COUNTRY PRESENTATION INDONESIA

Joint IAEA-KINS Workshop on Safety Review and Assessment for Licensing Nuclear Power Plants

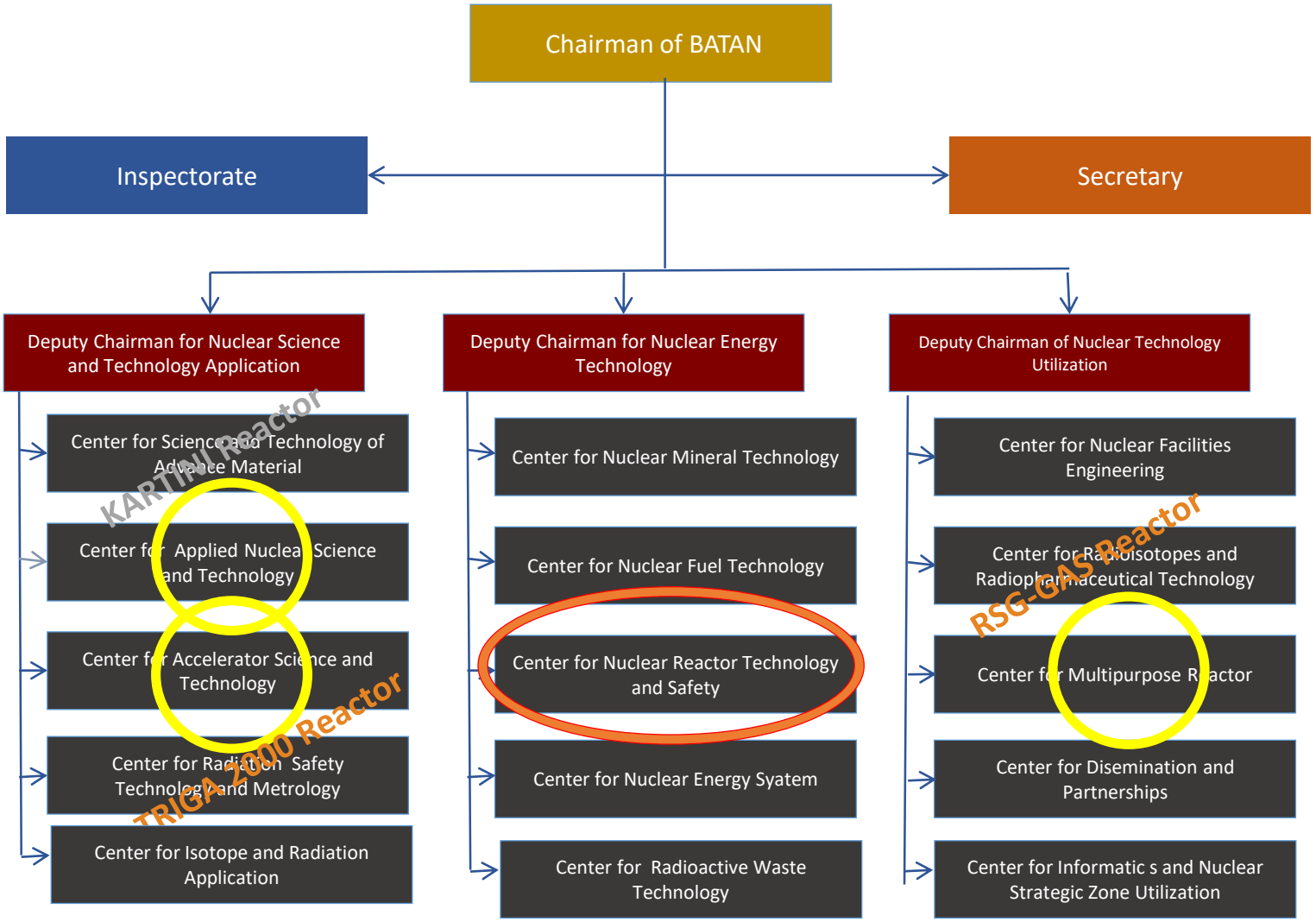
Daejeon, Korea, 27 to 31 May 2019

Syaiful Bakhri

Center for Nuclear Reactor Technology and Safety – National Nuclear Energy Agency BATAN


Tlk. Baffin
Samudra Arktika
Greenland
Islandia
Samudra Arktika
YT
AK
Laut Siberia Timur
Laut Kara
Laut Bering
Irlandia
Swedia
Finlandia
Polandia
Spanyol
Rusia
Laut Okhotsk
Italia
Ukraina
Maroko
Samudra Pasifik Utara
Yunani
Algeria
Kazakhstan
Turki
Mongolia
Jepang
Libya
Suriah
Turkmenistan
Kirgistan
Korea Selatan
Niger
Mesir
Irak
Iran
Afghanistan
Tiongkok
Laut Tiongkok Timur
Nigeria
Arab Saudi
Pakistan
Sudan
Nepal
Laut Filipina
Oman
Yaman
India
Myanmar (Burma)
Sudan Sel.
Etiopia
Laut Cina Selatan
Filipina
Republik Demokratik
Thailand
Laut Arab
Vietnam
Kongo
Kenya
Tlk. Benggala
Angola
Papua Nugini
Tanzania
Laut Lakadewa
Zambia
Malaysia
Indonesia
Laut Banda
Mozambik
QLD
NT
Madagaskar
Australia
SA
WA
Samudra Hindia

ORGANIZATIONAL STRUCTURE OF BATAN



BATAN's Research Facilities

Headquarter
BATAN Jakarta

Nuclear Complex Pasar Jumat

Exploration Complex Kalan

Nuclear Complex Serpong

Nuclear Complex Bandung

Nuclear Complex Yogyakarta

RESEARCH REACTORS IN INDONESIA

Triga Mark II

- Location: Bandung
- Operated in 1964 with a power of 250 kW
- Increased reactor power triga to 2000 kW, in 2000
- Function: research and production of isotopes
- Renewal of operating permit was approved

Reaktor Kartini

- Location: Yogyakarta
- Operated in 1979
- 100 kW reactor power
- Function: research and training of reactor operators
- Op license till 2020. under renewal of operating permit

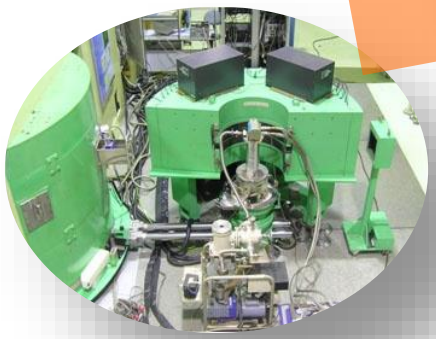
RSG G.A Siwabessy

- Location: Serpong, Tangerang
- Operated in 1987
- 30 MW reactor power
- Function: research, isotope production and material testing
- Op license until 2020, renewal of operating permit is under progress

UTILIZATIONS OF RSG-GAS REACTOR

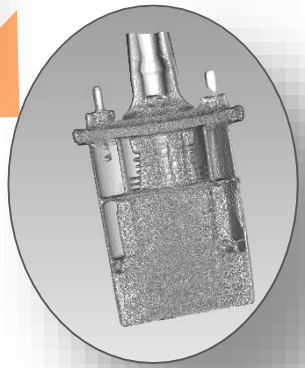
RI Production

Power Ramp Test



Neutron Spectrometer and Diffractometer

Neutron Activation Analysis



Neutron Radiography

Complex of Nuclear Area Serpong

- Total extents of BATAN area in Serpong is ±25 Ha
- Around 800 employees are working in BATAN-Serpong

Nuclear Fuel Element Factory

Nuclear Engineering Facilities

Nuclear Waste Management

General Workshop

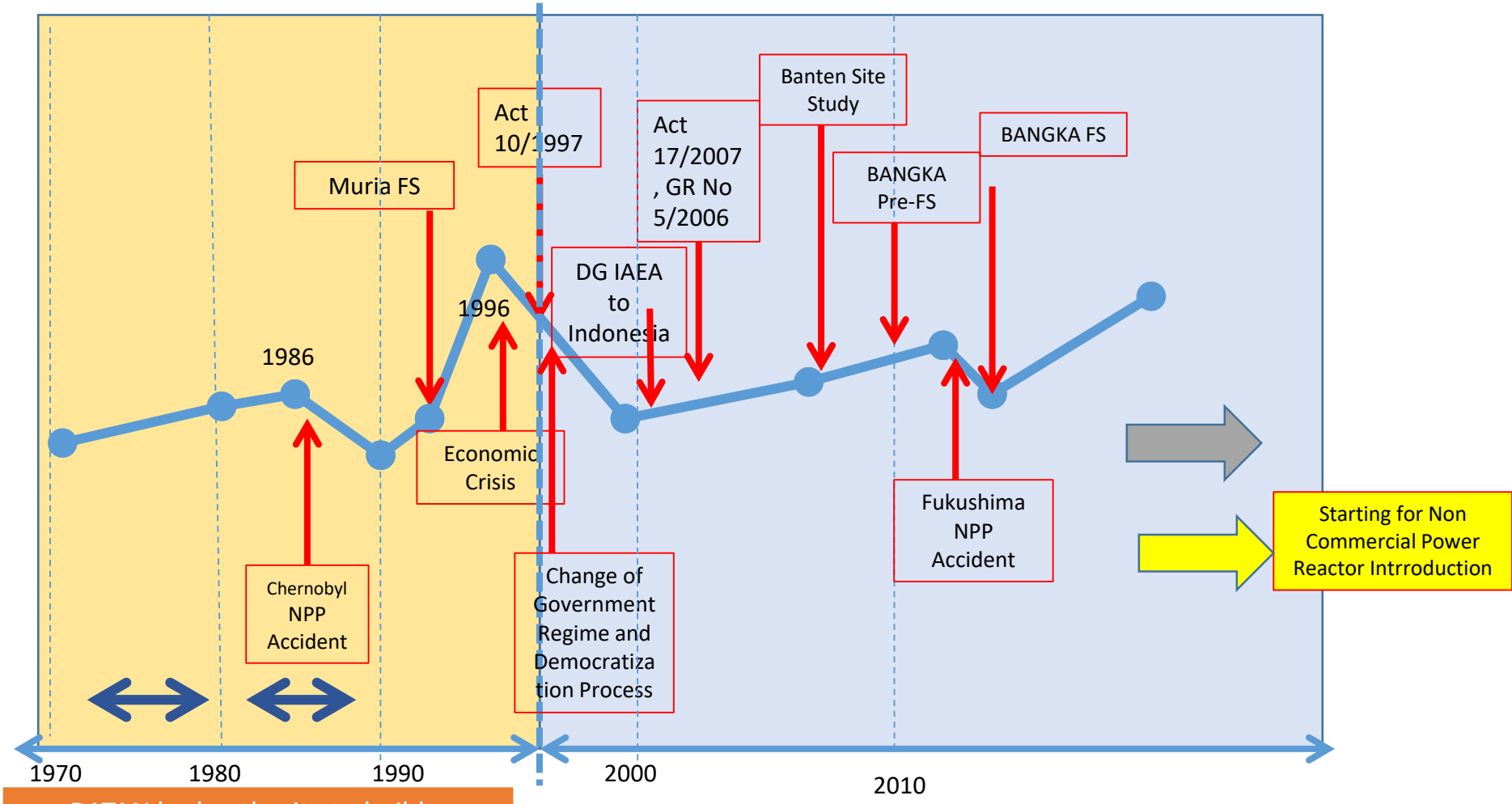
RSG-GAS Reactor

Center for Nuclear Reactor Technology and Safety

Center for Radioisotope Processing

Management of BATAN-Area

HISTORY OF NPP INDONESIA

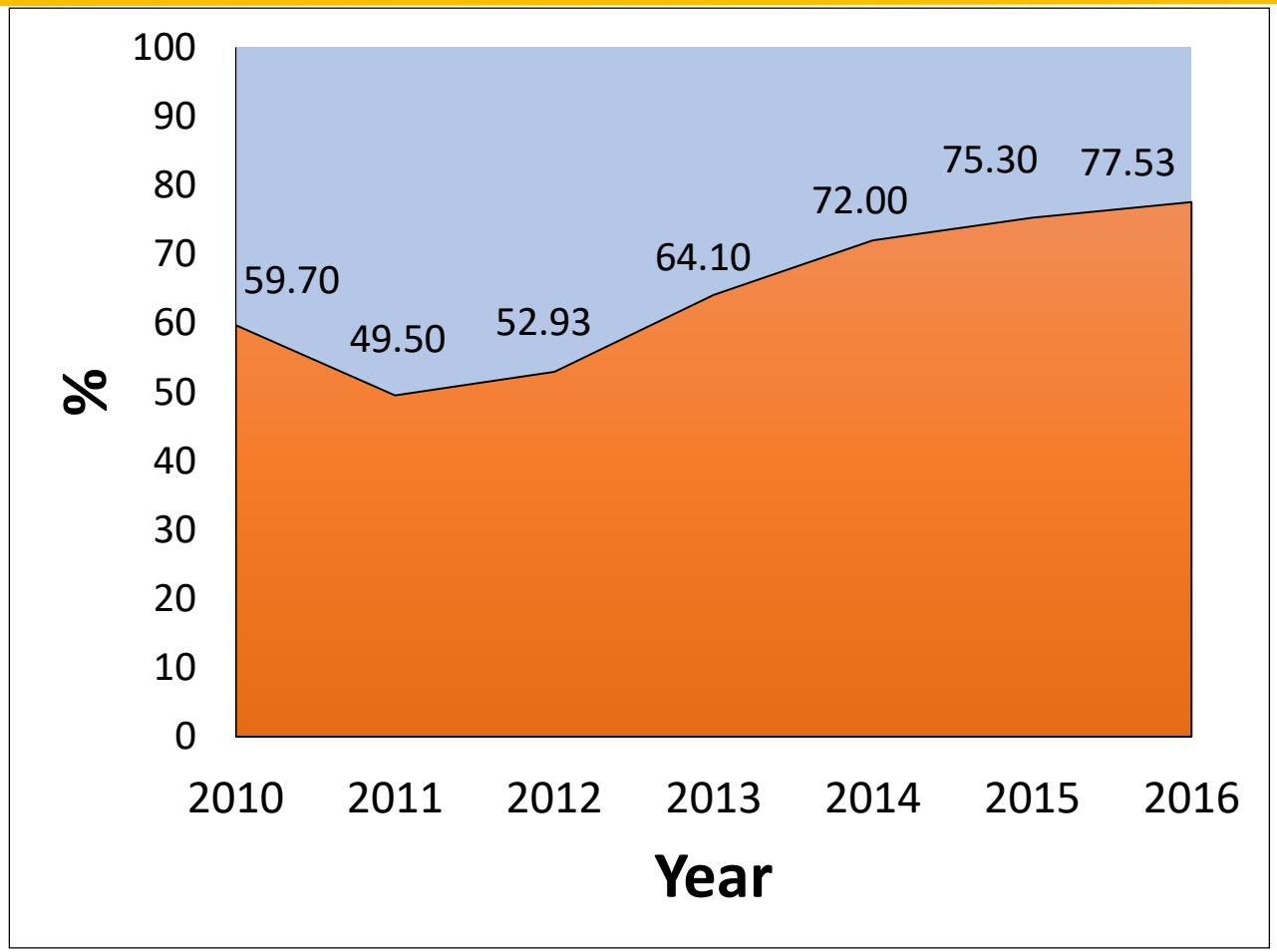


BATAN had authority to build a commercial NPP

BATAN has no authority to build a commercial NPP

Development of Nuclear Research Facilities

NATIONAL POLLING & BANGKA BELITUNG



Bangka Belitung NPP site Local Survey

Year	Result (%)
2011	35
2012	28
2013	42.3
2014	56.5

BANANA Build Absolutely Nothing Anywhere Near Anyone.

NIMEY Not In My Election Year

NIMBY!

A MODEL/MILESTONE FOR INDONESIAN NPP

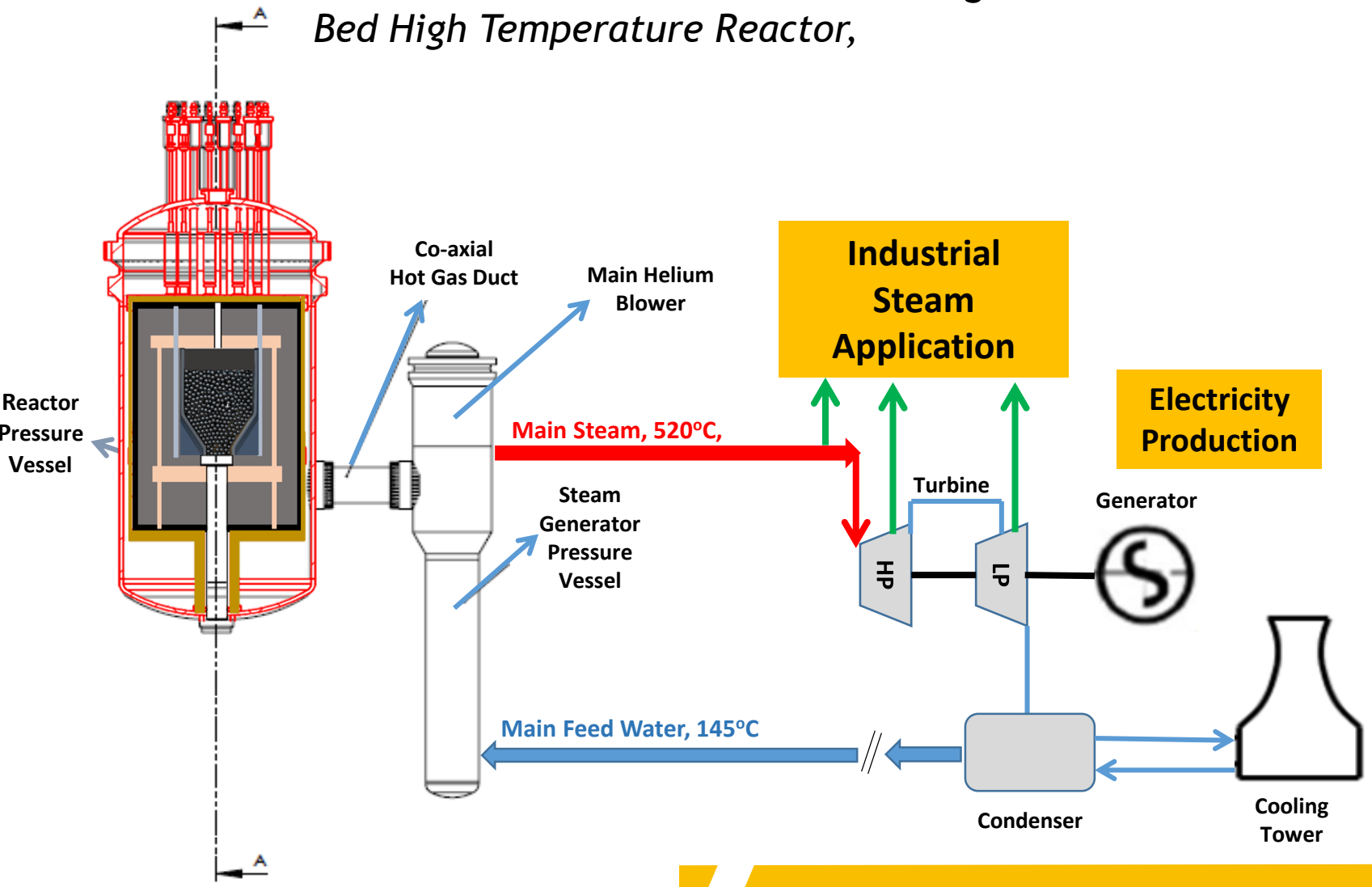
- ~267 millions people.
- 17.504 island
- Distributed electricity demand.
- Distributed natural resources.

Need an **"NPP Model** cope with huge demand for electricity and/ heat application.

- Small Modular Nuclear Reactor
- Cogeneration options
- Passive Safety Features
- -

REAKTOR DAYA EKSPERIMENTAL (Experimental Power Reactor)

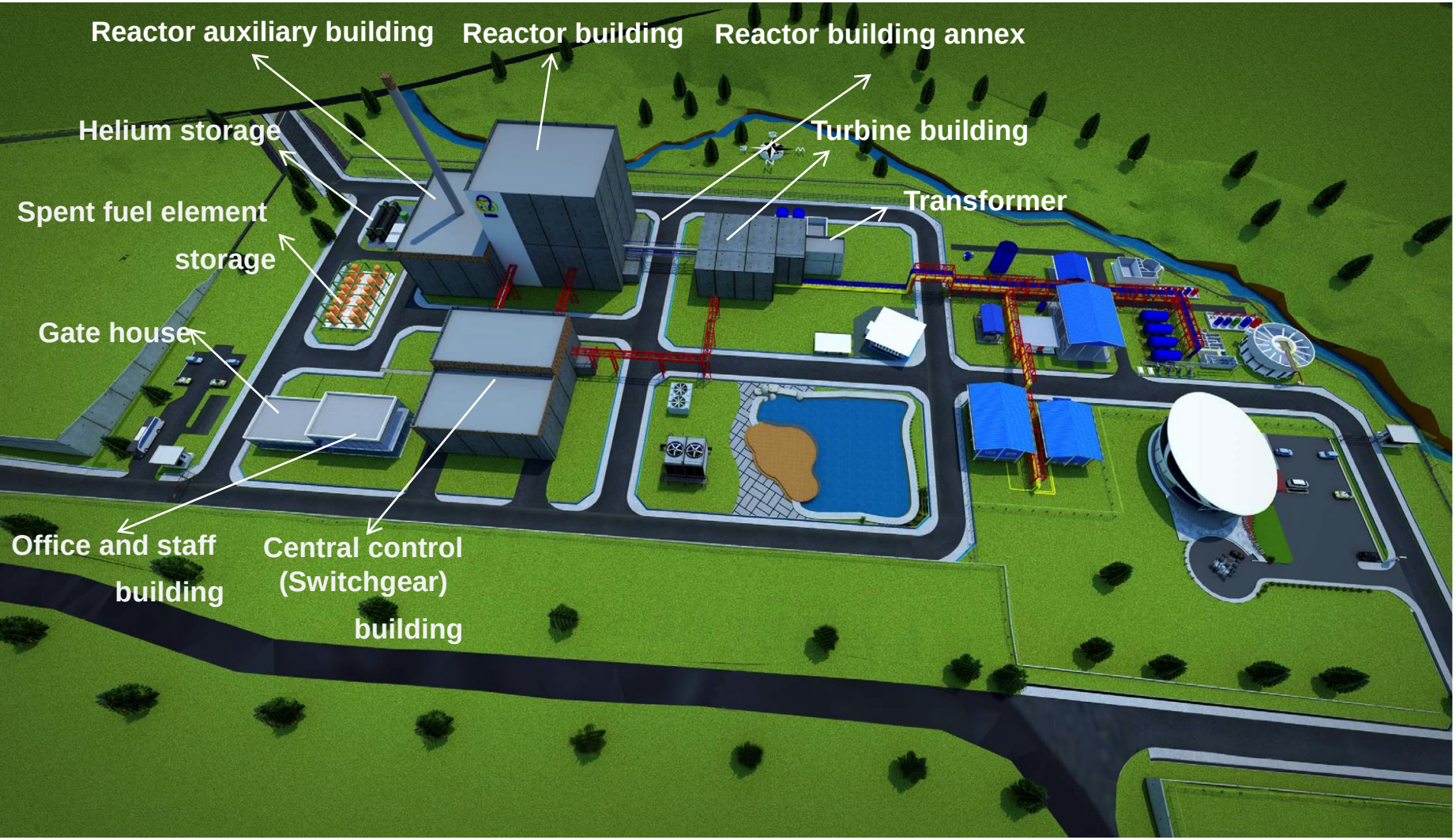
Based on Gen-IV nuclear reactor design of *Pebble Bed High Temperature Reactor*,



GENERAL DESIGN DATA

Reactor Type	High Temperature Gas Reactor (HTGR)
Thermal Power	10 MW
Outlet coolant temperature	700 ^{o}C
Inlet coolant temperature	250 ^{o}C
Fuel	Low-enrichment uranium
Fuel element type	Pebble
Direction of coolant flow	Downwards
Pressure vessel	Steel
Primary coolant pressure	3.5 Mpa
Plant live time	40 years
Total steam flow	Approx. 4.0 kg/s
Number of turbine generator	1
Inlet SG water temperature	145 ^{o}C
Inlet turbine temperature	520 ^{o}C
Inlet turbine pressure	6 Mpa
Electric generator output	Approx. 3 MW

BUILDING ARRANGEMENT

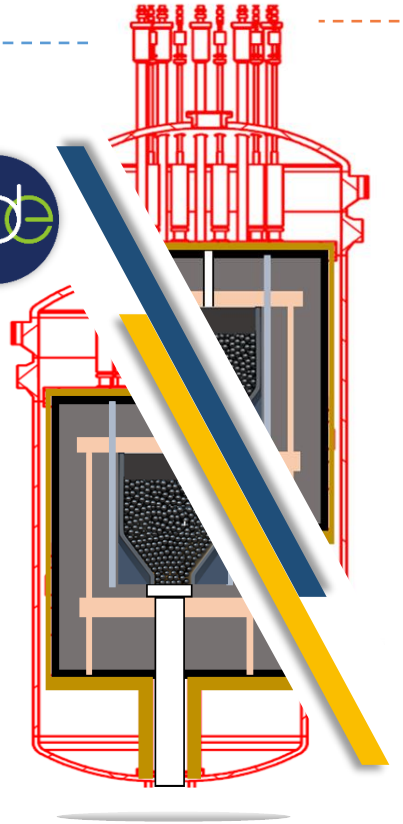


Safety Features Requirements (Control & Cooling):

Passive Safety Features

1. Neutronically:
(strong) negative temp. reactivity feedback, low power density.

2. Slim reactor core diameter (~1.8m): shorter heat transfer path.

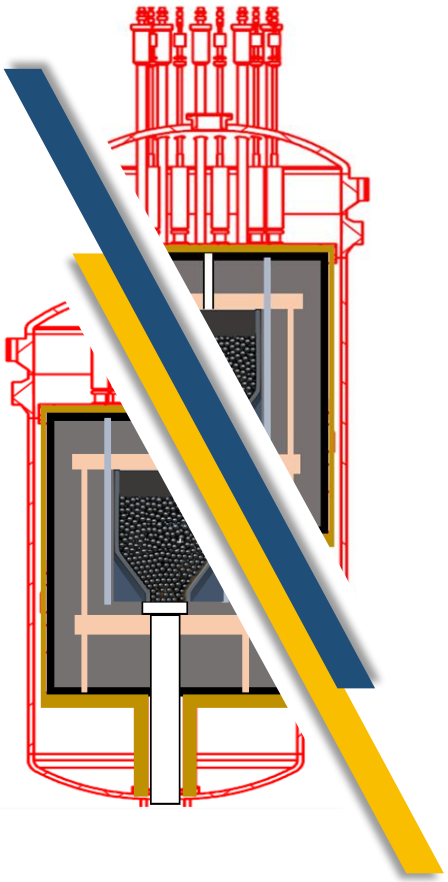


3. Significant graphite composition with physical characteristic:
   a) High heat conductivity: good heat transfer capability
   b) High heat capacity: slower temperature increase for the same given energy.

RDE design able to transfer decay heat only by natural mechanism without any active systems.

Fukushima accident scenario will not occur in RDE.

NUCLEAR REACTOR



Based on Gen-IV nuclear reactor design of *Pebble Bed High Temperature Reactor,*

Main Safety Features of RDE :

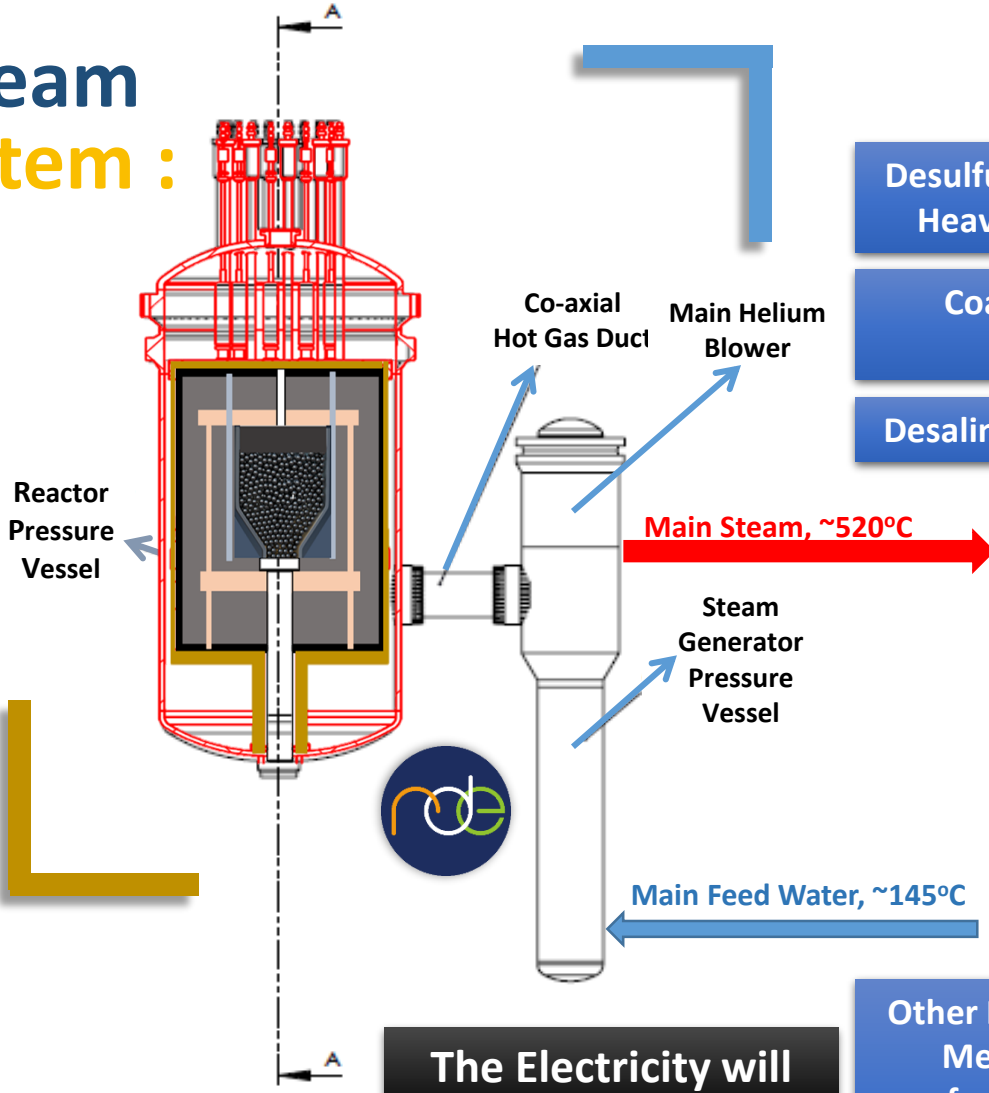
1. Maximum temp. of the fuel is below 1600^{o}C in any condition, even the hypothetical severest accident.
2. As the fuel temp. below 1600^{o}C, TRISO-based fuel design assure a non-hazardous radiation release to environment [zero-evacuation feature].

Superior safety features support the design to be built near industrial complexes to supply **electricity** and/ **hot steam**.

STEAM SUPPLY SYSTEM

Nuclear Steam Supply System :

Nuclear Reactor,
Hot co-axial gas duct,
steam generator, and
main He circulator



Desulfurization or Steam injection Heavy oil Recovery Laboratory

Coal quality improvements Laboratory

Desalination Pilot Plant Laboratory

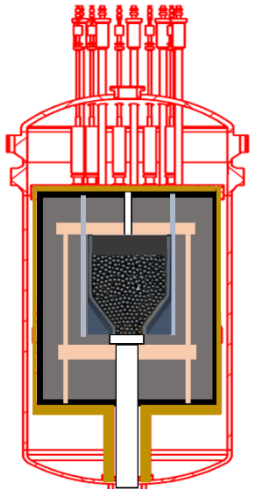
Outlet :

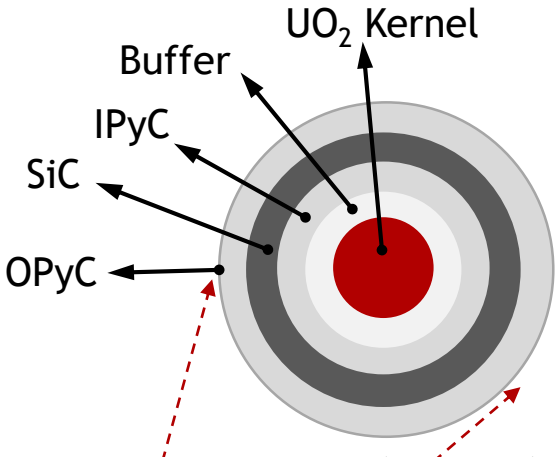
Helium 700°C from the core flows to the *Steam Generator* to get **superheated steam (~520°C, ~6 Mpa)**

The Electricity will Puspiptek Serpong Complex Grid

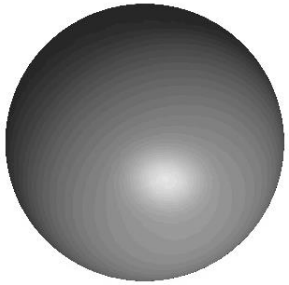
Other Potential Lab. Applications : Membrane methane steam reforming, methanol, dimethyl ether production, coal liquefactions, etc

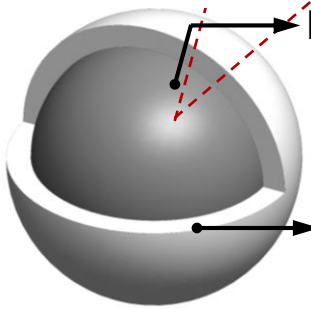
TRISO-based Fuel Design





Pebble Fuel
(OD = 6 cm)





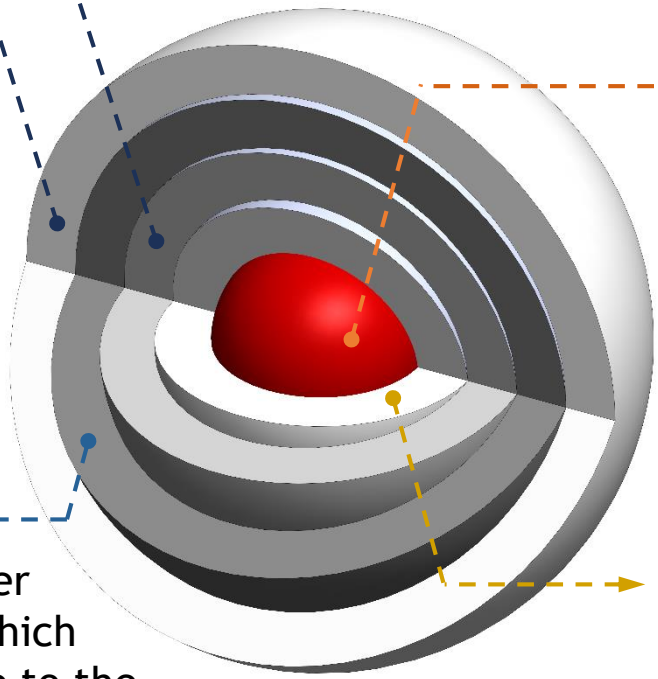
Safety Features Requirements

TRISO Particle (Tri-isotropic) :

Inner Pyrolitic Carbon *(IPyC)*

Outer Pyrolitic Carbon *(OPyC)*

Pyrolitic carbon layer to mechanically strengthen the TRISO particle (density ~1.75g/cm^3).



UO_2 Kernel

Uranium oxide fuel material, for RDE 17% U-235 enrichment.

Silicon Carbide *(SiC)*

High density sillicon carbide layer (~3.18g/cm^3). Main constrain which avoid the fission product release to the environment even in the most severe accident.

Buffer

Low density carbon layer (~1.05 g/cm^3)

TRISO fuel design guarantee the 'contain' safety aspect of RDE

REGULATORY BODY

Nuclear Energy Regulatory Agency, - Badan Pengawas Tenaga Nuklir (BAPETEN)

A Non-Ministerial Government Institution which is under and responsible to the President of Republik Indonesia. Founded on 8 May 1998 and began actively working on 4 January 1999 according to Article 4 par (1) Act no 10 / 1997.

The regulatory roles before January 1999 was carried out by a bureau of BATAN, namely, Atomic Energy Supervision Bureau.

Main task of BAPETEN comprise of:

- **Drafting and establishing nuclear safety regulations;**
- **Controlling nuclear installations and nuclear materials through licensing and inspection systems that cover all stages of NPP establishment (from site evaluation to decommissioning stages);**
- **Controlling the use of radioactive materials and other radiation sources through licensing and inspection systems.**

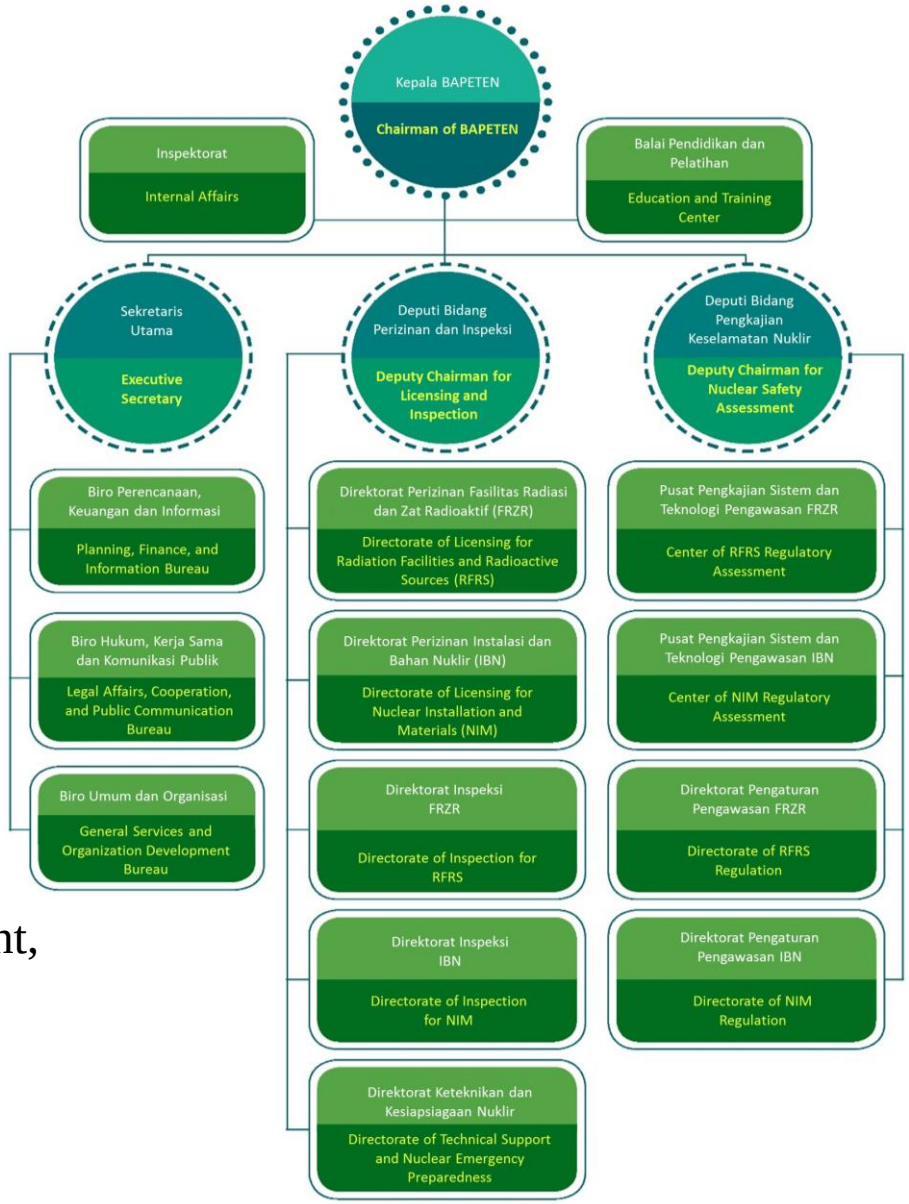
Regulatory Body

Nuclear Energy Regulatory Agency (BAPETEN)

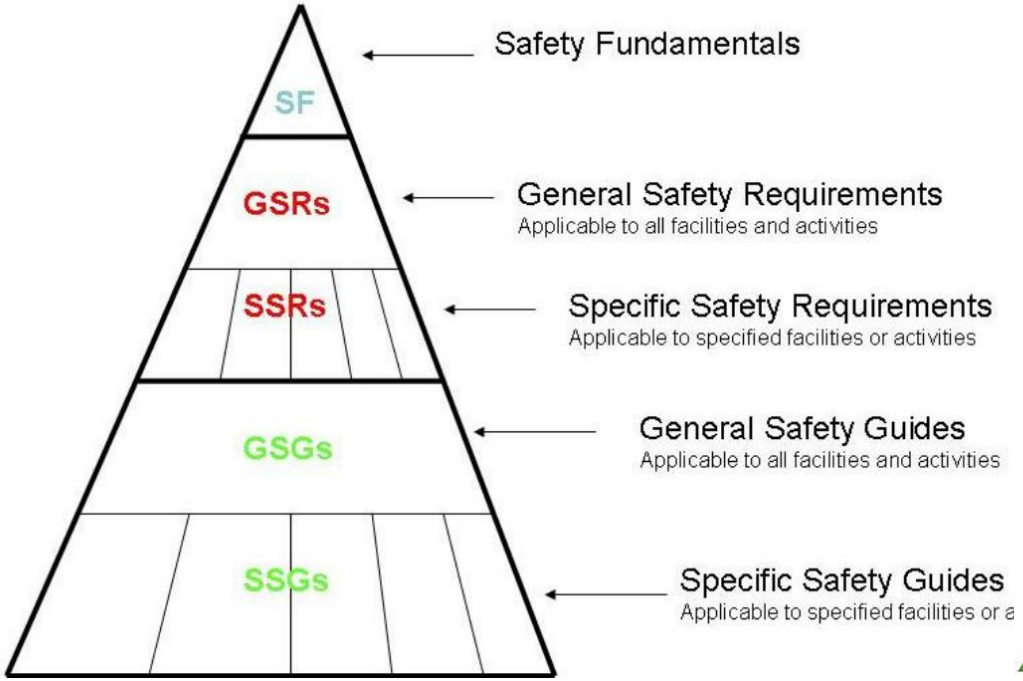
According to Nuclear Energy Act No. 10 of 1997 the supervisory function of BAPETEN in protecting public health and the health of the environment covers:

- Regulation Making
- Licensing
- Inspection

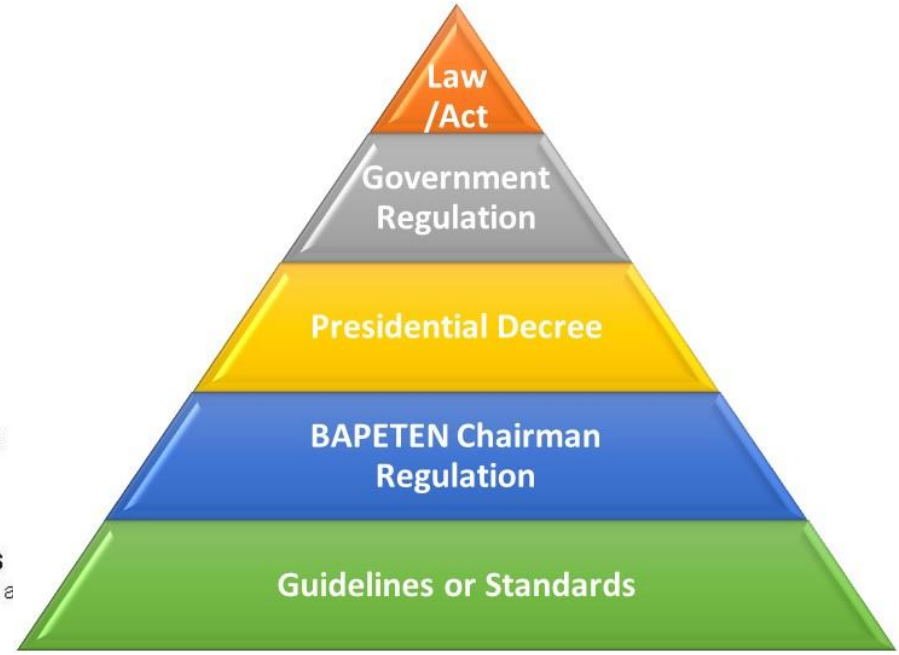
Seven directorates, two centres for assessment, three bureaus, an Internal Affairs department and one Education and Training Centre



Regulation Framework



IAEA



BAPETEN

The highest level in the hierarchy of regulation in Indonesia is the 1945 Constitution. This Constitution then implemented by following hierarchy of laws, regulations and guidelines in Indonesia

Licensing Steps

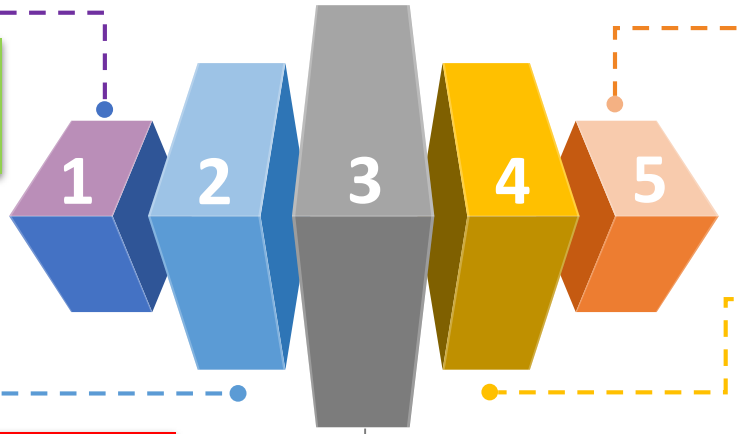
Site Licensing

DONE
(Jan 2017 - Jan 2021)

Design Approval

1. Detail Design
2. Safety Analysis Report

IN PROGRESS- Graded Approach was agreed with BAPETEN:
(27 August 2018: initial documents was submitted)



Operational Permit

Commissioning Permit

Construction Permit

Docs:

1. Safety Analysis Report
2. LCO Document
3. Management System Document
4. Radiation Protection and Safety Doc.
5. System Safeguard Doc
6. Physical Protection Plan Doc
7. Ageing Management Doc
8. Decommissioning Program
9. Emergency Preparedness Program
10. Construction Program
11. Environmental Impact License

Initial draft already prepared by BATAN in 2016.

SAR and Conc. Design reviewed by IAEA in 2016. Oct. 2017, and February 2019

Meeting and Coordination with BAPETEN (15 December 2017, 4 April 2018, 27 April 2018, 24 Mei 2018, 4 July 2018, 03 Augustus 2018)

Monday, 28/01/2019,

Submission of Detail Engineering Experimental Power Reactor Design

Kembali 30 Januari 2019 | Berita BAPETEN

As a follow up to the issuance of site permits for the construction of Experimental Power Reactors (RDE) by BAPETEN, on Monday 28/01/2019, at Building 80 Puspitek Serpong, the Detail Engineering Design (DED) documents second phase have been submitted by BATAN to BAPETEN.

The document was symbolically submitted by the Head of the Technology and Safety Center for Nuclear Reactor BATAN Geni Rina Sunaryo and received by the Director of BAPETEN Nuclear Material Licensing and Installation, Budi Rohman. The event was also attended by Deputy of Nuclear Energy Technology BATAN, Suryantoro, Head of Sub Directorate of Nuclear Materials and Reactor Licensing, Wiryono and BATAN Incorporate.

Design Development

Thank You

NATIONAL NUCLEAR ENERGY AGENCY OF INDONESIA

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Humas Batan @humasbatan badan_tenaga_nuklir_nasional Humas Batan

Fuel Temp. Transient @DLOFC