



Nuclear Safety and
Security Commission

NSSC's Strategy for the Regulation of Advanced Reactors

*: Learning from Experience, Building through
Partnership*

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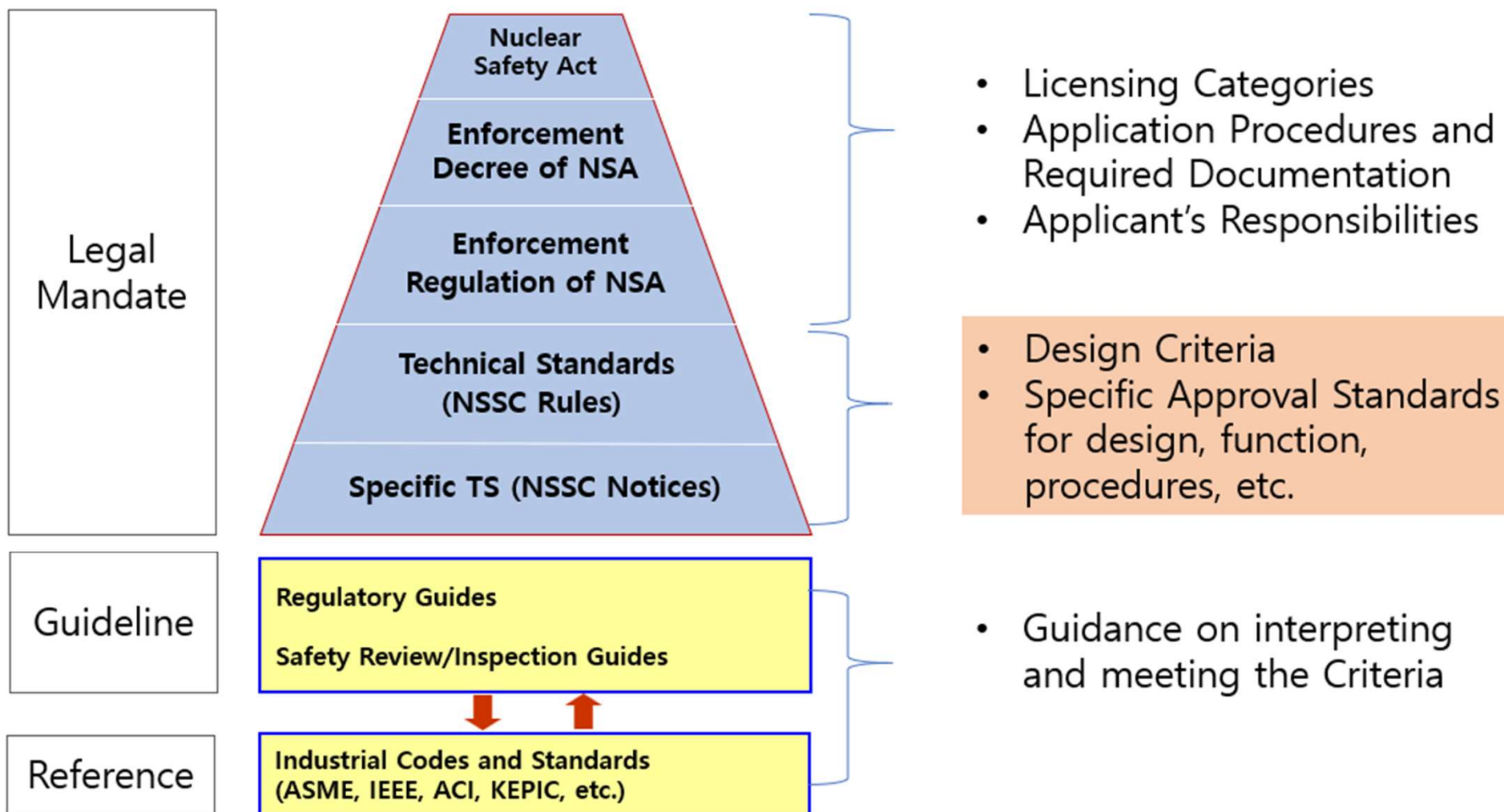
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1. Overview of Korea's Regulatory Framework

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◆ Structured Hierarchical Framework

: *Balancing between Legal Stability and Operational Flexibility*

◆ Is it effective to integrate technical innovation?

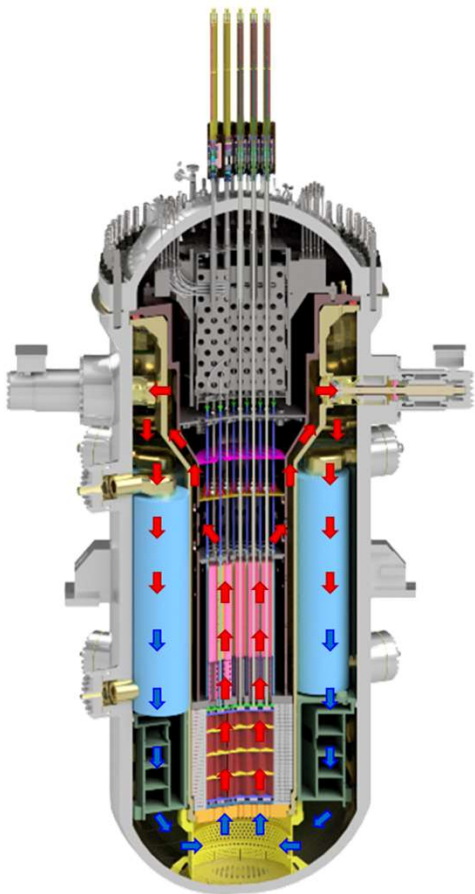
- ❖ Primarily centered on LLWRs for electricity generation
- ❖ Prescriptive style - dictating specific design solutions

2. Lessons Learned from SMART100

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< Key Licensing Progress >

SMART100



- Applied for Standard Design Approval (SDA) in Dec. 2019
- Reviewed by KINS through April 2024
- Result reviewed by NSSC Technical Advisory Committee through July 2024
 - *Subcommittees for Passive Safety Systems and Off-site Power*
- SDA issued by NSSC in September 2024

Power: 365MWt (110MWe)

Type: PWR

Design: Integral type

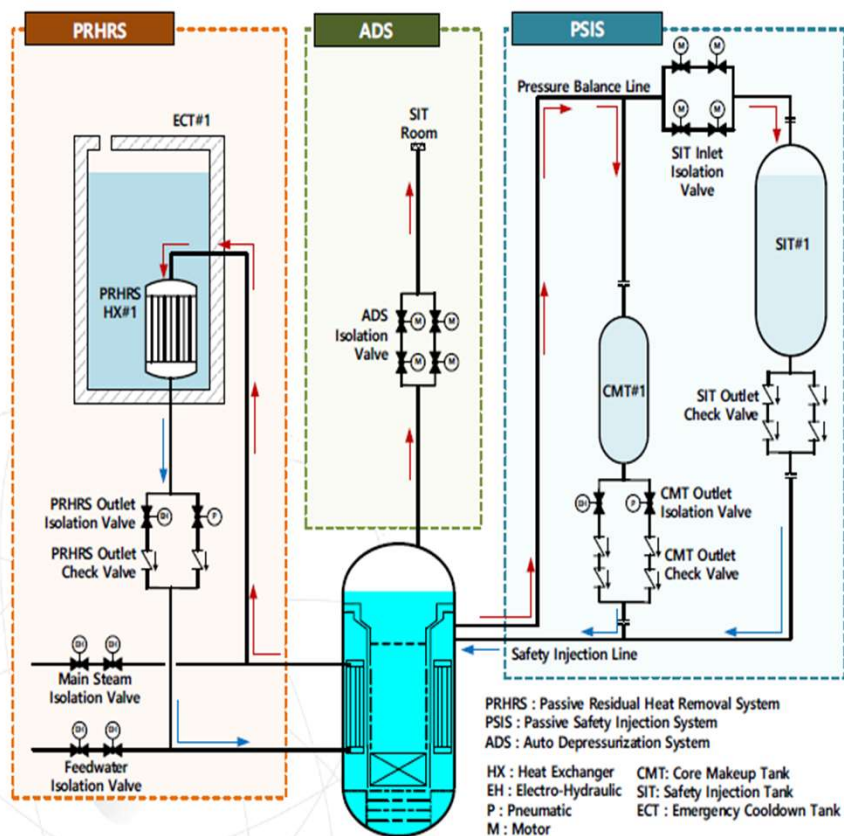
Safety System: Fully Passive

Coping Time: 72 hours

Safety-Class DC power

2. Lessons Learned from SMART100

◆ Key Regulatory Issue 1: Passive Safety Systems



Safety Injection System (SIS)

- : Relies on a gravity-driven ECCS
- Ensures decay heat removal capability under worst-case LOCA scenario

Residual Heat Removal System (RHRS)

- : Employs natural circulation loop
- Maintains the reactor in a stable Safe Shutdown State for at least 72 hours

Auto Depressurization System (ADS)

- : Safety-class system to enable SIS operation
- Ensure sufficiently rapid depressurization under conservative LOCA scenario

2. Lessons Learned from SMART100

◆ Key Regulatory Issue 2: Off-site Power System

- **Regulatory Requirement:** NSSC Notice requires two physically independent off-site power systems
- **Applicant Design:** Features two off-site power systems that are not physically independent

Key Design Feature of SMART100, intended for deployment in remote areas such as deserts where independent off-site power is unavailable

Licensing Outcome:

The applicant's evaluation of the Safety-grade DC power system's capability was accepted during the review; **however**, NSSC commissioners engaged in extensive discussion regarding the suitability of granting an exemption from a clear requirement.

** Note: NSSC Rules on Design Criteria allow exemptions or alternative applications based on the judgment of the NSSC*

2. Lessons Learned from SMART100

◆ Lessons learned from SMART100

First SDA for a fully passive system

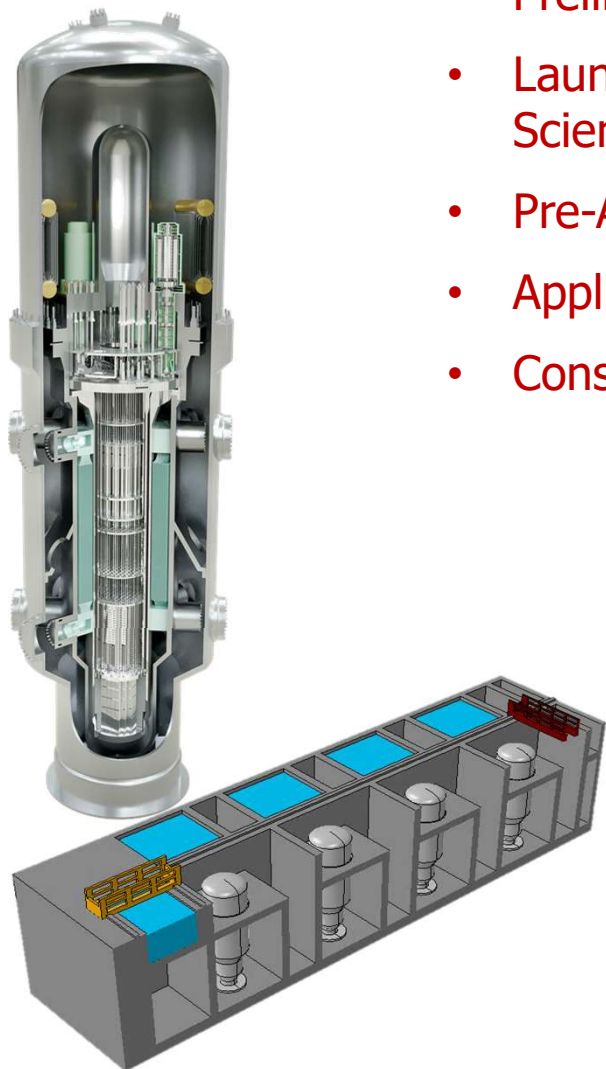
- ✓ **Limited experience and data** regarding the reliability of the passive features were major challenges. * Regulators need to enhance tailored **technical capacity** focusing on code credibility, various testing, and equipment verification results
- ✓ New designs require **extensive discussion** between the regulators and the developer.
 - * It is highly desirable to initiate these dialogues during **the early stages of design.**
- ✓ The existing LLWR-based framework is generally applicable to LWR SMRs, provided there are **modifications or flexible interpretations.**
- ✓ Under a prescriptive regulatory culture, granting **exemptions from prescribed criteria remains a challenging** decision.

3. Regulatory Readiness for i-SMR

3. Regulatory Readiness for i-SMR

< Key Facts of i-SMR >

- Preliminary Design led by KHNP (2020~2023)
- Launched as a National R&D Project supported by the Ministry of Science and the Ministry of Energy (2023~present)
- Pre-Application Design Review (2023~2025)
- Applied for Standard Design Approval (SDA) in Feb 2026
- Construction of FOAK unit incorporated into the national energy plan



Power: 170 Mwe (4 Module type: 680 Mwe)

Type: PWR / Integral+Steel Containment Vessel

Core Control: Boron-Free

Control Rod Drive Mechanism: In-vessel

Safety System: Fully Passive with AC/DC Non-Safety Class

Coping Time: 72 hours

Design Life: 80 years

3. Regulatory Readiness for i-SMR

◆ 1. Pre-licensing Review (Aug 2023~Dec 2025)

❖ The innovative safety design concept of iSMR pushes the existing regulatory frame further: the SMART100 approach (relying primarily on flexible interpretation) is no longer sufficient

- **(Establishment)** Lacking a statutory basis for pre-licensing reviews, a framework was established via an **Inter-agency MoU** and integrated into **National R&D project**.
- **(Operation)** Managed through two committees : **1) Safety issue review 2) Regulatory Research**
 - 1) The developer submitted **21 Technical Review Reports** (including gap analysis)
 - 2) Facilitated dialogues between the developer and researchers conducting iSMR-targeted R&D
- **(Scope)** Included preliminary and concept/basic design, construction, and security
- **(Outcome)** Achieved mutual understanding and identified regulatory gaps (9 major issues, 12 specific gap items)

3. Regulatory Readiness for i-SMR

❖ 2. Establish NSSC notice on Alternative Application of Technical Standards (Oct. 2025)

- ❖ Anticipating a significant number of requests for exemptions or alternative applications:
We need clear procedures and requirements for applying “alternatives” to mandated criteria

** Note: Current NSSC Rules on Design Criteria allows for exemptions or alternative applications based on the judgment of the NSSC*

❖ 3. Regulatory R&D addressing iSMR Safety Issue (2024~present)

- ❖ The iSMR's novel design and safety functions require substantial updates to regulatory capacity to **verify methodologies, models, and codes** used by the developer
 - Identify key topics thorough the pre-licensing design review
 - Plan R&D projects and select qualified researchers
 - Facilitate technical exchange and structured discussion between developer and researchers

3. Regulatory Readiness for i-SMR

❖ 4. Establishment of Dedicated SMR Regulatory Governance (2023~2025)

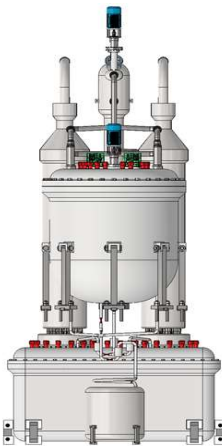
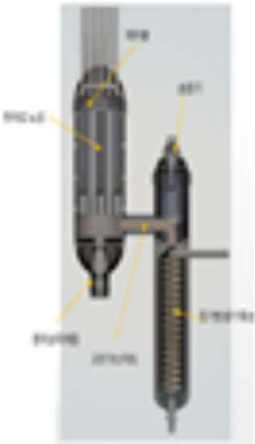
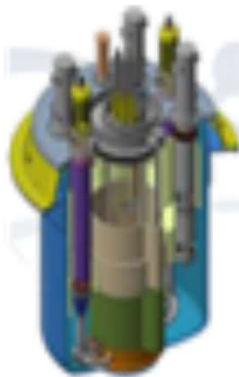
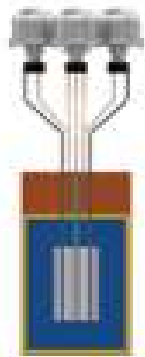
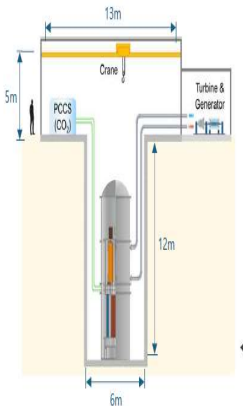
- ❖ Advanced Reactor Safety Division, NSSC (July 2023): Serves as the policy lead.
- ❖ SMR dedicated Review Team, KINS and KINAC (Jan~March 2025): Conduct the technical review.
- ❖ SMR R&D Program Management Office (March 2024): Manage technology development.

❖ 5. Revision of Specific Technical Standards (2025~present)

- ❖ To prepare for the iSMR review and future LWR-SMR designs:
Initiating amendments to NSSC Notices to incorporate state-of-the-art technology and international standards
- ✓ E.g.) Revision of accident source term regulation to reflect international methodologies (AST) and to allow MST (Feb 2026, revision completed)

4. Roadmap for Building the SMR Regulatory System

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Title	MARINA	HECTAR	H-SFR	Nuspace Power	BeSMART
Type	MSR	HTGR	SFR	HPR	HTGR
Purpose	Marine propulsion	Heat supply	Power generation	Power generation (Extreme environments)	Power generation
Design					

4. Roadmap for Building the SMR Regulatory System

◆ Challenges Ahead of Us

These **various purposes and designs** were **not** considered or incorporated into Korea's **Nuclear Safety Act framework** (from high-level legal procedures down to specific technical codes).

e.g: Current reactor categorization focuses on 1) Power Generation and 2) Research/Education with technical standards based on large-scale LWRs.

Nuclear safety and regulatory culture: The existing system has been developed around a pre-structured set of requirements with a heavily prescriptive style.

There is a limited statutory basis to reduce **regulatory uncertainties** or to engage formally with developers during early stages.

Korea's advanced nuclear technology and strong support of the government's (e.g. "SMR promotion special Act, Jan 2026) necessitate **regulatory readiness at an expedited speed.**

4. Roadmap for Building the SMR Regulatory System

'Roadmap for SMR Regulatory System'

To provide regulatory predictability to the developers and enable the regulator to secure the resources necessary to build an optimal infrastructure (Published in Feb 2026)

(Goal) By 2030, establish a regulatory framework covering diverse purposes and designs, shifting the safety validation paradigm toward performance-based approach.

(Strategy)

1. Apply **lessons learned and experience** from previous cases, such as SMART100 and iSMR
2. Ensure reliability through **alignment with international standards** and requirements
3. Enable **concurrent development** of safety standard through regulator-developer partnership

4. Roadmap for Building the SMR Regulatory System

(Task 1) Phased Establishment of SMR Regulatory Framework : Initiating amendment of NSA from 2028

- ✓ **Expanding the Regulatory Scope** to accommodate diverse reactor design and various application purposes.
- ✓ **Enhancing Legal Certainty and Regulatory Transparency** by codifying alternative application provisions (currently residing in NSSC notice)
- ✓ **Promulgating 'Technical Standard for SMRs'** as an alternative rule, allowing applicants to opt-in based on their technical features.

(Direction of the new standards) Preserving structural consistency while the requirement are focusing performances to allow design-specific safety criteria and integrating RIPB elements.

- ✓ **Establishing Infrastructure for Risk-Informed Performance Based Regulation** (e.g., regulatory technology, guides, review manuals, quality assurance systems).



4. Roadmap for Building the SMR Regulatory System

(Task 2) Effective and Efficient Safety Evaluation System

- ✓ **Codifying Pre-application Reviews** and finalizing operational framework for a full-scale launch in 2027 (3 developers expected to apply)
- ✓ **Enhancing the Effectiveness of the Topical Report System** to streamline licensing by expanding the scope to include all major technical topics (2027)
- ✓ **Launching Design-Specific Working Groups** involving all stakeholders to enhance technical competence and address anticipated regulatory issues

** Three groups (SFR, MSR, HTGR) will begin operations in 2026.*



4. Roadmap for Building the SMR Regulatory System

(Task 3) Strengthening Regulatory Infrastructure and Capability

- ✓ **Expending SMR Regulatory R&D** in alignment with the pace and scale of emerging licensing demands (Ongoing)
- ✓ **Stabilizing and enhancing SMR dedicated organizations** (Ongoing)
- ✓ **Operating dedicated training programs** for safety reviewers and inspectors, while supporting HR development through university partnership (Beginning 2027)
- ✓ **Continuing active participation** in IAEA and OECD/NEA initiatives and bilateral cooperation

* e.g., NHSI, SMR RF, and ATLAS

Thank you for your attention!

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