# National Practises of Regulatory Review & Assessment for Research Reactors in Indonesia

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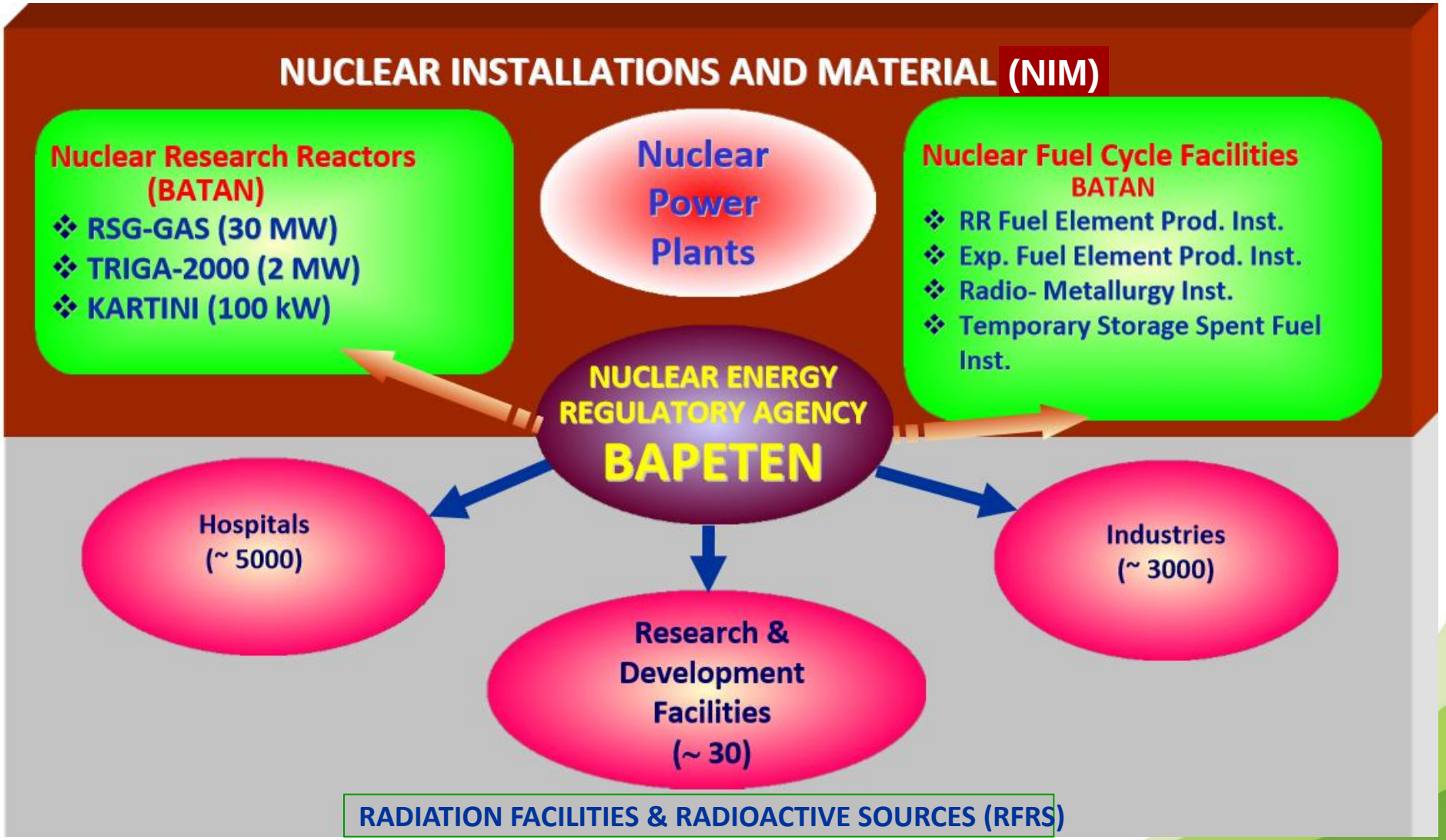
# Regulatory Objects



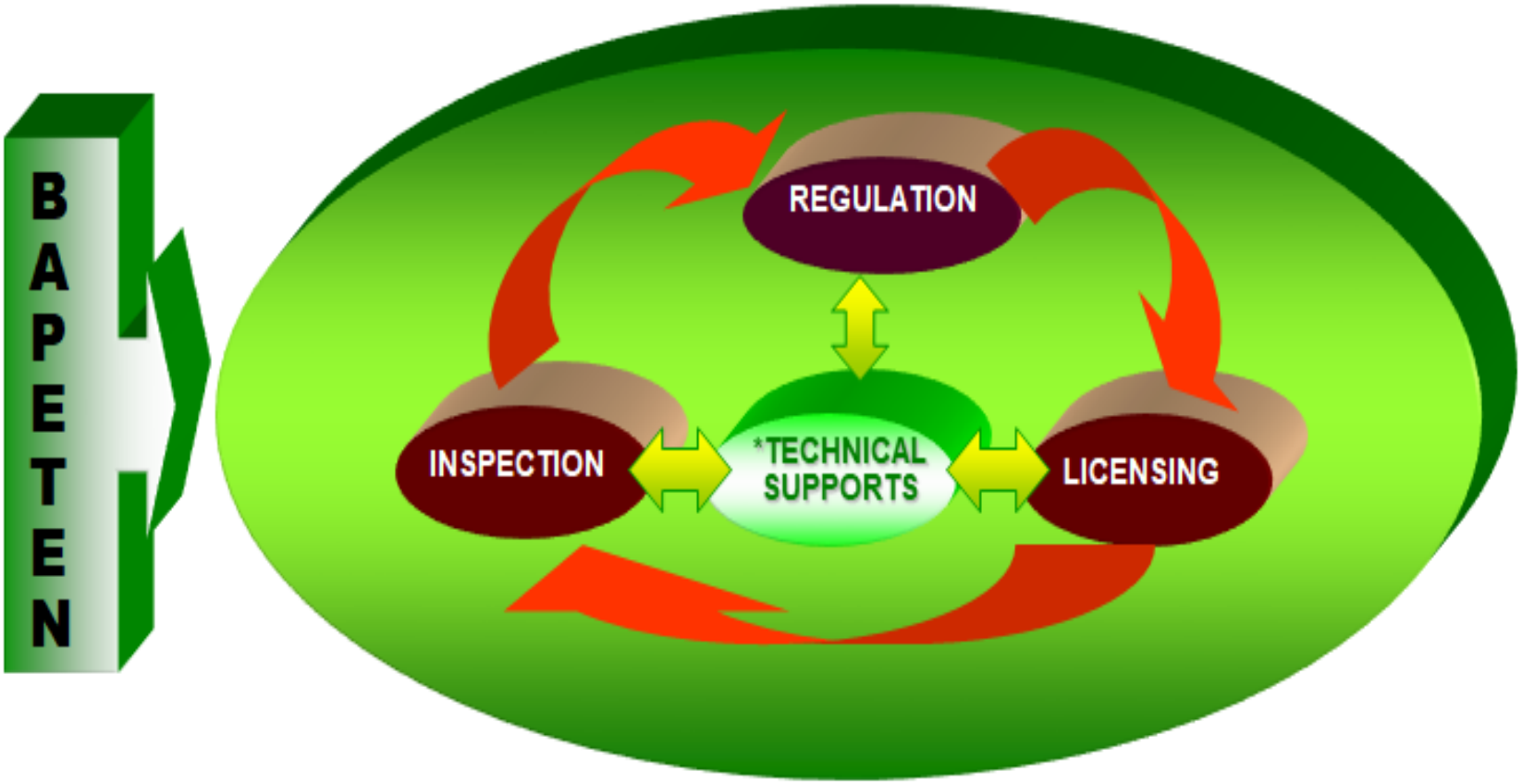
# Research Reactors in Indonesia

- MPR-30 (RSG-GAS) Reactor, Serpong (suburb of Jakarta)
  - 30 MWt maximum power; Uranium Silicide 19.75%
  - Pool type with $H_2O$; Beryllium reflector.
  - Construction: 1983. First criticality: 1987.
  - **Production:** Mo-99 & Ir-192

- TRIGA-2000 Reactor, Bandung, West Java
  - 2000 kWt maximum power; U-ZrH 19.75 %
  - Pool type with $H_2O$; Graphite reflector.
  - Construction: 1960. First criticality (250kW): 1964.

- Kartini Reactor, Yogyakarta, Center of Java
  - 100 kWt maximum power; U-ZrH 19.75 %
  - Pool type with $H_2O$; Graphite reflector.
  - Construction: 1975. First criticality: 1979.

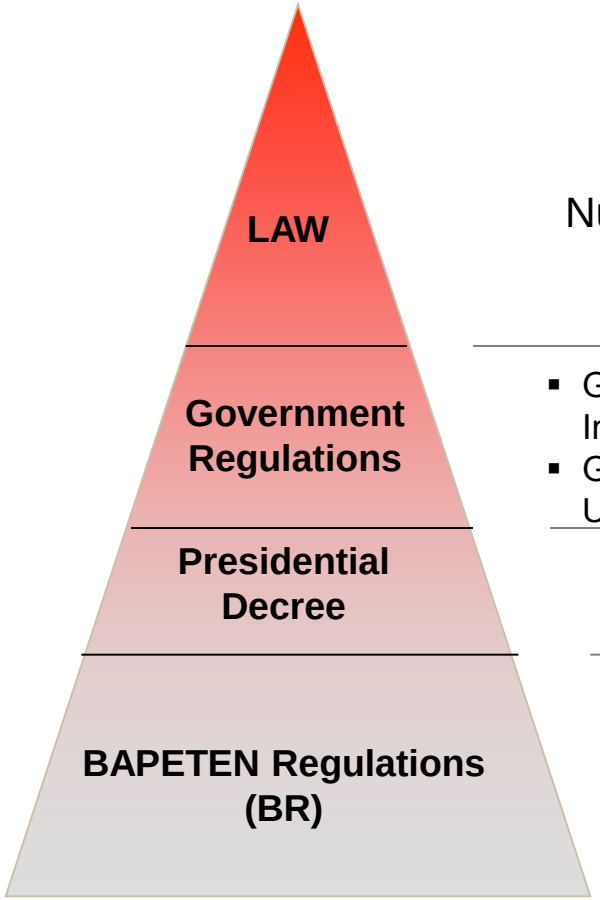
# Regulatory Infrastructures




*** Technical Supports:**

- **Center of Regulatory Assessment (P2STPIBN) → provides assessments & recommendations regarding regulation making, licensing and inspection processes**
- **Emergency Preparedness & Engineering Center**

# Hierarchy of Law & Regulation System




Nuclear Energy Act 10 Year 1997

- GR No. 54 Year 2012 “Safety & Security of Nuclear Installations”
- GR No. 2 Year 2014 “Licensing of Nuclear Installations & Utilization of Nuclear Materials

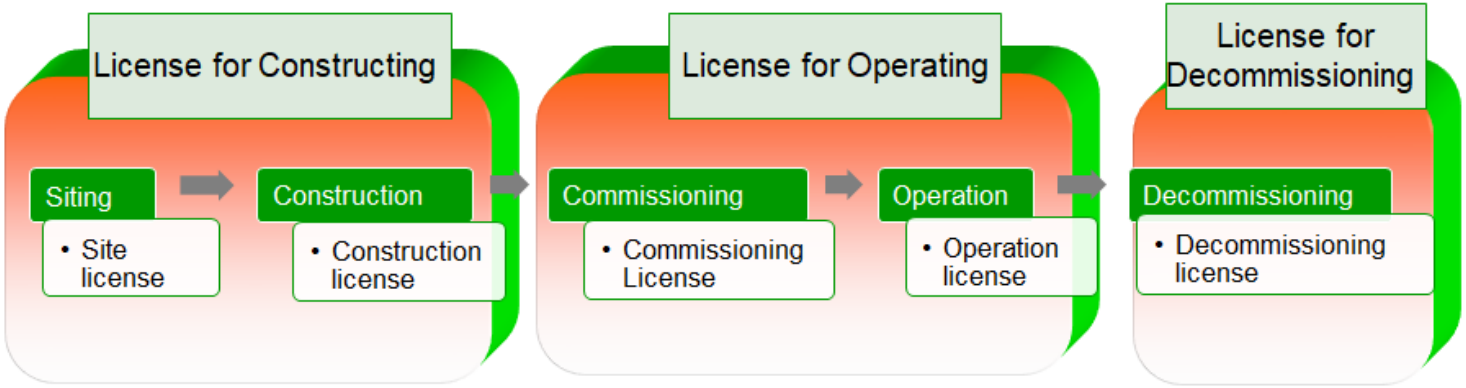
1. BR No. 1 Year 2011 “Safety Design Provision for Research Reactors”
2. BR No. 2 Year 2011 “Safety Operation Provision for Research Reactors”
3. etc.

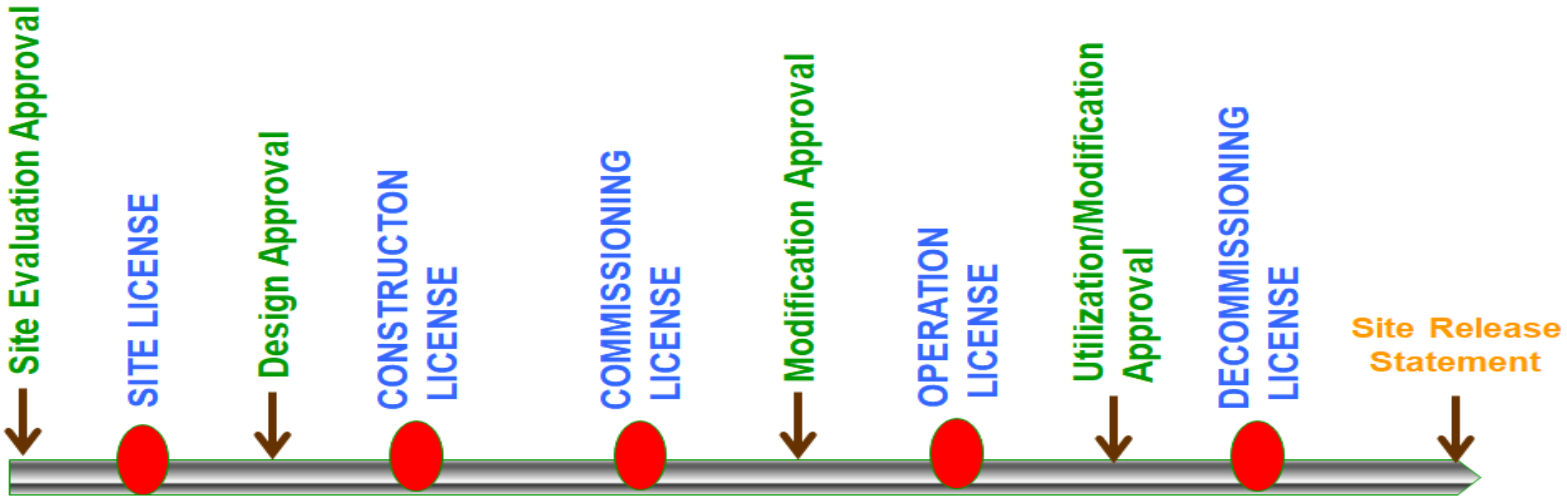
# National Regulations for RR

- BR No. 8 Year 2008: Safety Provision of Ageing Management for RRs
- BR No. 1 Year 2011: Safety Design Provision for RRs
- BR No. 2 Year 2011: Safety Operation Provision for RRs
- BR No. 5 Year 2011: Maintenance Provision for RRs
- BR No. 5 Year 2012: Safety of Utilization & Modification of RRs
- BR No. 8 Year 2012: SAR Preparation for RRs
- BR No. 9 Year 2013: Operational Limits and Conditions for RRs
- BR No. 2 Year 2014: Core Management & Handling & Storage of Nuclear Fuel in RRs
- BR No. 2 Year 2015: Verification and Safety Review for RRs
- BR No. 1 Year 2010: Preparedness and Nuclear Emergency Response
- BR No. 4 Year 2010: Management System of Nuclear Facilities & Activities
- BR No. 4 Year 2013: Protection and Radiation Safety
- BR No. 4 Year 2009: Decommissioning of Nuclear Reactor
- BR No. 4 Year 2018: Safety Provision of Site Evaluation for Nuclear Installation

# Licensing of Nuclear Reactor

**MULTI STEPS (5 STEPS)**



# Technical Requirements

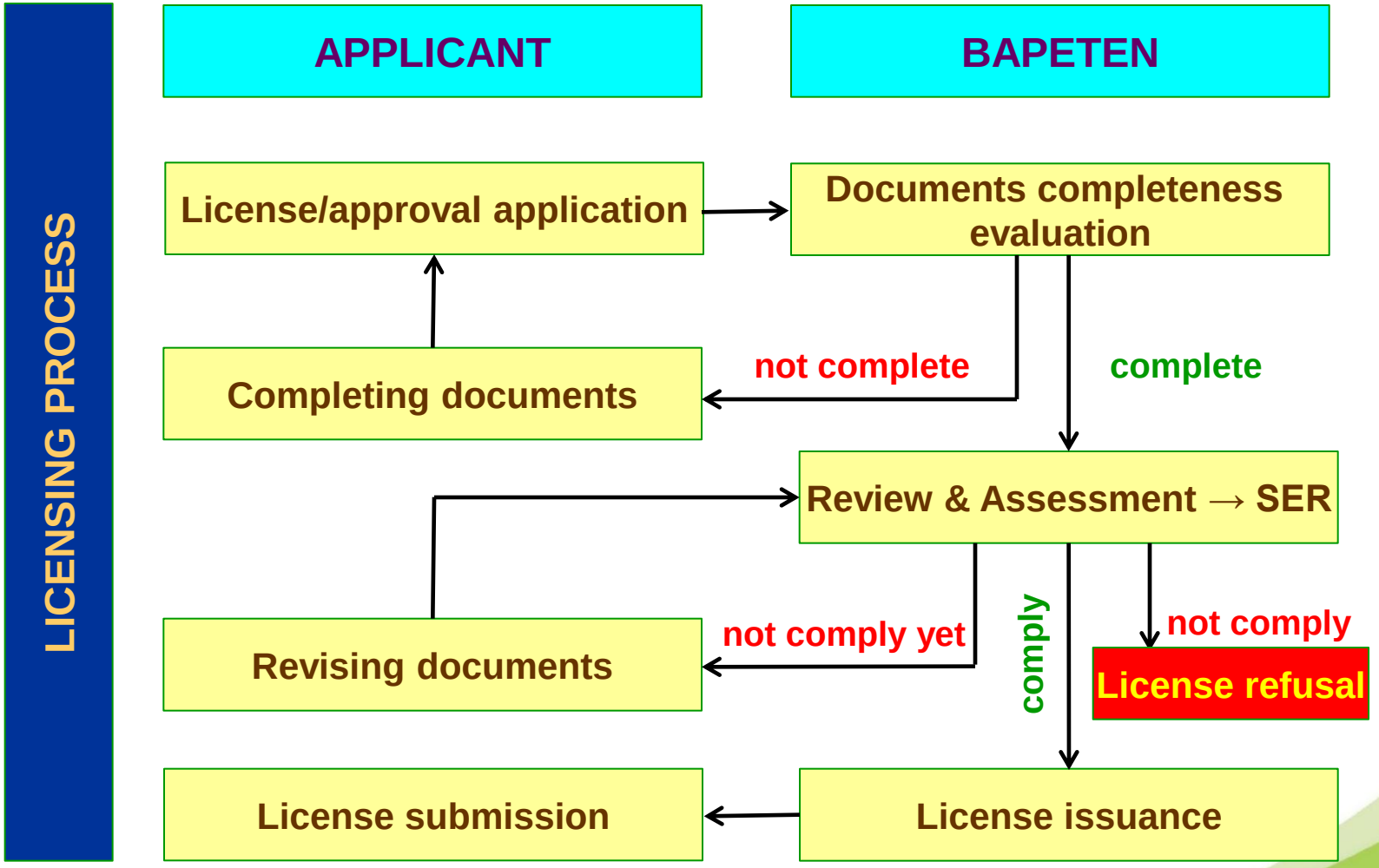
## Operation license

- SAR
- LCO
- Management system document
- Environmental license implementation report
- Decommissioning Program
- Nuclear Preparedness Program
- Physical Protection Plan
- Protection & Radiation Safety Program
- Safeguards systems document
- Maintenance Program

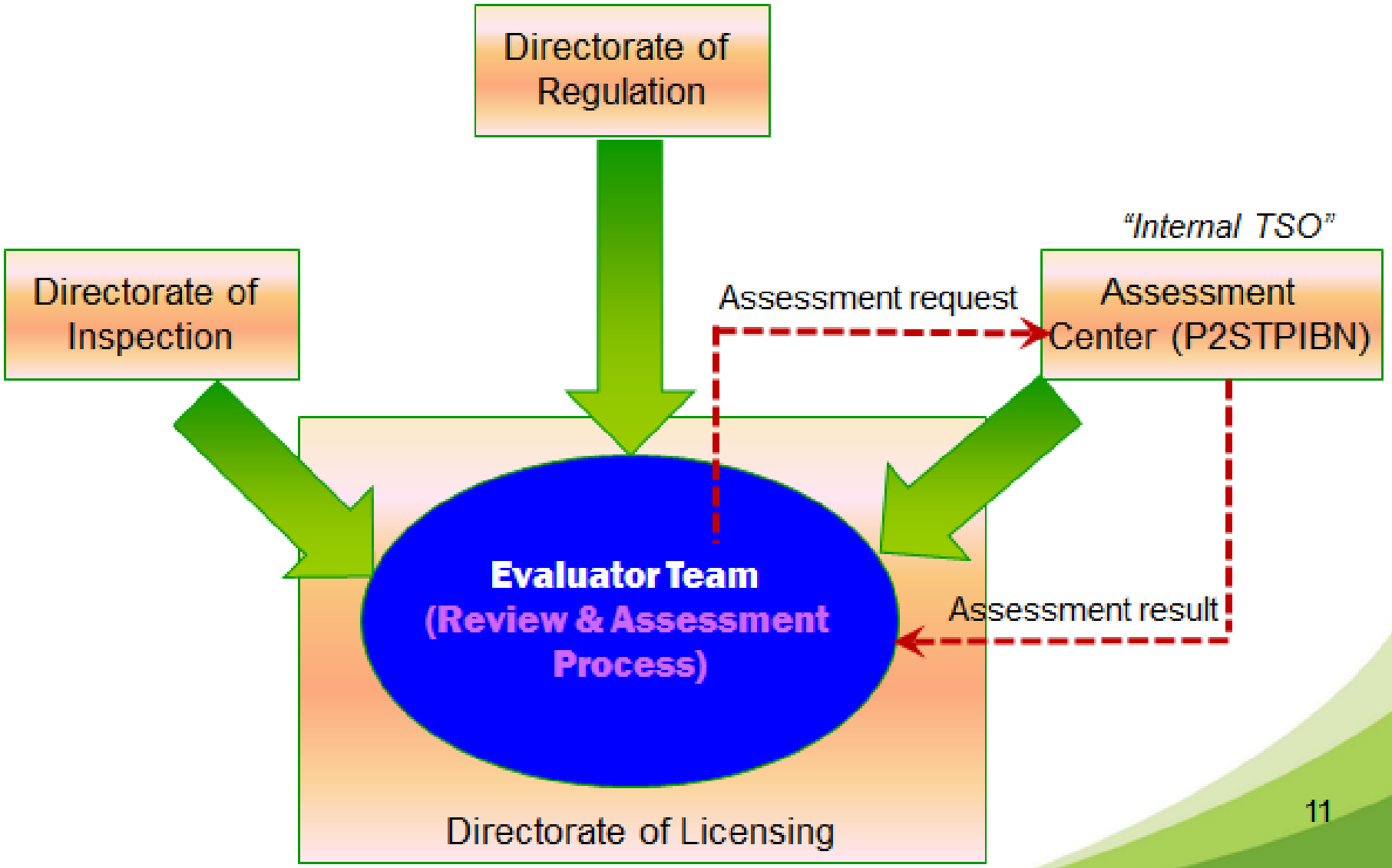
## Utilization/Modification Approval

- Utilization/Modification Program
- Management system document

# Licensing Process



# Review and Assessment Process



# Assessment Process

Assessment request from relevant directorate received by P2STPIBN

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Head of P2STPIBN establishes specialist team and appointed chairman of the specialist team

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Chairman of the specialist team make a schedule and distribute the tasks of assessment in accordance with field studies

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Implementation of assessment carried out in accordance with the agreed schedule (field verification/visit could be done if needed)

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The initial meeting to discuss the preliminary results of assessment

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Final meeting to discuss the final results of assessment

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Preparation of the final report of the assement results

# Resources & Cooperation for Review & Assessment

- Human Resources:

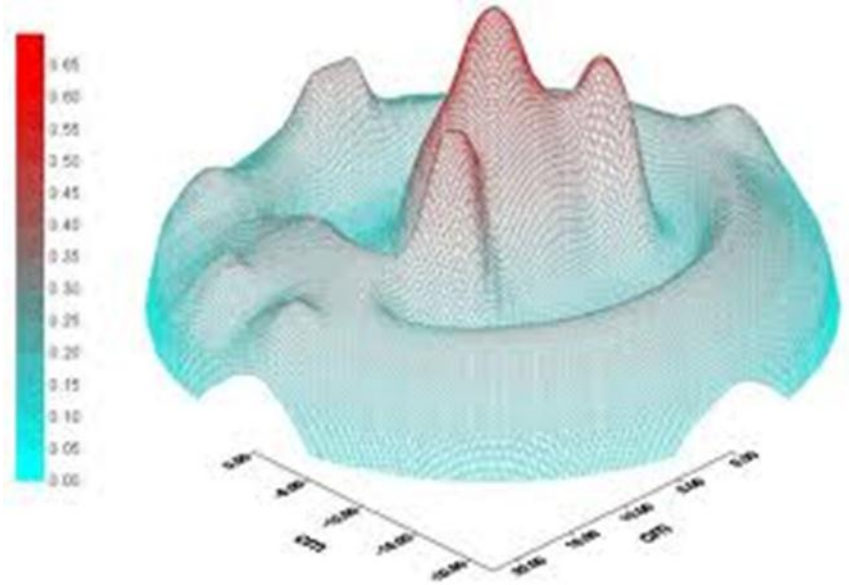
| | |
|---|---|
| Licensing Division | 20 |
| Regulation Division | 5 |
| Inspection Division | 5 |
| Assessment Center | 10 |

- Methodology: Conservative deterministic approach (DSA)
- Calculational tools: computer codes
- External technical supports: national universities (ITB, UGM, etc.), professional experts
- Regional cooperations: IAEA, Japan, Korea, Australia, etc.

# Computer Codes

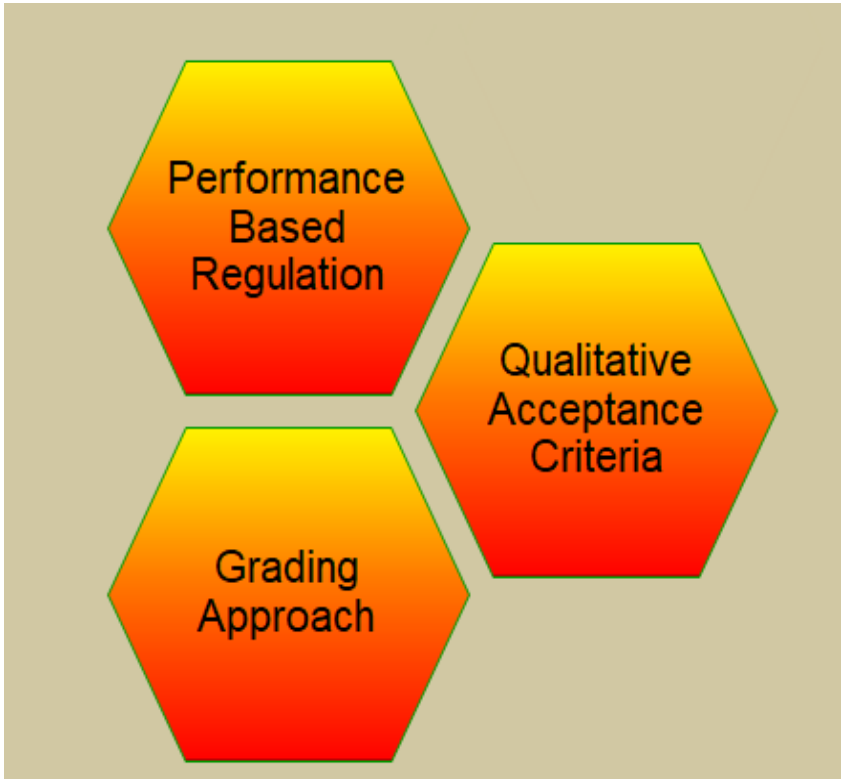
- Should be appropriate for their field of application
- Widely used by various regulatory body

- MCNP5,6,X
- RELAP5
- PARET
- SRAC
- MVP
- ORIGEN
- SCALE 6.1
- ANSYS FLUENT
- ANSYS MECHANICAL
- PC COSYMA
- Etc.



# Acceptance Criteria

- Siting
- Design
- Operation
- SAR
- Periodic Safety Review
- Ageing Management
- Utilization & Modification
- Operational limits & conditions
- Nuclear emergency response
- Management system
- Radiation protection
- Etc.



# Example of Acceptance Criteria for Design

*Nuclear safety goal is achieved through the application of defence in depth*

- Defence in Depth (5 levels) → Research reactors ≥ 2 MW

*Safety system*

- Reactor shall be designed automatically initiating safety system in accident condition

*Code and Standard*

- The applicant shall determine the current codes and standards for SSC important to safety
- Code and standard shall comply with Indonesian National Standard
- If not available, use the similar one from vendor country

# Example of Acceptance Criteria for Design

*Structure, System, and Components*

- Shall be classified into safety classes, seismic classes, and quality classes

*Engineered safety features (ESF)*

- Designed based on safety analysis
- Operate automatically
- If not in automatic mode, manual operation shall be ensured

*Safety Analysis*

- Deterministic method, can be combined with probabilistic method and technical judgement

*Operational Limits and Conditions (OLC)*

- Consist of safety limit, safety system setting, limiting condition for normal operation, surveilance requirements, administration requirements.
- AOO shall be anticipated using defence in depth level 1 or 2

# Example of Acceptance Criteria for Design

## General design requirements

- design of SSC reliability
- design to accomodate operation & maintenance
- design for nuclear emergency response & preparedness
- design for accomodating decommissioning
- design of radiation protection
- design of physical protection
- design for human factor
- design for minimizing the ageing factor

## Spesific design requirements

- design of reactor core
- design for shutdown
- design of RPS
- design of reactor coolant system
- design of ECCS
- design of confinement system
- design of utilization, modification & experimental tools
- design of I & C system
- design of nuclear fuel handling & storage
- design of electric power supply system
- design of radioactive waste management system
- design of building & structure
- design of auxiliary system

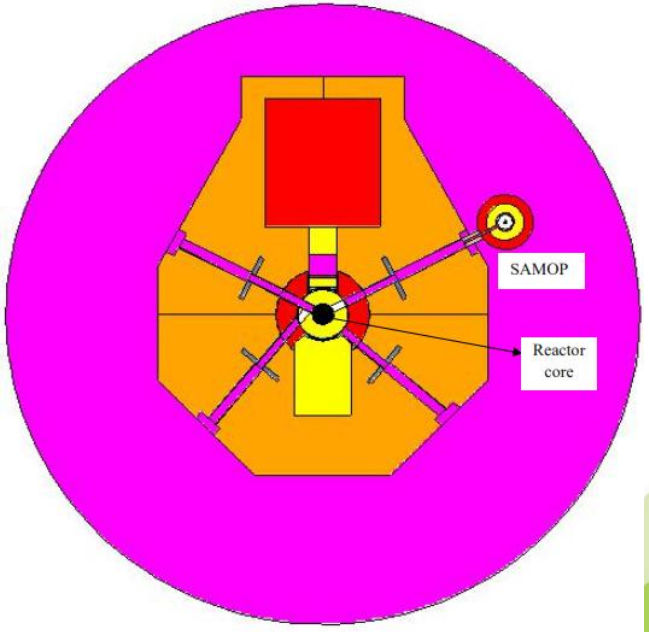
# Review & Assessment Practises (1)

- The application of operation license renewal for Kartini Reactor (2019) and RSG-GAS Reactor (2020)
- Documents evaluated:
  - ✓ SAR
  - ✓ PSR
  - ✓ Report of Ageing Management Program
- Assessment Request:
  - ✓ Remaining life Assessment of SSC important to safety
  - ✓ Calculation of OLC parameters (example: power peaking factor, maximum fuel temperature)
  - ✓ Calculation of radiological consequences at normal & accident conditions
- External support by Universities:
  - ✓ R&A of several chapters of PSR
  - ✓ Concrete of biological shielding assessment

# Review & Assessment Practises (2)

- The Application of Approval for SAMOP Testing Facility as Utilization of Kartini Reactor (2017)
- SAMOP (Subcritical Assembly for Mo-99 Production): Subcritical assembly which utilizes neutrons from reactor's beamport

- Documents evaluated :
  - ✓ SAMOP Utilization Program
  - ✓ Management System Program
- Assessment request:
  - ✓ Calculation of neutronics aspect
  - ✓ Calculation of thermal hydraulics aspect
- Verification inspection



# Challenges (1)

*Ageing Management*

- Lack of baseline data of design in review and assessment of ageing management

  Example:

✓ initial thickness of reactor tank

✓ detailed engineering design of steel reinforcement concrete of biological shielding

- Remaining life assessment

- Lack of funding ~ the sufficiency of data

# Challenges (2)

*Safety Analysis*

- Utilization of appropriate computer codes ~ diversity in design

*Graded Approach*

- Need a clear guidance for implementation

*Utilization & Modification*

- Various kinds of utilizations & modifications to enhance research reactors utilization

*Lesson Learnt of Fukushima*

- Need an in-depth study for implementation to existing research reactors

# Development of National Regulations

*All national regulations were developed referring to IAEA safety standards*

- Revision of BR No. 1 Year 2011: Safety Design Provision for research reactors to adopt IAEA SSR-3 "Safety of Research Reactor"
  - ✓ DEC concepts (Need in-depth study for implementation)
  - ✓ Safety-security interfaces (Harmonization of regulations)
  - ✓ Safety requirements of subcritical assemblies

- Development of BR on safety assessment for nuclear installations → IAEA SS No. GSR Part 4 (Rev.1) "Safety Assessment for Facilities & Activities"

# Practical Implementation of SSR-3

- Interpretation of BDBA as DEC accidents
- Incorporating DEC at chapter “Safety Analysis” in the process of operation license renewal
- Enhancing Defence in Depth concepth to withstand DEC
- Revision of BAPETEN Regulations on the safety of research reactors: design & operation aspects
- Assessment for the development of guidance on graded approach implementations for research reactors

# Feedback on the Implementation of IAEA Standards

Technical documents on the implementation of new concepts in SSR-3, such as:

- *Defence in depth*
- *DEC*
- *Interfaces between safety & security*

are helpful to overcome various interpretations

# Thank You

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