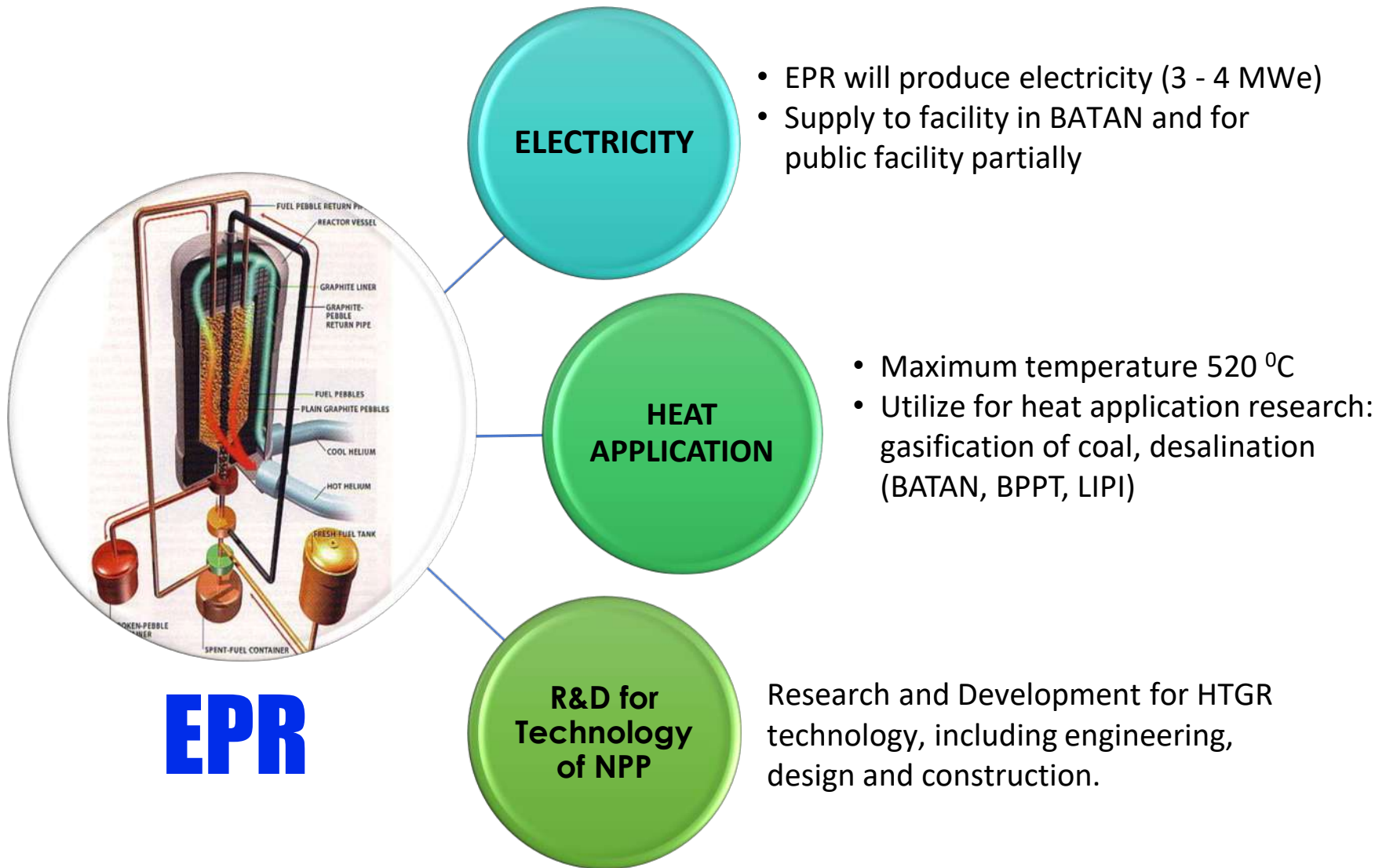
EPR Conceptual Design

- High Temperature Gas-cooled Reactor (HTGR)
- Pebble Bed Reactor (PBR) type
- UO_2 fuel
- Power $10 MW_{th}$



Dia. 60mm
Fuel Sphere





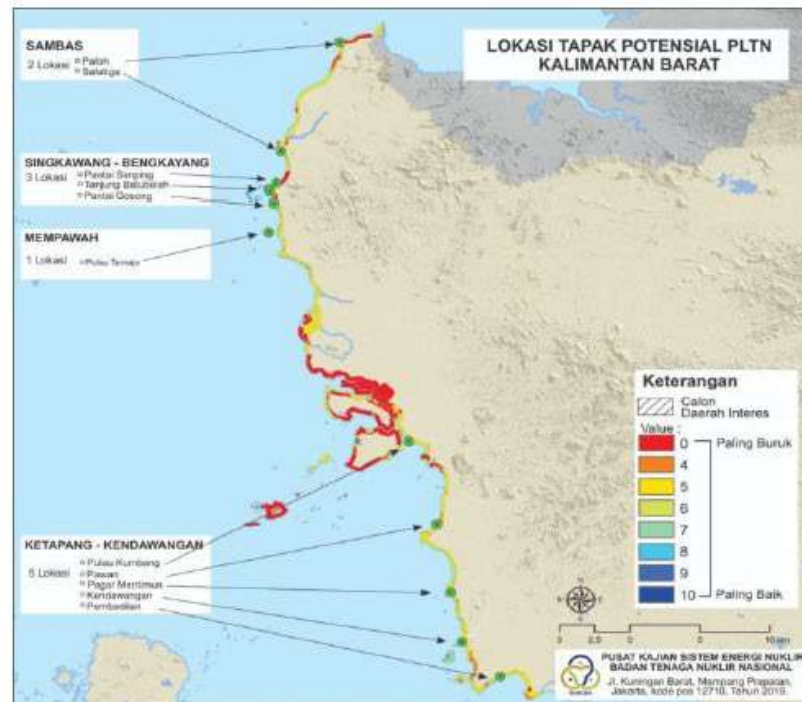
EPR

- ✓ Feasibility study of large scale NPP (PWR) in Muria Peninsula (Central Java) and Bangka-Belitung island have been completed.
- ✓ Now is considering to the study for small scale NPP (Small Modular Reactor) for West Kalimantan, East Kalimantan, Bangka-Belitung, and other inhabited island that needs a relatively small portion of electricity.

Based on the National Energy General Plan, nuclear can be utilized with some criteria such as:

- For fulfilling the needs of growing energy demand by supplying national energy in a large scale
- Reducing carbon emissions
- Economic competitiveness (NPP electricity selling price \leq 7 cent/kWh - the Amount of Cost of Generation Provision (BPP) as basis for Power Purchase Agreement)

- National Priority Research Grant, title: PROTOTYPE OF COMMERCIAL SCALE SMR
- Site: West Kalimantan



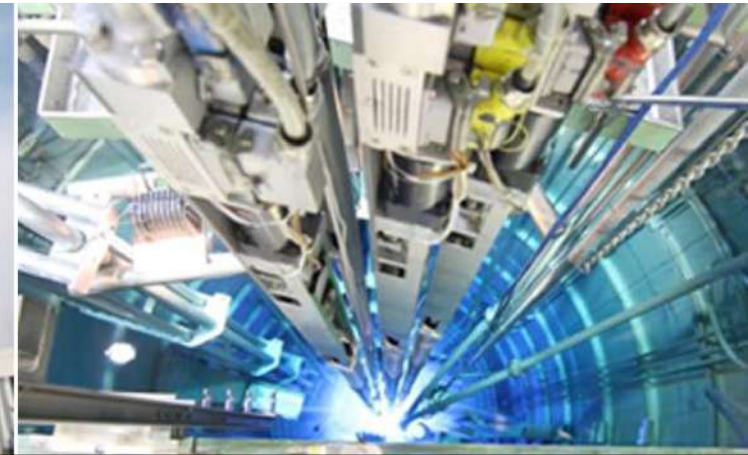
Research Reactor in Indonesia



Bandung nuclear area



Yogyakarta nuclear area



Serpong nuclear area

- TRIGA 2000 reactor
- TRIGA Mark II type
- Location: Bandung
- Operated in 1964 on 250 kW
- Upgrade power to 2000 kW in 2000
- Function: research, training, and radioisotope production

- Kartini reactor
- TRIGA Mark II type
- Location: Yogyakarta
- Operated in 1979
- Now operating on 100 kW
- Function: research and training for reactor operator

- G.A Siwabessy Multi Purpose Reactor
- MPR Pool type
- Location: Serpong, Tangerang
- Operated in 1987
- Now operating on 15 MW
- Function: research, radioisotope production and material testing

Bandung Research Reactor



TRIGA

TRAINING. RESEARCH ISOTOP PRODUCTION

Power Reactor : 1 MW

Flux neutron : $5,18 \times 10^{13}$ n/cm².sec

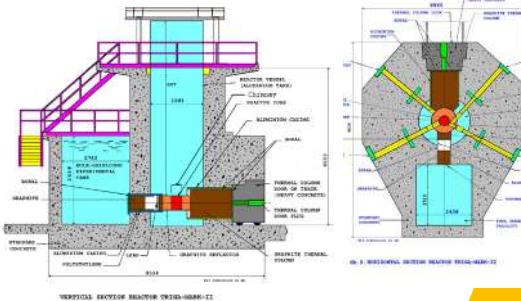
Average Flux: $3 - 5 \times 10^{13}$ n/cm².sec

Pneumatic: $1 - 2 \times 10^{13}$ n/cm².sec

Beam Port : $1 - 7 \times 10^8$ n/cm².sec

Installed Facilities

Center Thimble, Pneumatic Moving System, Rotary Roller Rack (Lazy Susan), Irradiated Locations In Core (3), Beam port (4), Thermal Column, Thermalizing Column



Radioisotop Production:

Te(¹³¹I), Mo(^{99m}Tc), S(³²P), Br-82, Cr-51

Facilities and Laboratories



Bandung Nuclear Area , 3 Ha.

Facilities

1. Research reactor TRIGA 2000
2. Laboratories of Labelled compound and Radioisotope
3. Laboratories of Pneumatic and NAA
4. Laboratories of Radiometric
5. Laboratories of Animals,
6. Laboratories of Physics Material,
7. Laboratories of Thermal – Physics ,
8. Green House and
9. Laboratories of Safety
10. Laboratories of Computation

Equipments

1. Gamma Spectrometry (MCA)
2. Single Channel Analyzer (SCA)
3. XRF
4. XRD
5. HPLC
6. AAS
7. PSA
8. Dose Calibrator
9. Radiation protection device
10. Others



VISION

To become center of excellence on Labeled Compound and Radiometry facility and Research Reactor Technology development for public welfare.

MISSION

1. To ensure safe, reliable and sustainable operation of reactor TRIGA 2000 and its development
2. To assure the sustainability of irradiation services for training, research and development on Labeled Compound and Radiometry and production of radioisotopes
3. To promote the benefits of nuclear science and technologies
4. To maintain human resource (HR) capacity building on RR and NPP

In order to achieve the goal and accomplish the mission, strategic steps have been determined as follow:

1. Ensure a safe and reliable operation, maintenance and utilization of TRIGA 2000 by keeping the reactor components in a good condition and replace those degraded component and continue the development of nuclear reactor technology for engineering capability
2. To improve the irradiation and other related facilities both in terms of type and quantity. With regard to the improvement of the capacity and capability of radioisotopes production and labelled compound and radiometry
3. To improve the use of supporting laboratory to support advanced nuclear technique analysis
4. To develop the human resources in number as well as competence in order to maintain nuclear knowledge management in nuclear engineering, nuclear and radiation technology, safety and security and recruitment
5. To maintain HR Capacity Building on RR and NPPs



Thank You

Terima Kasih

wonderful
indonesia

