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IINDONESIA CURRENT STATUS ON NUCLEAR POWER SAFETY RESEARCH

Presented at

THE 5TH ANNUAL MEETING ASEAN NUCLEAR POWER SAFETY RESEARCH
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Content

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RESEARCH ORGANIZATION

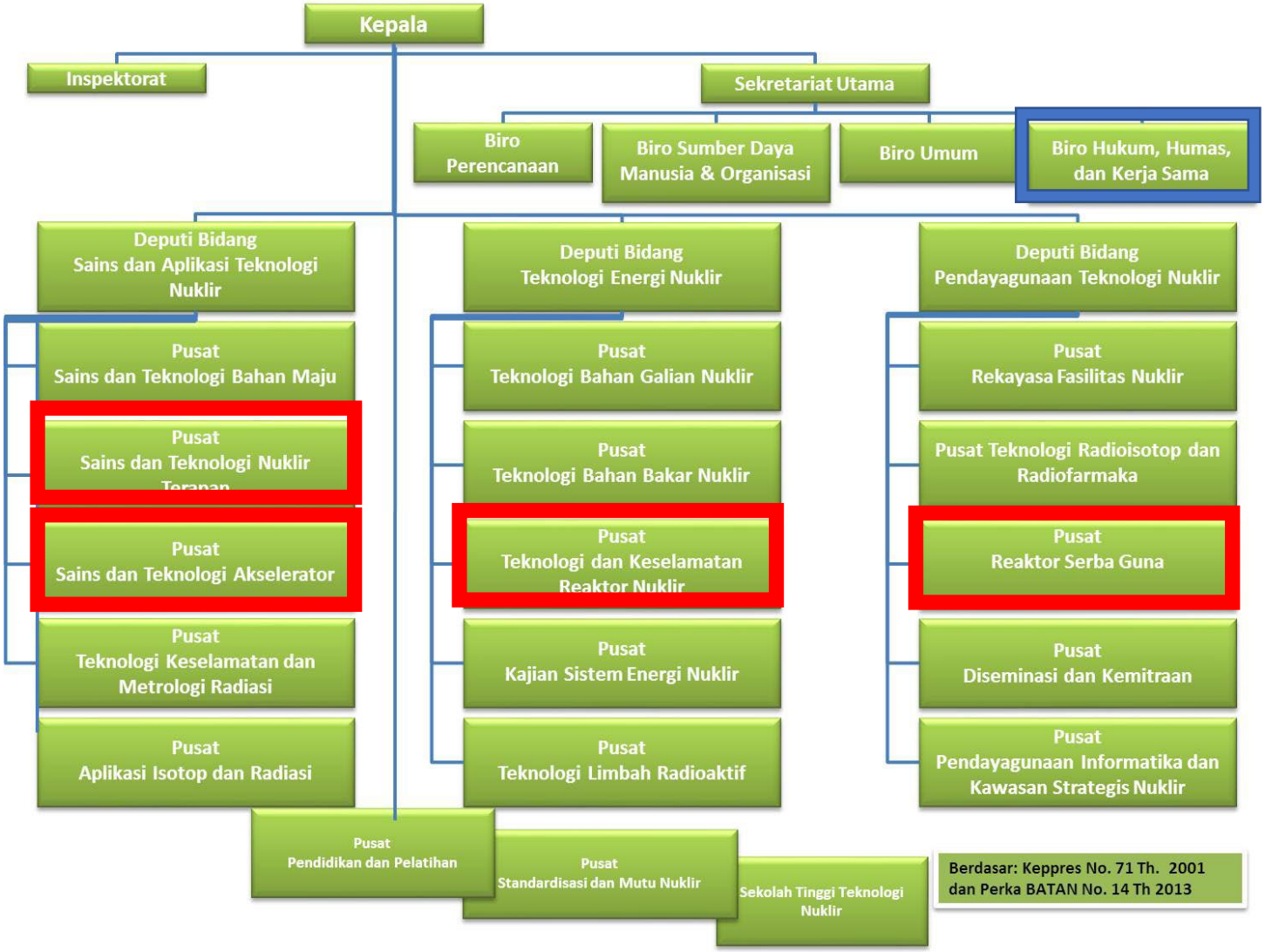
National Nuclear Research and Development

- Indonesia has operated 3 Research Reactors since 1964 i.e.:
  - Research Reactor TRIGA 2000 Bandung, 2 MW_{th}, 1964.
  - Research Reactor, Kartini, 100 kW_{th} 1971
  - Multipurpose Research Reactor G.A. Siwabessy, 30 MW_{th}, 1987
- All three reactors were operated by National Nuclear Energy Agency of Indonesia (BATAN) in accordance with its governmental specific role as promoting organization on nuclear activities.
- The research reactor has been used for radioisotope and radio-pharmacy productions, material testing, neutron radiation and activation, education and training, research and development, human resources development for Research Reactor and Nuclear Power.

Serpong Nuclear Facilities Area

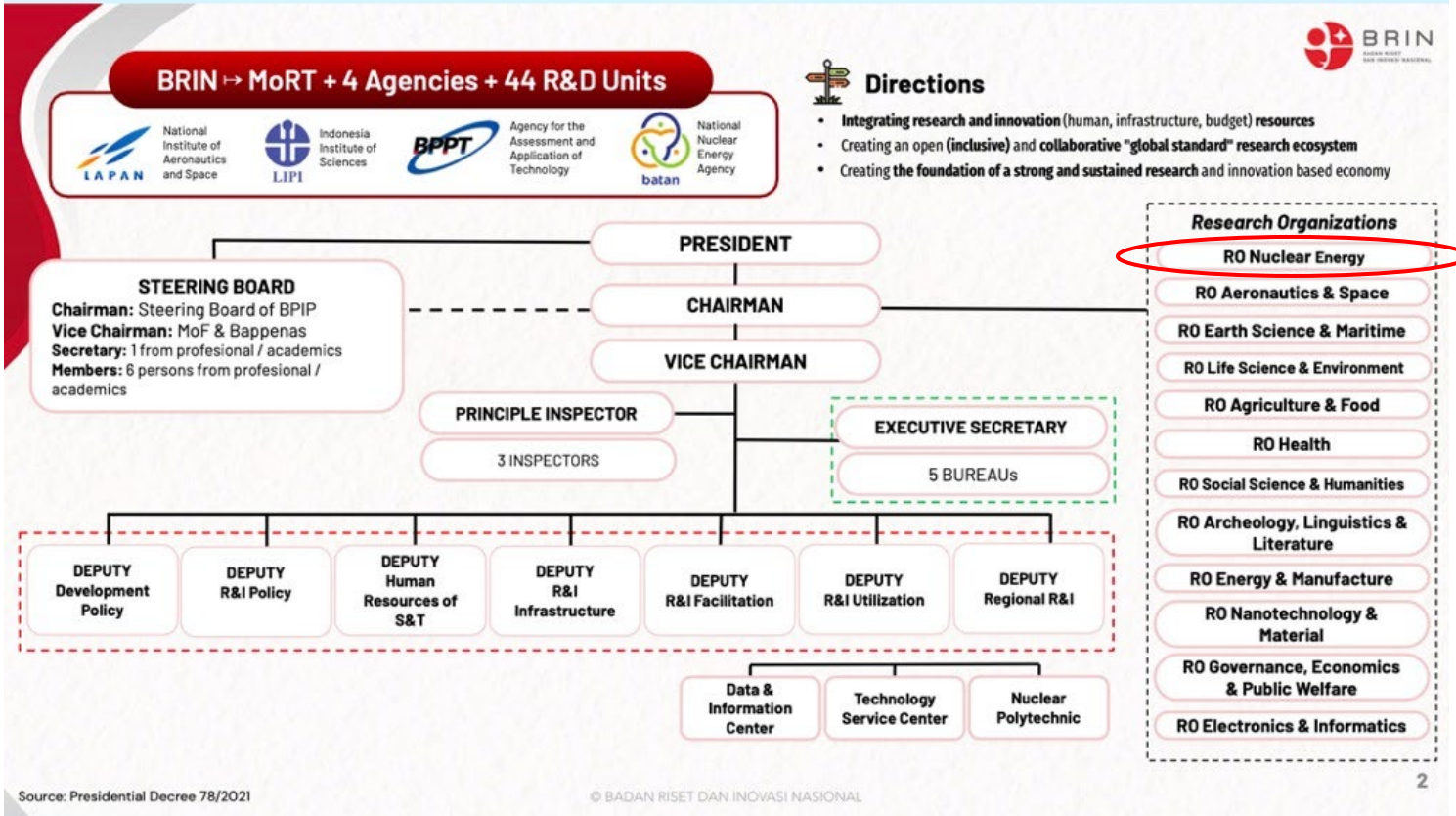
In parallel with the construction of MPR-GAS, other nuclear installation and facilities were developed so that all nuclear fuel cycle were fully mastered to support Nuclear Power Program in Indonesia.

National Nuclear Energy Agency of Indonesia (BATAN)



Structure Organization of BRIN

Since Sep 2021, 4 R&D Agencies and 44 R&D Unit were merged into BRIN



RESEARCH ORGANIZATION FOR NUCLEAR TECHNOLOGY

- RESEACH CENTRE FOR RADIATION PROCESS
- RESEARCH CENTRE FOR ACCELERATOR TECHNOLOGY
- RESEARCH CENTRE FOR FUEL CYCLE AND RADIOACTIVE WASTE
- RESEARCH CENTRE FOR RADIATION DETECTION AND NUCLEAR ANALYIS
- **RESEARCH CENTER FOR NUCLEAR REACTOR TECHNOLOGY**
- RESEARCH CENTETR FOR RADIOISOTOP, RADIO PHARMACA AND DOSIMETRY
- RESEARCH CENTER FOR NUCLEAR SAFETY, METROLOGY AND QUALITY

Research Group – PRTRN:

No	Nama Kelompok Riset	Nama Koordinator
1	**Sistem Termofluida Reaktor Nuklir** *Reactor Thermal-Fluids Systems Development*	Dr. Mulya Juarsa, S.Si., MESc.
2	**Sistem Keselamatan Reaktor Nuklir** *Safety Systems of Nuclear Reactor*	Dr. Julwan Hendry Purba, ST., M.App.IT.
3	**Faktor Manusia, Instrumentasi dan Kendali Reaktor Nuklir** *Human Factors, Instrumentations and Controls of Nuclear Reactor*	Dr. Sigit Santoso, M.Eng.
4	**Keandalan Sistem Pendingin dan Rekayasa Proses Reaktor Nuklir** *Cooling System Reliability and Process Engineer of Nuclear Reactor*	Dr. Geni Rina Sunaryo, M.Sc
5	**Dispersi dan Konsekuensi Radiasi Reaktor Nuklir** *Radiation Dispersion and Consequences of Nuclear Reactor*	Dr. M. Budi Setiawan, M.Eng.
6	**Desain dan Fisika Reaktor Nuklir** *Design and Physics for Nuclear Reactor*	Dr. Anis Rohanda, M.Si
7	**Perekayasaan Instalasi dan Fasilitas Nuklir** *Engineering of Nuclear Installation and Facility*	Dr. Ir. M. Dhandhang Purwadi, MT.
8	**Keamanan dan Safeguard Reaktor Nuklir** *Security and Safeguard for Nuclear Reactor*	Alim Mardhi, ST., M.Sc.
9	**Bahan Struktur, Sistem dan Komponen Reaktor Nuklir** *Materials for Structure System and Component of Nuclear Reactors*	Prof. Dr. Mohammad Dani
10	**Sistem Energi Nuklir** *Nucelar Energy System*	Kurnia Anzhar, M. Si.
11	**Teknofisika Reaktor Nuklir** *Technophysics of Nuclear Reactor*	Dr. Alan Maulana, MT

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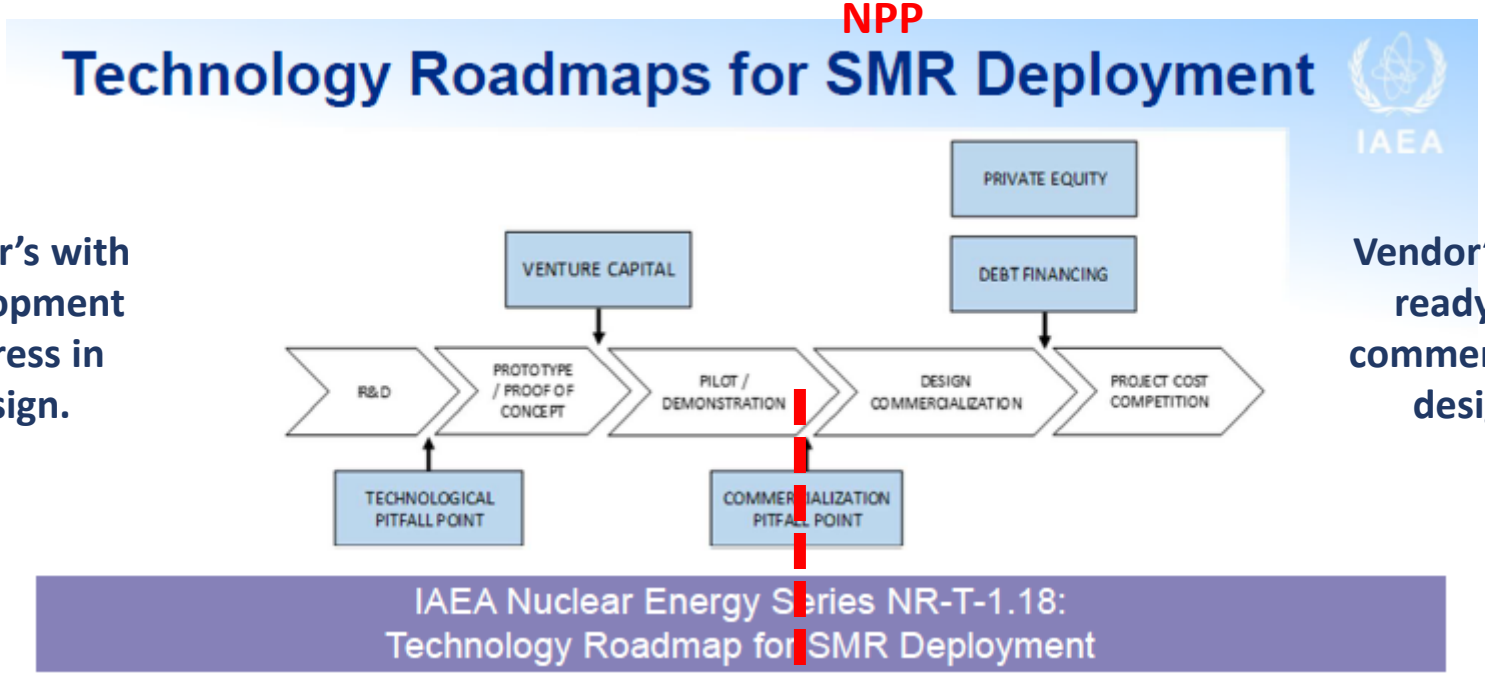
NATIONAL RESEARCH PRIORITY ON NPP/SMR

BRIN's Role as R&D Institution in NPP Development:

NPP



Vendor's with development progress in design.

Vendor's with ready-to-commercialize design.

BRIN's Role:
Technology Co-developer, and License Holder

BRIN's Role:
Technical Supporting Organization

Source: IAEA Presentation by S.Monti for the Tech. Roadmaps for SMR Deployments

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BRIN's Target on
Nuclear Reactor Technology Development

To realize a '*made-in-Indonesia*' advance NPP Technology through Co-Development with International and National Strategic Collaborations.

Not made-by-Indonesian,
*but it **co-developed** and **built as 'demo plant in Indonesia'**, BRIN is inviting and looking for collaboration on this endeavour.*

To realize a '*made-in-Indonesia*' advance NPP Technology through Co-Development with International Strategic Collaborations.

It is possible to have a commercial H or Ammonia Business based on Demo Plant NPP.

#1 (demo plant) NPP
Milestone and part of

Nuclear Cogeneration assisted Net Zero Emission Program

Electric Market:
To be duplicated in many Indonesian island or remote area. Contribute in National Energy Security.

Non-Electric Market:

- **Hydrogen Production:** Fertilizer, Steel Industries
- Clean Coal Technology Processes
- Desalination:
- Etc.

Logic of the Target

Nuclear energy is one of important 'green energy' to reach Sustainable Development Goals.

Currently advance nuclear reactor technology concept are in development phase, all of them need to have a PROTOTIPE / DEMO PLANT to progress in their commercialization goal.

BRIN is national institution with an authority to develop, construct and be the License Holder of PROTOTYPE / DEMO PLANT.

BRIN is open for productive collaboration

to realize

'made-in-Indonesia' advance reactor.

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HTGR-based Development

PeLUIt / RDE (BRIN, Indonesia)

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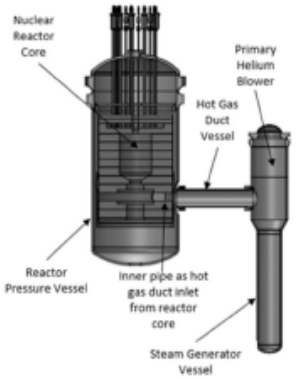
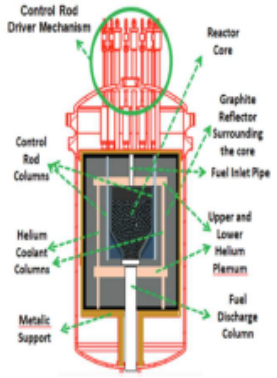


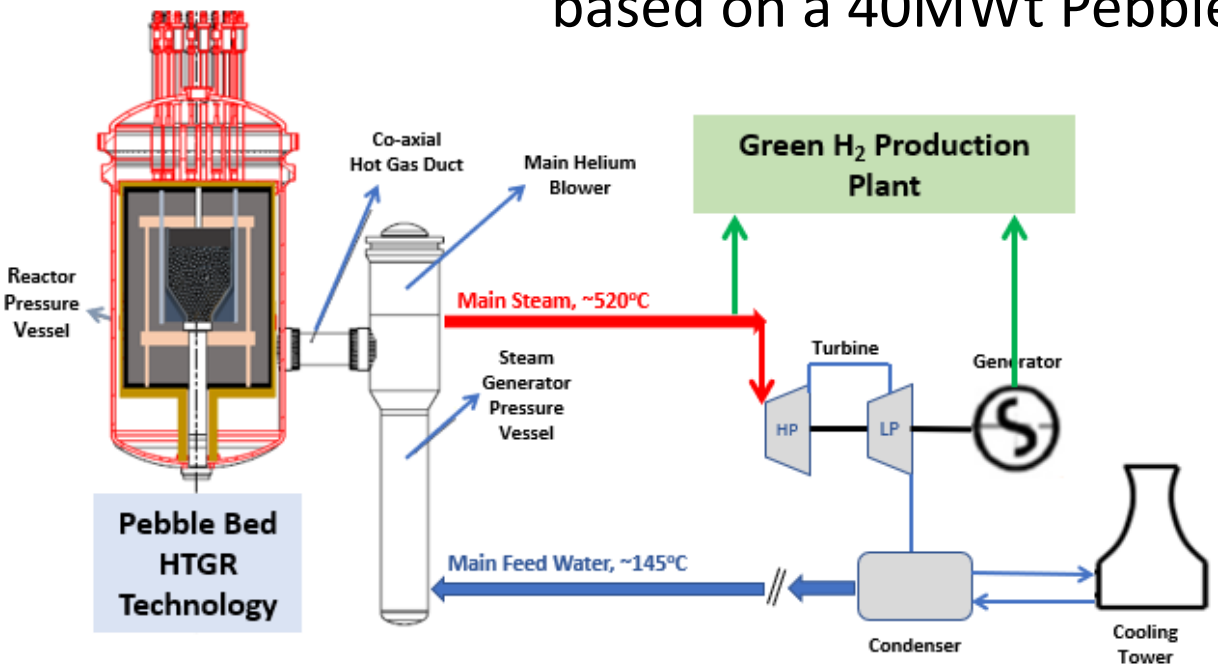


MAJOR TECHNICAL PARAMETERS	
Parameter	**Value**
Technology developer, country of origin	National Research and Innovation Agency (BRIN), Indonesia
Reactor type	Pebble bed high temperature gas-cooled reactor
Coolant/moderator	Helium/graphite
Thermal Power	40MWt and 10MWt
Primary circulation	Forced circulation
NSSS Operating Pressure (primary/secondary), MPa	3 / 6
Core Inlet/Outlet Coolant Temperature (°C)	250 / 750
Fuel type/assembly array	Spherical elements with coated particle fuel
Number of fuel assemblies in the core	27 000
Fuel enrichment (%)	17
Core Discharge Burnup (GWd/ton)	80
Refuelling Cycle (months)	On-line refuelling
Reactivity control mechanism	Control rod and small absorber sphere
Approach to safety systems	Combined active and passive
Design life (years)	40
Plant footprint (m^2)	~ 24 000
RPV height/diameter (m)	11.1 / 4.2 (inner)
RPV weight (metric ton)	180
Seismic Design (SSE)	0.26g
Fuel cycle requirements / Approach	LEU, open cycle, spent fuel intermediate storage at plant
Distinguishing features	Inherent safety, no need for offsite emergency measures
Design status	Conceptual design of uprated 40MWt is in progress. For the initial 10MWt RDE, site license issued in 2017.

BAPETEN. However, due to change in main policy of nuclear reactor development, the licensing processes was halted. Although the research and development of RDE are still continuing, particularly related to safety analysis and its cogeneration potential. Since the end of 2021, as worldwide trend of hydrogen as an important key in energy transition is stronger, cogeneration application for hydrogen production becoming the main focus. In particular, a collaboration with an energy state-own company called PERTAMINA was started to develop a hydrogen production system based on PeLUIt/RDE. Guided by the initial techno-economic analysis for the hydrogen production using HEEP Software from IAEA an uprated power level to have a more superheated steam and electrical output in parallel is needed. Also based on initial safety analysis, an uprate up to 40MWt, is possible with generally the same core geometry of previous RDE design while maintaining its passive safety features.

Our National Collaboration

Develop a **Zero Emission Hydrogen Production System** based on a 40MWt Pebble Bed HTGR



System Performance Target:

Produce a ZeroEmission-H_2 with a competitive cost.

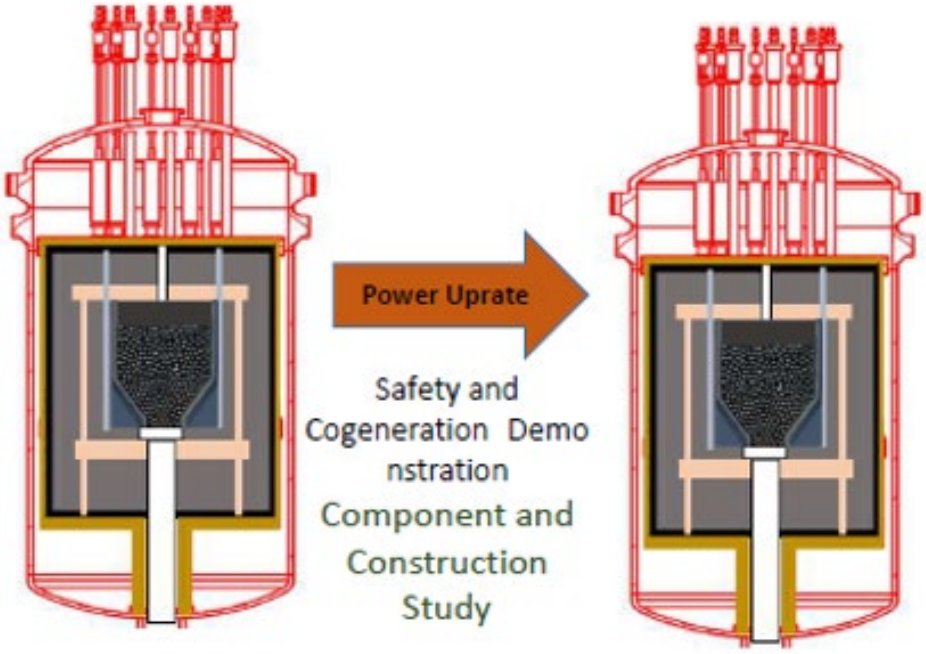
International Collaborators:

INET, CNNC

Uprating Principal PeLUIt-40

RDE – 10 MWt

PeLUIt40



- **Function : Nuclear Steam Supply System (NSSS)** in coupling with Cogeneration system to produce Hydrogen
- Thermal power 40 MWt (uprating RDE 10 MWt)

Uprating power with preserving :

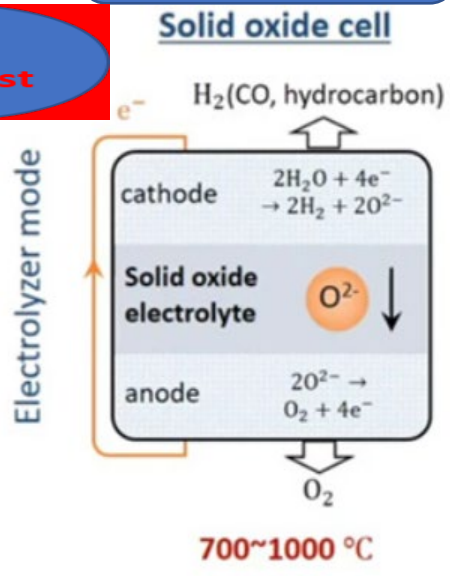
- **Fuel Desing**
- **Core Geometry**

Consequences : increase fuel pebble bed feeding per day.

H-Production Method: SOEC + SMReforming

Steam Electrolysis

Our Interest



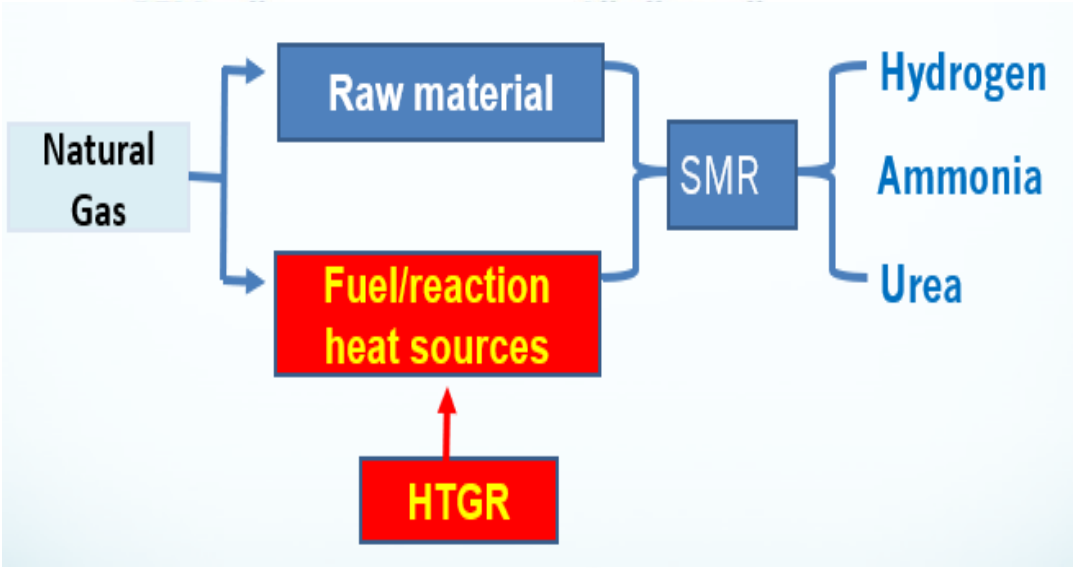
Sourcer: Intro to Solide Oxide Celss (https://youtu.be/N8s_MR87wno)

High-T Electrolysis

More efficient H-Production method

Nuclear reactor supply heat and electricity.

Steam Methane Reforming



NuScale Tech. based Cooperation

SENSITIVE BUT UNCLASSIFIED

Indonesia-Japan-United States Partnership Announcement at G20 Leader Summit on Small Modular Reactor (SMR) Project

United States Seeks Indonesia's Confirmation on G20 Partnership Announcement
On September 15, United States Special Presidential Envoy for Climate Advisor Ambassador Robert Blake met with Indonesian Ambassador Roeslani in Washington DC agreed to seek a joint statement with Indonesia, Japan, and the U.S. at the G20 Summit announcing partnership to build an SMR pilot nuclear power plant in West Kalimantan, Indonesia. Washington is awaiting confirmation that the announcement can proceed. **The announcement is a great opportunity to showcase trilateral cooperation on an innovative clean energy project that works toward meeting Indonesia's COP26 commitments and supports Indonesia as a first mover in the region.**

National Collaborators:

INDONESIA POWER

NuScale Tech. based Cooperation

National Collaborators:

INDONESIA POWER

The announcement would include activities to support Indonesia in meeting its goal:

1. **A supply chain study** supported by Japan's Ministry of Economy Trade and Industry (METI).
2. **Targeted technical support** under the U.S. Department of State Foundational Infrastructure for the Responsible Use of SMR Technology (FIRST) program.
3. **A SMR feasibility study** by the U.S. Trade and Development Agency (USTDA) in partnership with Indonesia's National Research and Innovation Agency (BRIN), Indonesia Power, and NuScale.

Made-in-Indonesia and Working Toward Net Zero Emissions Goal

The SMR plant will be a 'made-in-Indonesia' power plant and will be designed to position Indonesia as a regional leader and technology hub for ASEAN. By deploying innovative clean SMR technology first in the Indo-Pacific region, Indonesia is advancing climate action and clean energy access throughout a critical part of the world. The plant will be based on U.S. NuScale technology, Japanese industrial expertise, and Indonesia workforce prowess and ***will work toward Indonesia's goal of Net Zero Emission by 2060***.

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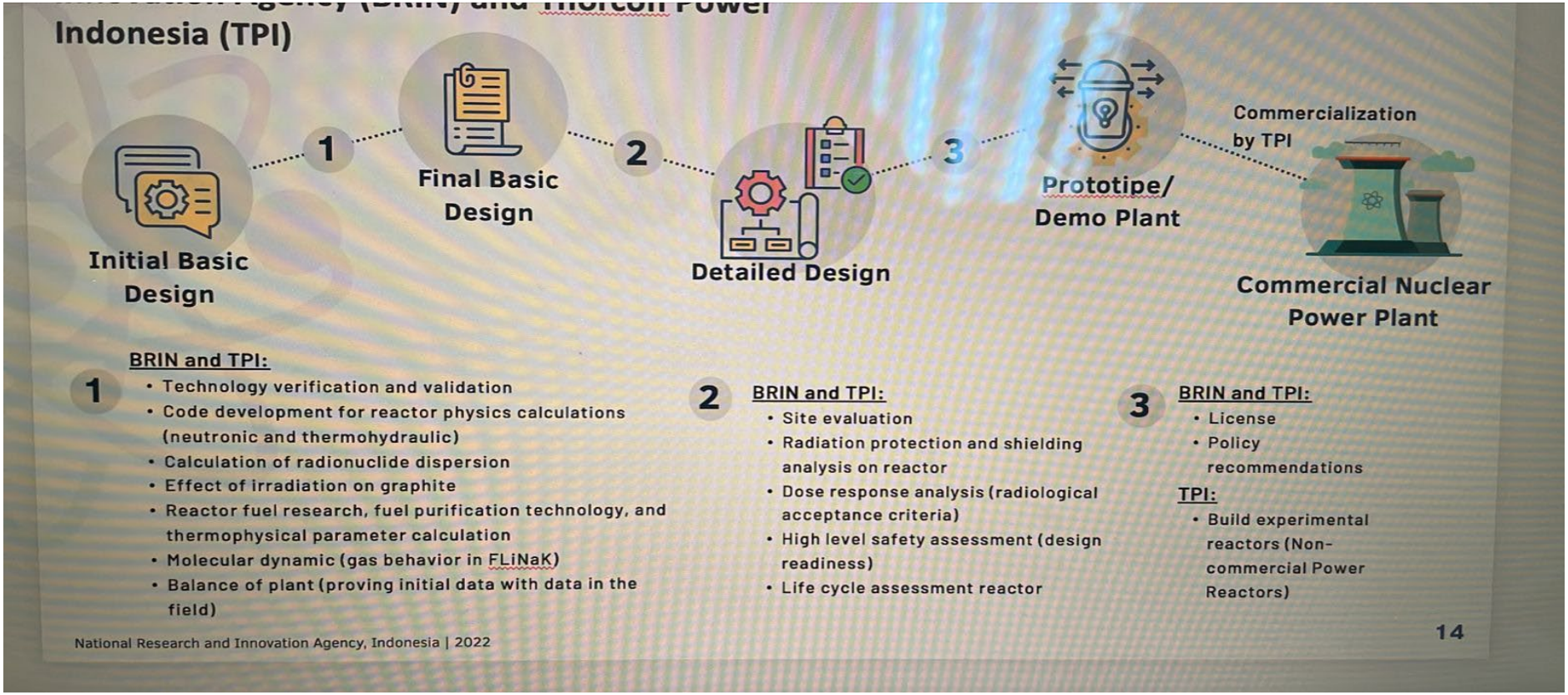
COST-COMPETITIVE, CARBON-FREE HYDROGEN PRODUCTION

Hydrogen has the capability to help decarbonize both the electricity and transportation sectors by being used for energy storage or as a fuel for hydrogen fuel-cell vehicles, trains, ships, and airplanes. However, most of the hydrogen today is produced by fossil fuels, and not carbon-free sources of energy. NuScale's innovative small modular reactor (SMR) is ideal for producing clean hydrogen in a cost-competitive manner.

Energy from a single NPM in the form of superheated steam and electricity are directly routed to a HTSE system operating at 850°C. Only 2% of the electrical output (1.8 MWe) of the NPM is used to increase the process steam temperature from 300°C at the NPM outlet to 850°C for the electrolyzer. Moreover, hydrogen produced by a NuScale HTSE system is forecasted to be cost competitive with high capacity factor renewable hydrogen cost estimates while also providing continuous, controlled hydrogen production.

One 250 MWt NuScale module can produce 2,053 kilograms of hydrogen per hour, or nearly 50 metric tons per day. A single NPM could produce enough hydrogen to power 38,000 fuel cell vehicles or 1,500 long-haul fuel cell trucks at average annual usage rates in the US.

BRIN – TPI Co-Development



Key #1: Consolidation Research Group Internal

- **Determine Target**

To see and toward *Frontier* Research Team with target basis PR

- **Human Resources Capacity Building**

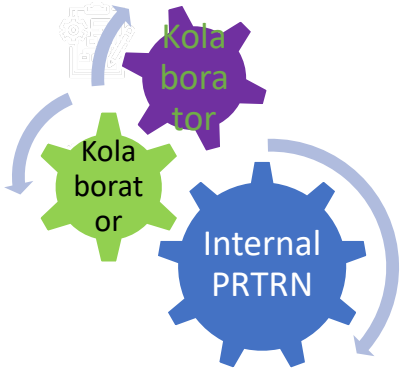
Internal Human Resources Development (Training, DBR,dll)

Requitement external Human Resources with various scheme (Barista, PostDoc,VR)

- **Develop Thematic Collaboration:** RIIM, PRK, RKI
- ***Develop Frontier Research Tradition:*** *weekly meeting*

Strengthen Competition and Networking Research group Perkuat Kompetensi dan Jejaring Kelompok Riset sebagai 'roda' utama litbang dan invensi.

Key #2: Sinergy to develop



1. **Develop competency on Reactor Safety Analisys using real case**
   - Contamination case
   - Sub-cooled Reactor Case
2. **Develop Enabling Competency on developing:**
   - High Temperature Gas-cooled Reactor
   - Advance PWR Type Small Medium Reactor
   - Molten Salt Reactor (Outside Pull)

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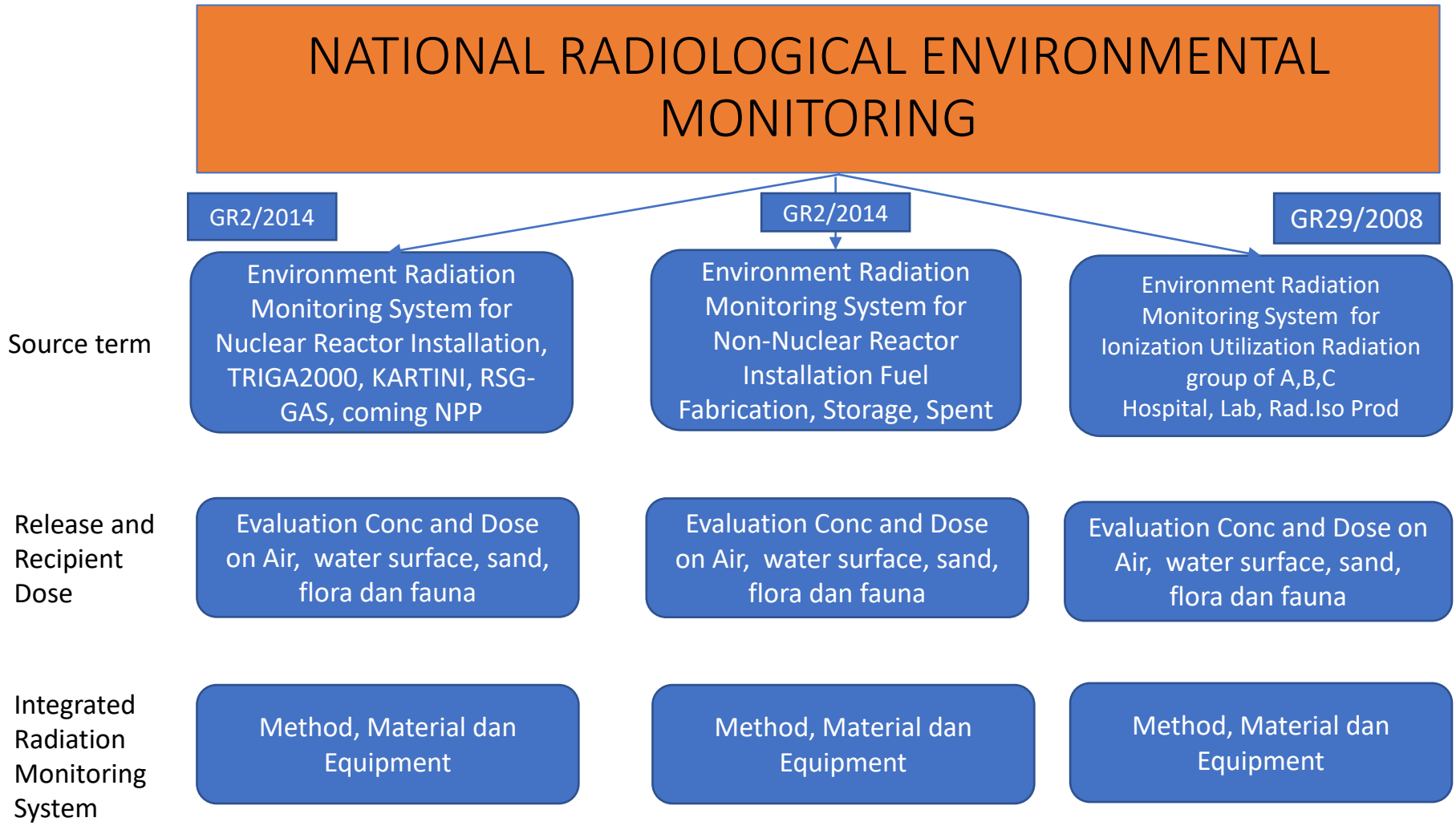
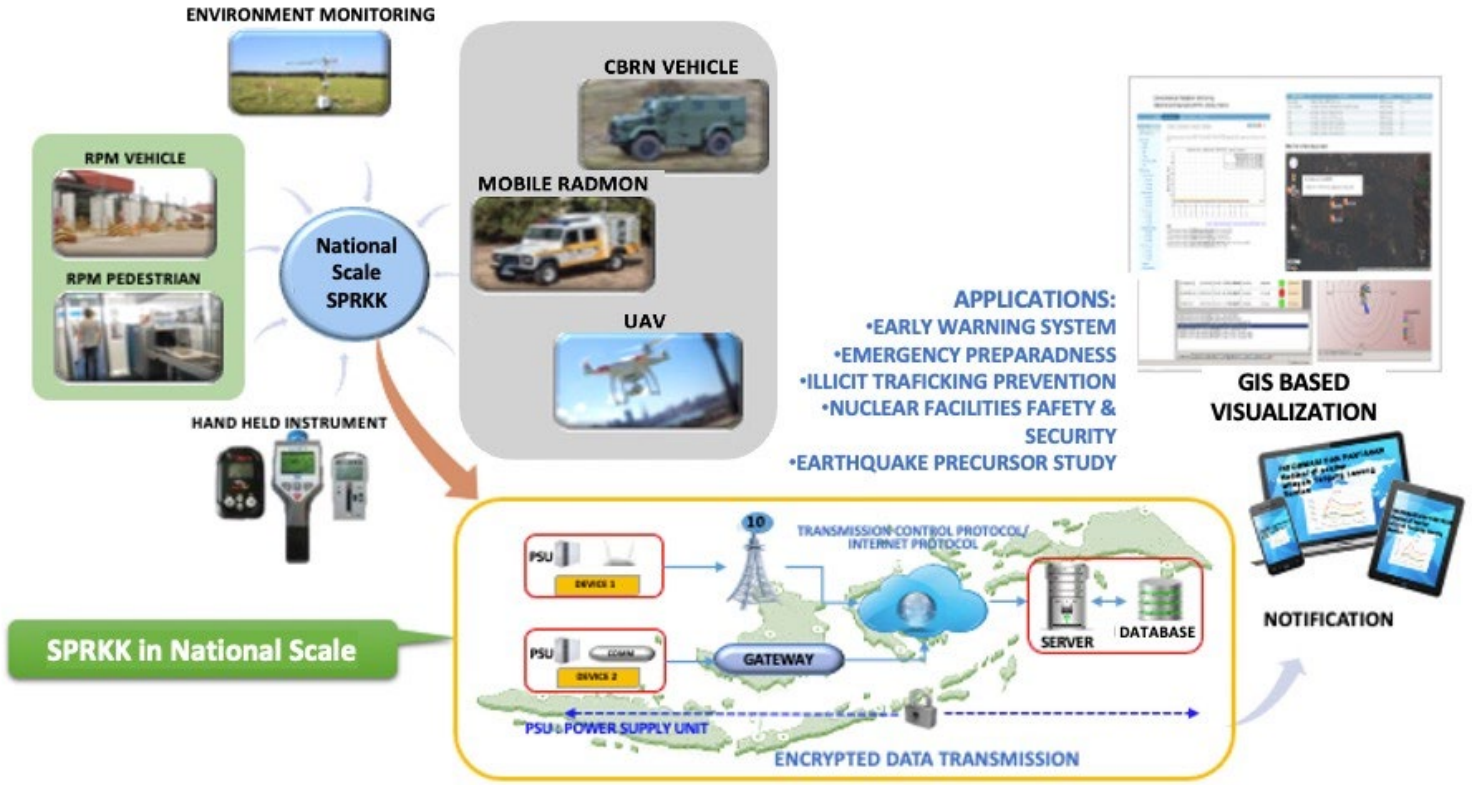
NATIONAL RESEARCH PRIORITY ON RMS RADIATION MONITORING

NATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING



RADIATION MONITORING SYSTEM FOR SAFETY AND SECURITY



National Research Priority Program (PRN) 2020-2024
Development of Safety and Security Radiation Monitoring System (SPRKK)

Radiation Monitoring System Interfacing Development

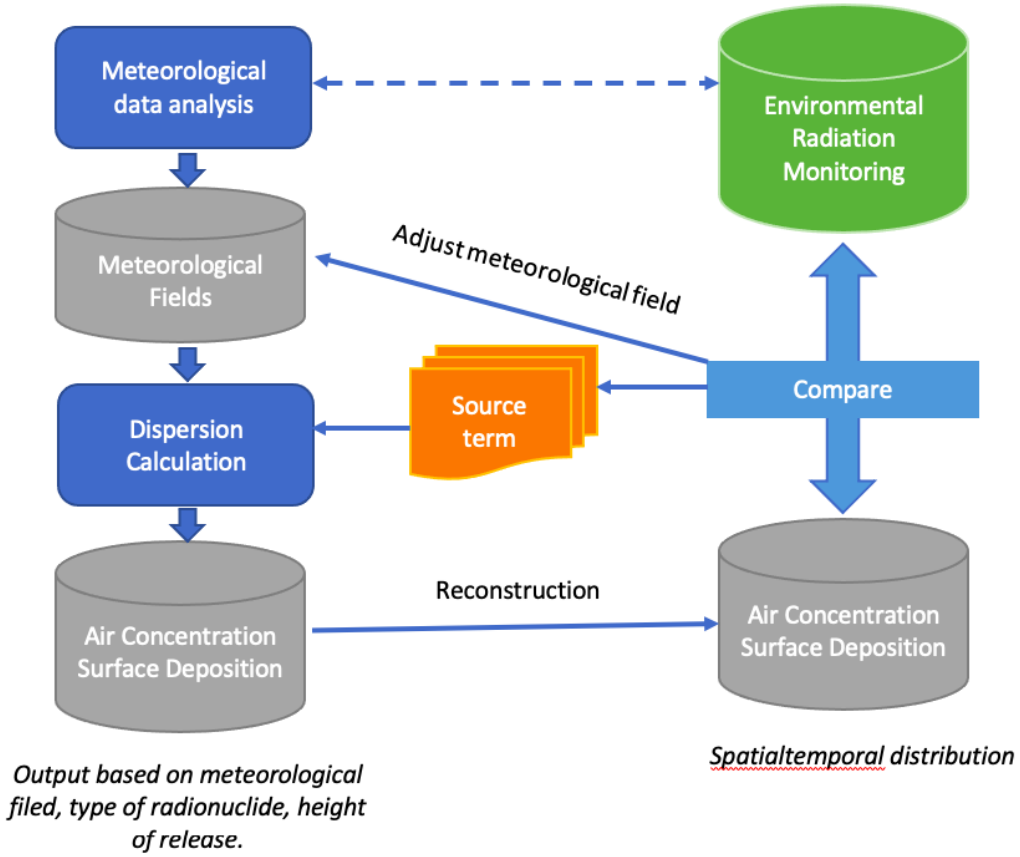
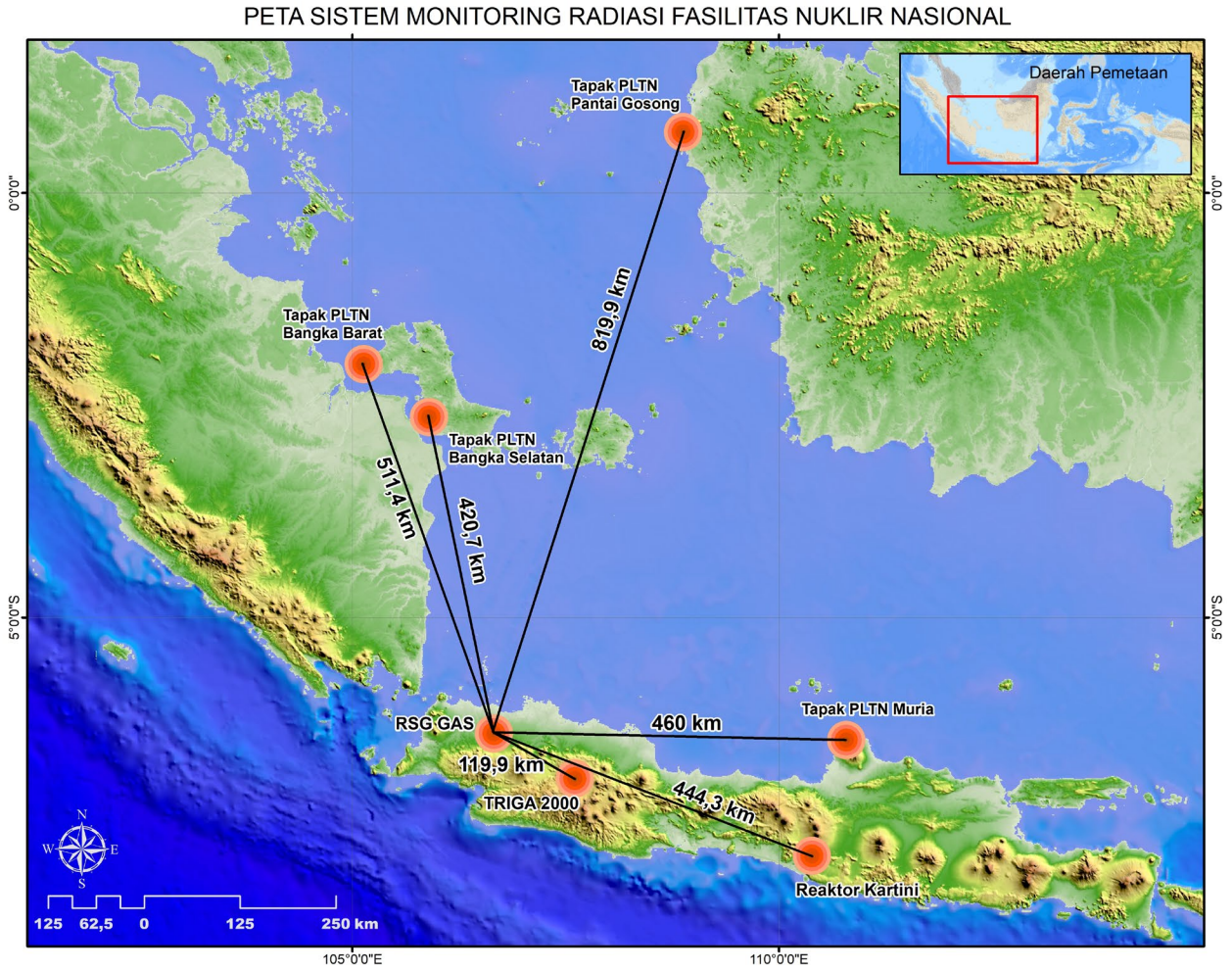


Figure 2.
Concept of Environmental Radiation Monitoring System

National Radiation Monitoring System



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RESEARCH COLLABORATION

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RESEARCH COLLABORATION

- The National Research and Innovation Agency (BRIN) proposes a global sharing of funding and partnerships related to the implementation of research and innovation.

- In terms of researcher mobility, BRIN invites, welcomes, and encourages researchers to conduct research in Indonesia in collaboration with researchers at BRIN and other stakeholders, while taking into account the guidelines for implementing policies and applicable regulations.

- BRIN have opened a mobility scheme for hundreds of guest lecturers, visiting researchers, and postdoctoral students to come to Indonesia

CONCLUDING REMARK

Concluding Remark

- Indonesia has provided two national research priority which may relate to ASEAN NPSR activities i.e.

- National Research Priority on NPP/SMR
- National Research Priority on Radiation Monitoring System
- BRIN encourage the researcher to develop collaboration research with University, Industrial Research Institution domestically and Global

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