

The 4<sup>th</sup> International Symposium on Probabilistic Methodologies for Nuclear Applications  
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*The evolving perception of probabilistic applications in the nuclear regulatory environment*

# **The Use of Probabilistic Methodologies in Passive Components in Korea**

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# Status of Nuclear Power Plants in Korea

▶ As of October 2022

## In Operation

24 Units (Commercial)

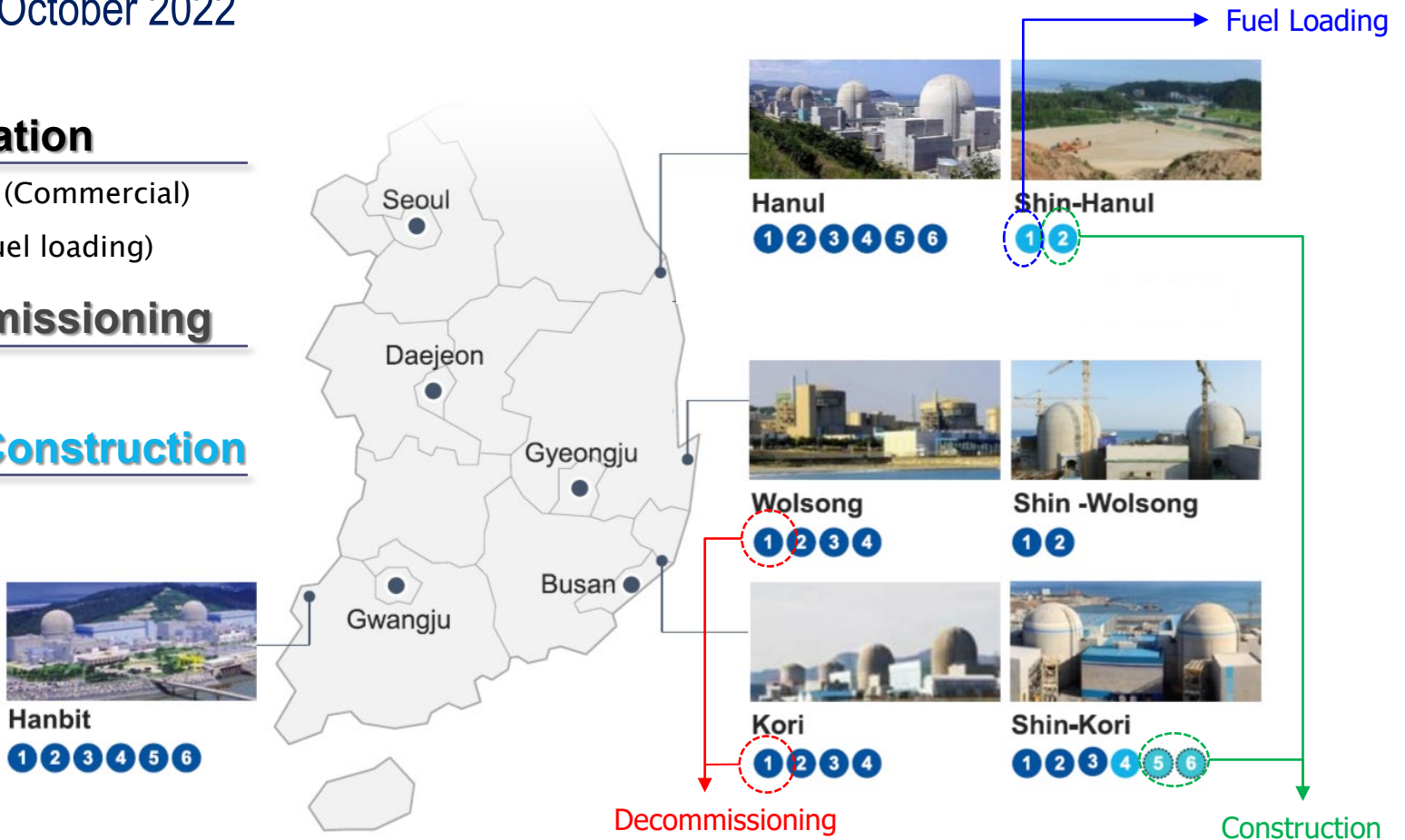
1 Unit (Fuel loading)

## Decommissioning

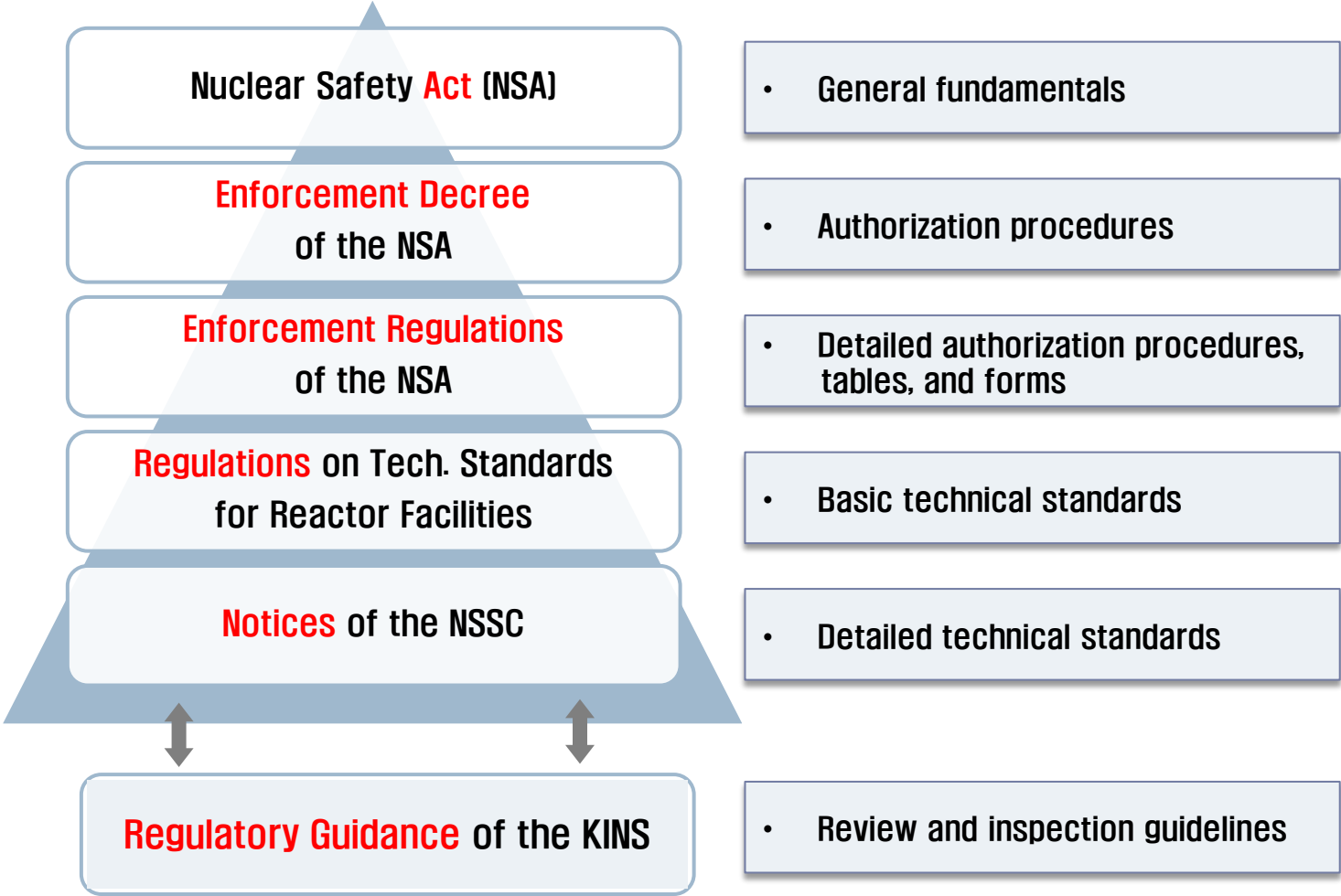
2 Units

## Under Construction

3 Units



# Regulatory Framework



# Reg. Requirements - Act

Act
Enf. Decree
Enf. Regulations
Regulations
Notices

## ▶ Nuclear Safety Act

### ▶ Article 21 (**Standards for License**)

- (1) The standards for the operational license as referred to in Article 20 shall be as follows:
2. Performance of the nuclear power reactor and related facilities shall conform to the **technical standards as prescribed by the Regulations of the Commission** in such a way that there may not be any impediment to the protection against radiation damages to human bodies, materials, and the general public caused by radioactive materials, etc.;

### ▶ Article 26 (**Safety Measures for Operation, etc.**)

- (1) In case a nuclear power reactor operator operates a nuclear reactor for power generation and related facilities, he or she shall take the following measures in accordance with the matters prescribed in the Regulations of the Commission for the safety of human bodies, material objects, and the public. (…)
4. **Measures related to the inspections** and testing during the operation of nuclear reactor facilities;

# Reg. Requirements - Regulation

Act
Enf. Decree
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- ▶ Regulations on Technical Standards for Nuclear Reactor Facilities, Etc.
  - ▶ Section 2 Structure, Installation, and Performance for Reactor Facilities
    - ▶ Article 15 (**Environmental Effects Design Bases**, etc.)

(1) The structure, systems, and components important to safety shall be designed to meet each of the following requirements to prevent any damage caused by environmental and dynamic effects:

3. They shall be appropriately protected against dynamic effects, (...) However, in cases where it is demonstrated that **the probability of fluid system piping rupture is extremely low** under the conditions consistent with the piping design basis, the dynamic effects related to postulated piping rupture may be excluded from the design basis.

- ▶ Section 3 Operation of Reactor Facilities
  - ▶ Article 63 (**Testing, Monitoring, Inspection, and Maintenance**)

(1) (...) And each of the following actions shall be taken as determined and **publicly notified** by the Nuclear Safety and Security Commission:

1. **The degree of degradation in materials and performance of safety-related SSCs due to aging shall be monitored and evaluated, and necessary measures shall be taken;**

# Reg. Requirements - Notice

Act
Enf. Decree
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## ▶ Notices of the NSSC

- ▶ No. 2016-11(reactor.16), Regulation on In-Service Inspection of Nuclear Reactor Facilities

<PWR>

- ▶ KEPIC MI (ASME Code Section XI)
  - Non-Mandatory Appendix R: Risk-Informed Inspection Requirements for Piping

<PHWR>

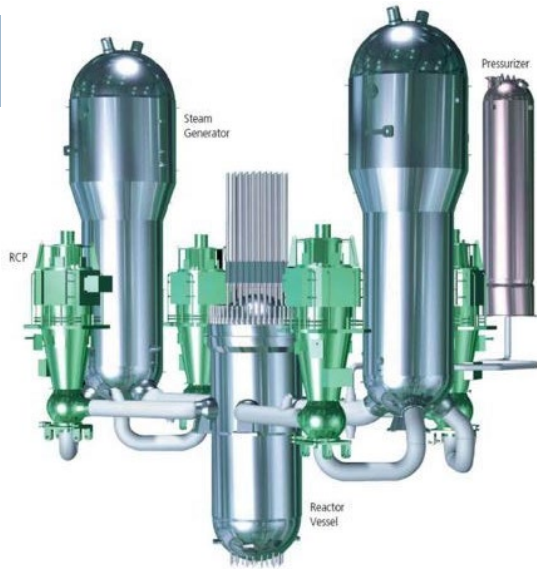
- ▶ CAN/CSA 285.4 & 285.8
  - Probabilistic Leak-Before-Break Evaluation of Pressure Tube

# Supplementary Requirements

- ▶ The probabilistic methodologies as [a supplementary tool](#) to the deterministic methodologies have been used to evaluate the integrity of passive components in Korea. The [standard review guidance of the KINS and topical reports](#) give a technical starting point to use probabilistic fracture mechanics for assessing some safety cases.
- ▶ **SRG** (Standard Review Guidance) of the KINS
  - ▶ 3.6.3 Leak-Before-Break Evaluation Procedures
  - ▶ 5.3.2 Pressure-Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock
- ▶ **Topical Report** reviewed by the KINS
  - ▶ SGMP (Steam Generator Management Program)

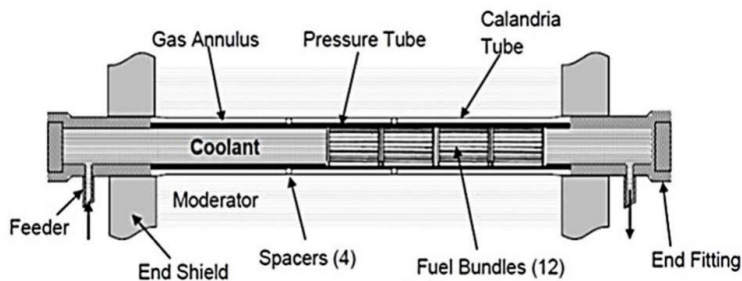
# Use of Probabilistic Methodologies

## PWR



- **Reactor Pressure Vessel**
  - PTS Analysis (SRG 5.3.2)
- **Steam Generator Tube**
  - Operational Assessment for Next Outage (TR-SGMP)
- **Piping System**
  - Risk-Informed ISI (ASME XI, App. R)
  - Leak-Before-Break (SRG 3.6.3)

## PHWR



- **Pressure Tube**
  - Leak-Before-Break (CSA 285.4 & 8)





**Thank you for your attention!**