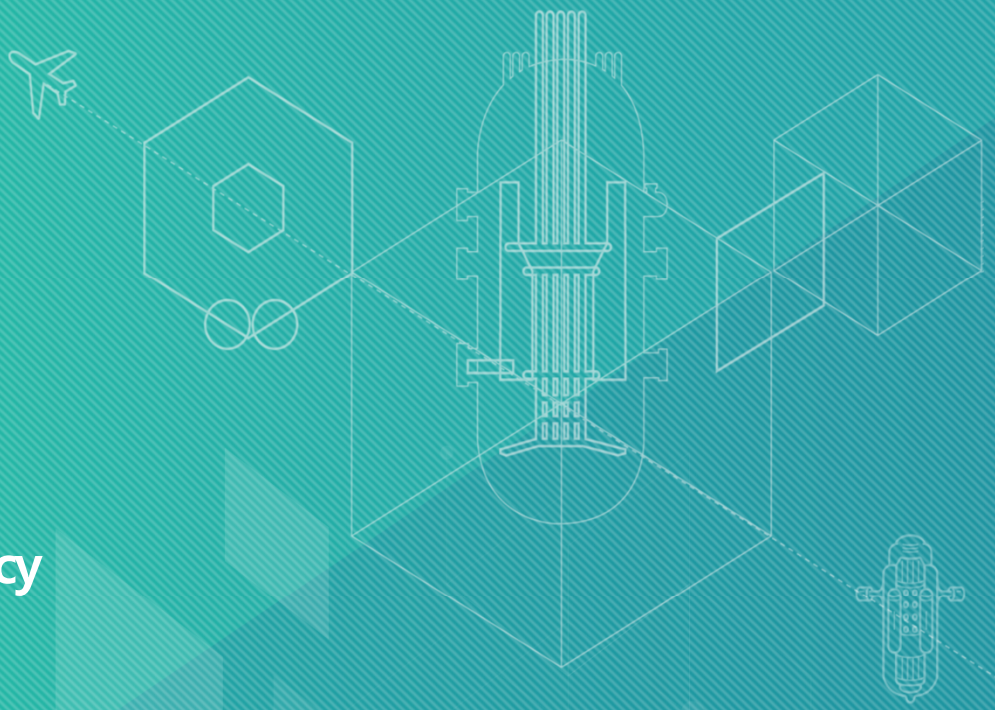
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Implementation Cases of i-SMR Design

: From Concept to Reality



2026. 10. 21.

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Yongse Kwon

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1. Introduction to i-SMR Development
2. Main Design Features
3. Implementation of Design Concept
4. Conclusion

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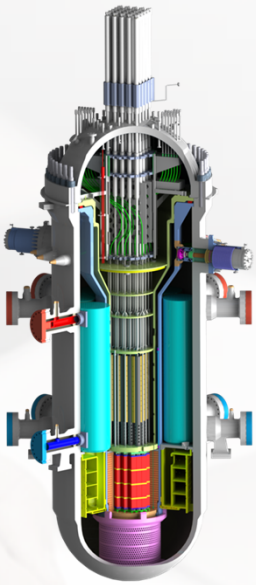
I

Introduction to i-SMR Development

1 Development Background

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SMART Standard Design (2012)



- World's 1st SMR issued SDA
- Proven PWR technology
- 100 MWe
- Hybrid Safety System (Active + Passive)

Innovative Concept

Soluble Boron Free Operation

In-Vessel CRDM

Steel Containment Vessel

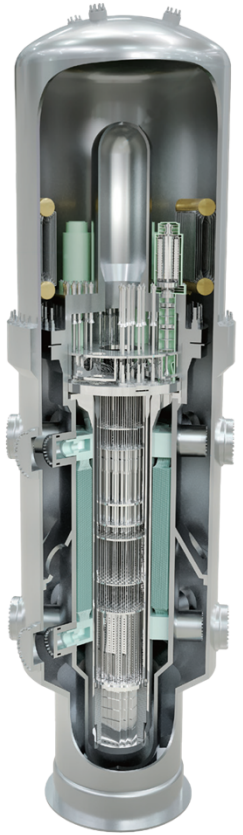
Full-Passive Safety Systems

Monoblock SG

Multi Reactor Module per Single Plant

Integrated Main Control Room

i-SMR Standard Design (2026)



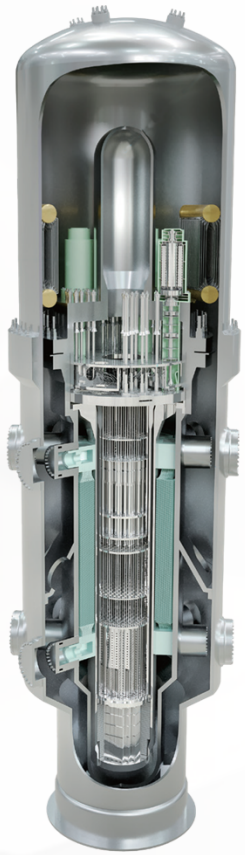
2 Design Objectives

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Top-tier Requirements of i-SMR

General

- Integrated PWR
- 170MWe / module
- 80 years design life



Safety

- CDF : 1.0×10^{-9} / Module·Year
- Fully Passive Safety System
- EPZ : Within site boundary

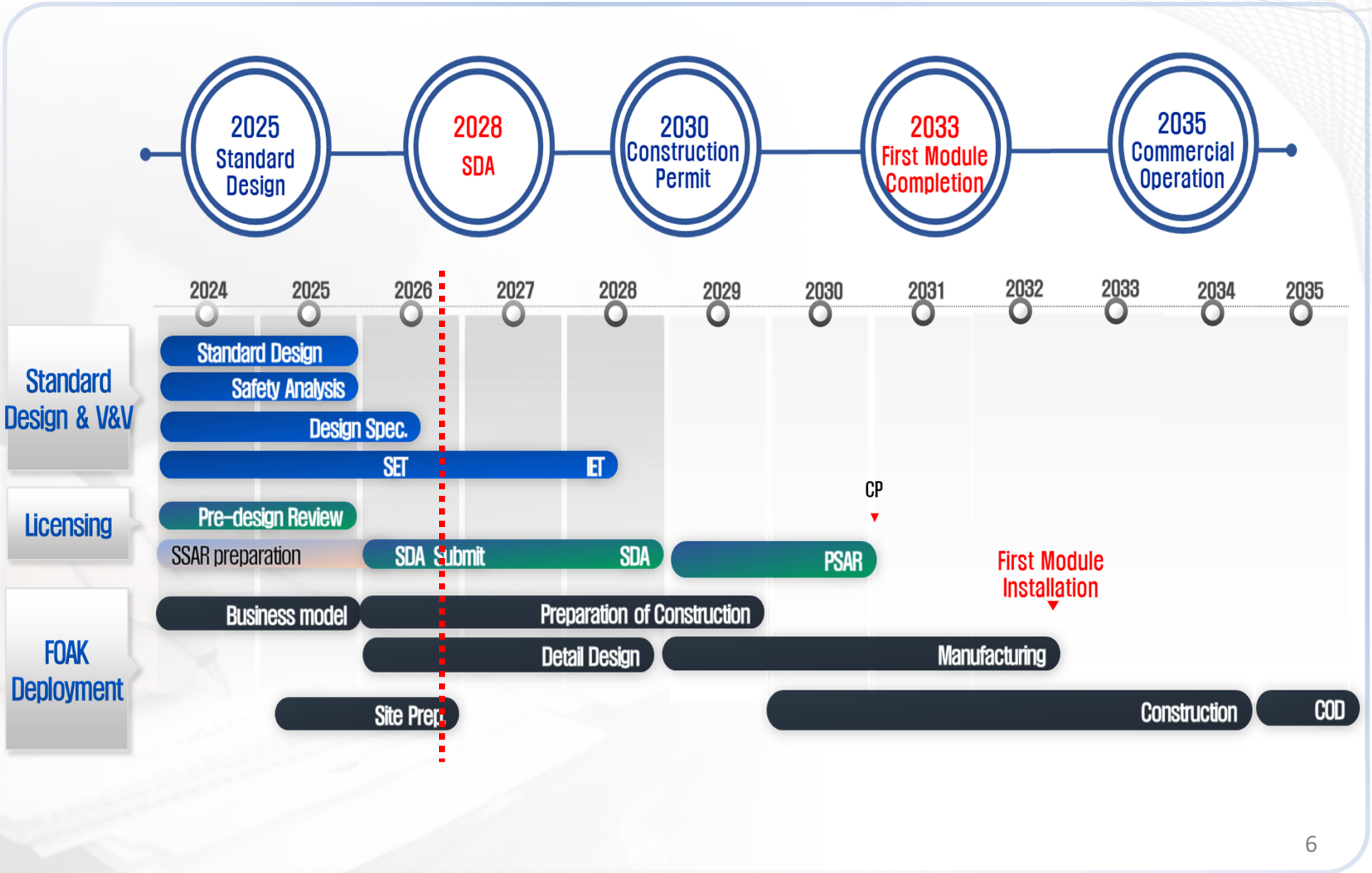
Economics

- Overnight cost : $3,500 /kWe
- LCOE : $65 /MWh
- Modular Design for Factory Manufacturing
- Construction time ≤ 42 month

Flexibility

- Boron Free Operation
- Multipurpose Utilization
- Load Following Operation

3 Project Milestone



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II

Main Design Features

1 Main Design Features

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Integral Reactor

- Elimination of LBLOCA
- Large water inventory and vertical flow
- Optimal for factory manufacture

Passive ESF

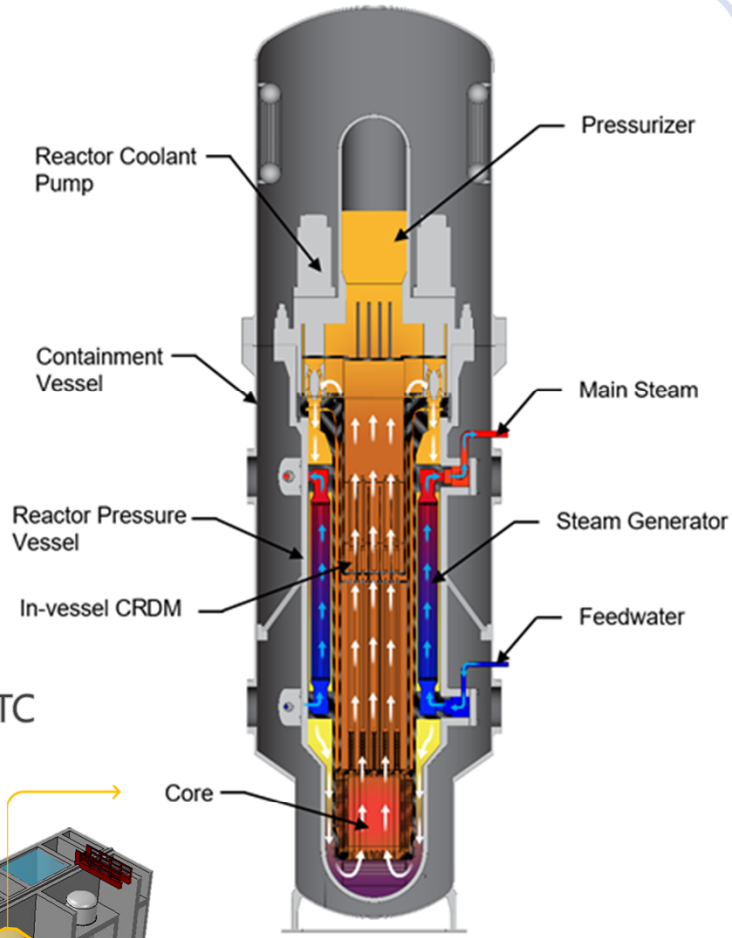
- No need of active power & operator action
- Reduced active components and maintenance
- Risk reduced under 1/100 of commercial plants

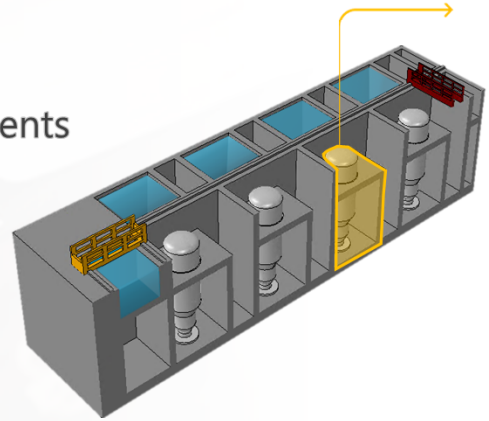
Boron Free

- Reduced liquid radioactive waste
- Minimized corrosion in PCS equipment
- Enhanced inherent safety via strongly negative MTC

Multi Module

- Integrated Main Control Room
- Sharing of non-safety components and systems
- Reduced operating personnel

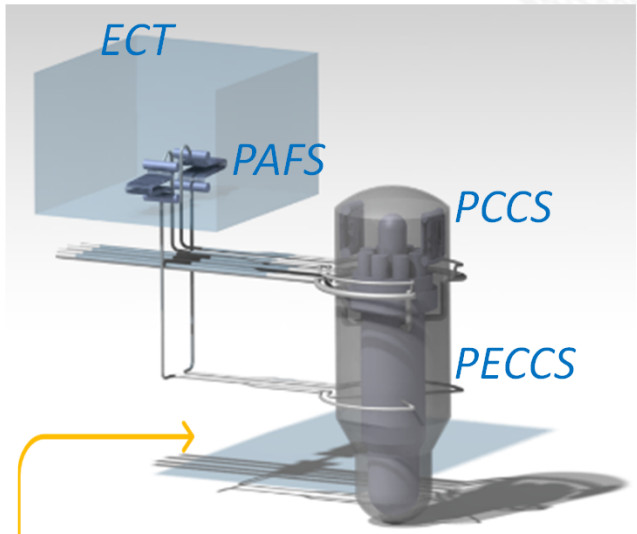




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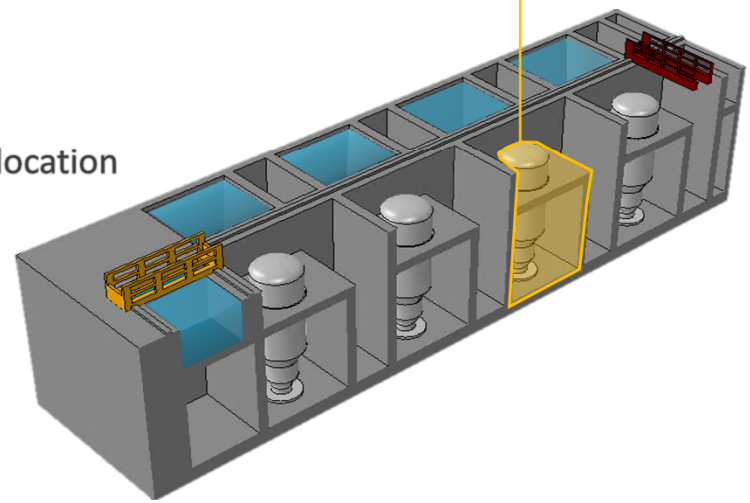
Full-Passive Safety Systems

- Passive Emergency Core Cooling System
- Passive Aux. Feedwater System
- Passive Containment Cooling System
- Isolation Valves mounted on Containment Vessel
- Fail-safe Design
- No AC/DC to operation



Reactor Protection Building

- Accommodating 4 reactor module
- Design against external hazard
- Underground reactor containment location
- Confinement Building



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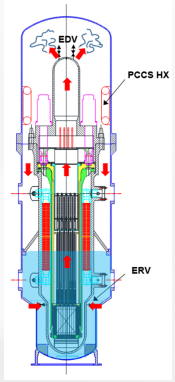
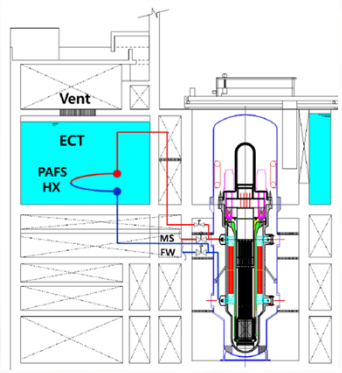
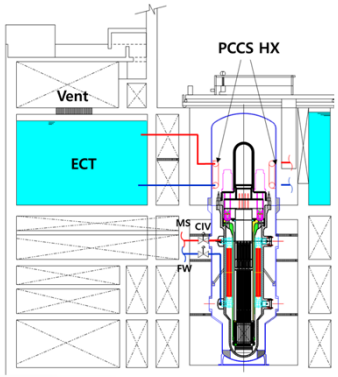
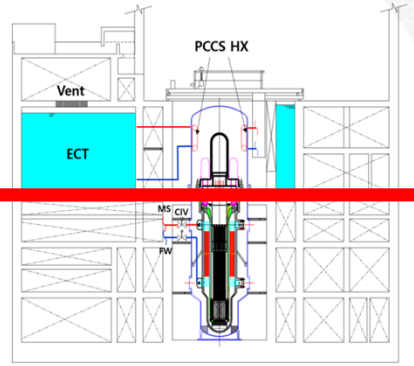
III

Implementation of Design Concept

1 Implementation of Design Concept

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Full-Passive Safety Systems

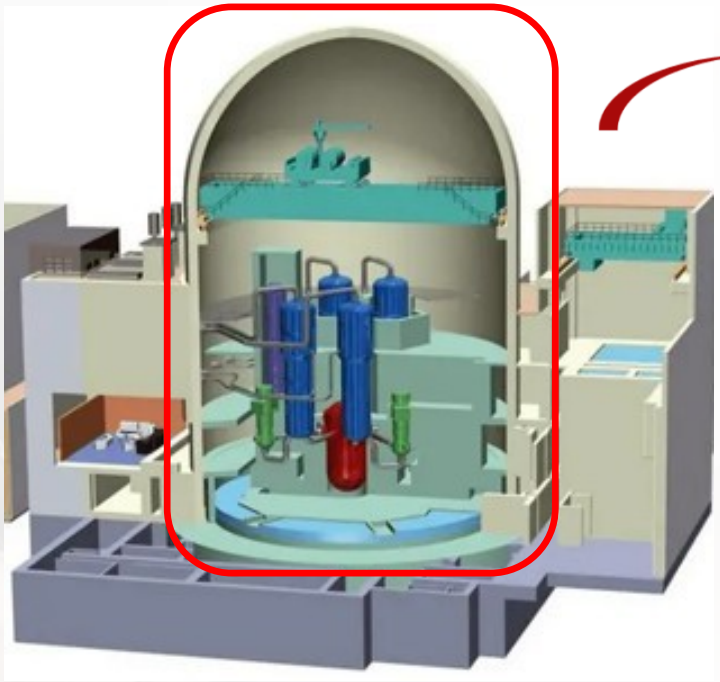
Passive Emergency Core Cooling System	Passive Auxiliary Feedwater System	Passive Containment Cooling System	Emergency Cooling Tank
			
• EDVs & ERVs, Fail-safe • Steam discharge (EDV) → Steam condensation (PCCS HX) → Water Recirculation into Rx (ERV)	• Steam bypass to ECT (Main steam / feedwater isolation) • Condensation by PAFS HX • Recirculation to SG	• Cool down inside CV w. PCCS HX • Pipe-connected w. ECT • Always on-duty to maintain CV temperature and pressure	• Ultimate Heat Sink • 1 ECT / Rx Module • Min. 72 hours cooling capability

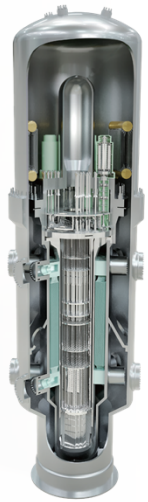
- No need of safety-class AC/DC & operator action
- SBO-proof due to full-passive systems
- Reduced active components and maintenance needs
- Risk reduced under 1/100 of commercial plants

Enhanced Safety & Maintainability
Reduced EPZ

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Integral Reactor w. Steel Containment Vessel





Containment Vessel

- Served as Containment Building
- Provide additional barrier
- Vacuum inside

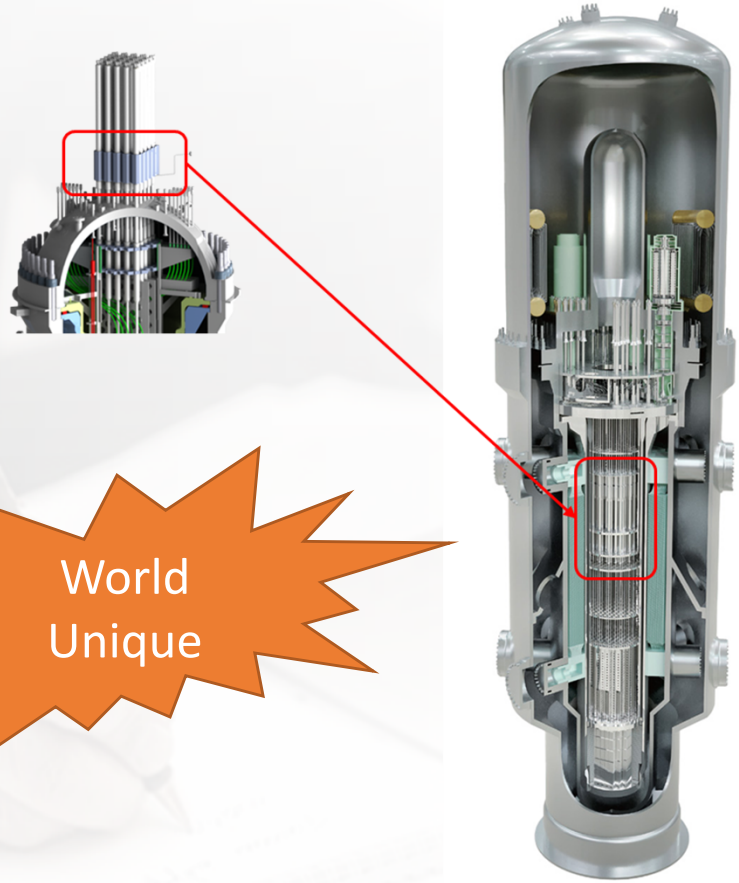
- Elimination of LBLOCA
- Additional physical barrier
- No hydrogen explosion due to vacuum inside

Enhanced Safety
Reduced EPZ

3 Implementation of Design Concept

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In-Vessel Control Rod Drive Mechanism



World Unique

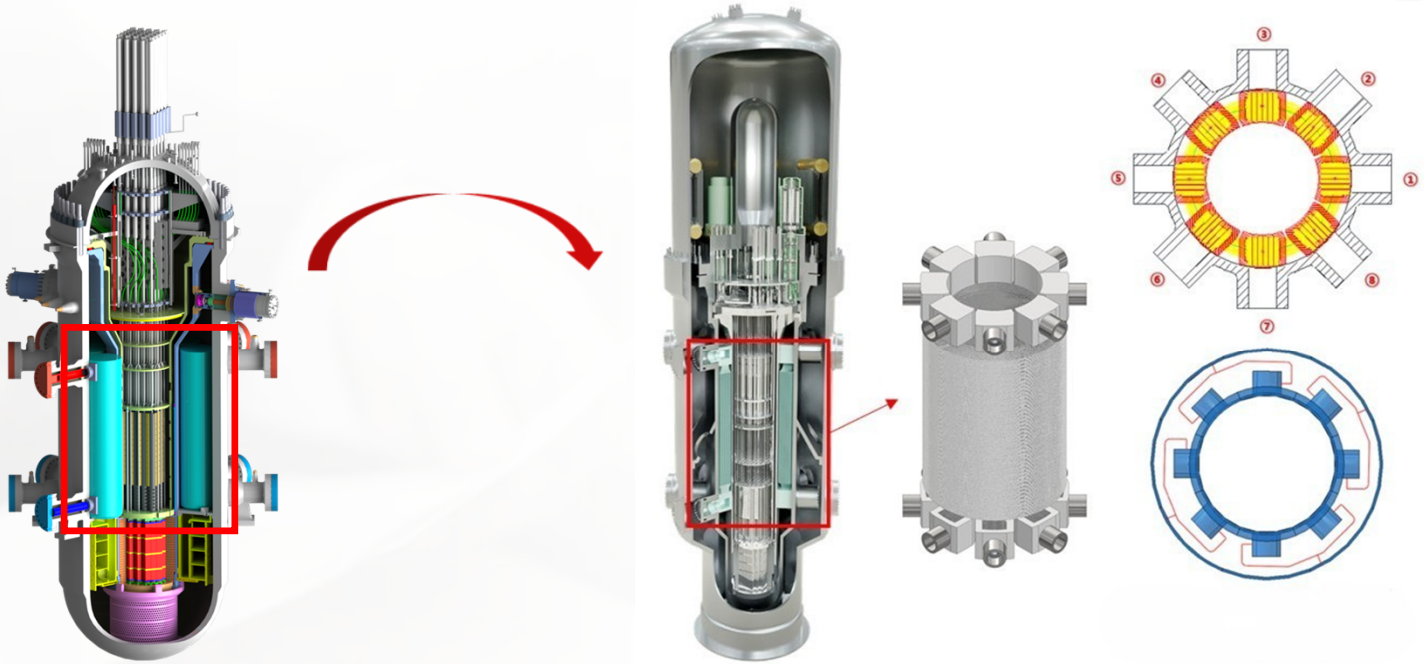
- Relatively Strong Control Rod Worth to compensate for Soluble Boron Free Operation
  → Rod Ejection Accident becomes a critical issue.
- Design to eliminate Rod Ejection Accident
- Preliminary Drop Test performed
- Equipment integrity under harsh environments is a key challenge

Enhanced Safety
Enable SBF Operation

4 Implementation of Design Concept

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Mono Block Helical Coiled Steam Generator



8 Cylindrical Cassette SG

Annular Monoblock SG

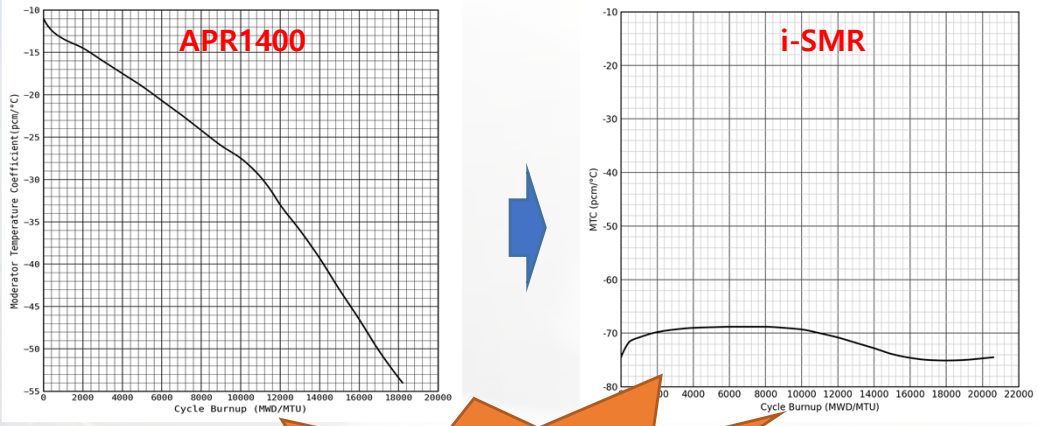
- Reactor Vessel Size Optimization
- No need of flow mixing before core inlet
- Enhanced tube inspectability
  (compared with SMART)

Improved Transportability
Simplified Reactor Internals
Enhanced Maintainability

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Soluble Boron Free Operation

- MTC with Burnup (APR1400 vs. i-SMR)



Strong
Negative MTC

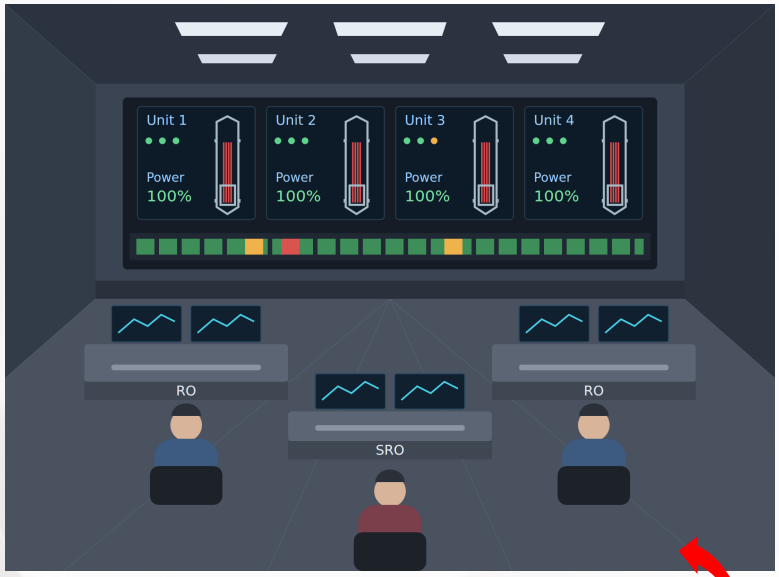
- Inherent Safety & no Boron Dilution Accident
- System Simplification
- Enhanced Equipment Integrity
- Lowered Personnel Exposure and Radwaste
- Make daily Load Follow Operation easier

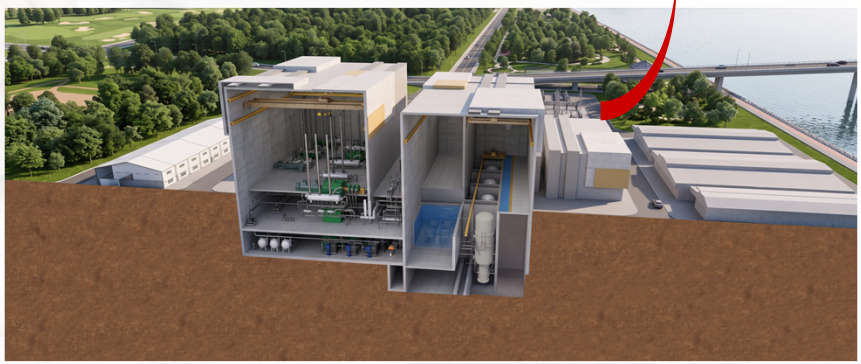
Enhanced Safety,
Economics & Flexibility

- Chemical & Volume Control System → Simplified to Makeup & Purification System
- Reduced radwaste, maintenance personnel exposure, RCS equipment corrosion
- High-density Gd Burnable Poison → Excess Reactivity Control at BOC
- Simple Direct Reactivity Control by Control Rods
- Combined Control of SG Output and Coolant Temperature → Secondary Reactivity Control (programmed)

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Multi Rx Module & Integrated MCR





- Control up to 4 reactors from a single MCR
- 3-operator staffing

Lower Maintenance Costs

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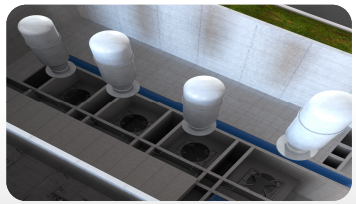
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IV

Conclusion

Conclusion

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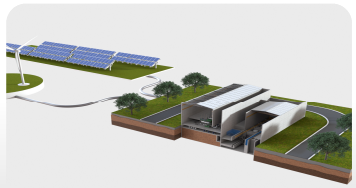
Safety (Inherent & Passive)

- Full-Passive Safety Systems
- Steel Containment Vessel
- In-Vessel Control Rod Drive Mechanism
- Strong Negative MTC due to Boron Free Operation
- Underground Reactor Installation



Economics (Modularization & Simplification)

- No Safety Class Active Pump & Boron Control Equipment
- Lower Maintenance Costs
- Integrated Main Control Room
- Modularization & Standardization for Factory Manufacture



Flexibility

- Load Follow Operation
- Compatibility with Renewable Energy Source
- Steam Utilization (Process Heat, District Heating, Hydrogen Production etc.)



Ready for Deployment

- Under Regulatory Audit (~ 2028) and Site Decision for FOAK (2025, near Busan)
- Robust Nuclear Industry Infrastructure of South Korea including KHNP, Doosan Enerbility
- Strong Governmental Drive & Support (11th National Electricity Plan, ~2035 FOAK)

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Thank You.

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