혁신 SMR과 규제 요건 개발 방향

- Focused on LWR-based SMR Licensing -

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경수로형 SMR 기술 개발 (부제: Green Energy를 위한 원자력의 역할)

2021 KNS Workshop

주제 : 혁신 SMR과 규제 요건 개발 방향

1. **안전기준이 강화되고 있다.**
2. **상용화를 목표로 하는 혁신 SMRs**
3. **혁신 SMRs, 규제 방향이 바뀌고 있다.**
4. **도전과 과제, 규제 현안들**
5. **결언, Change is Chance.**

설 광 원
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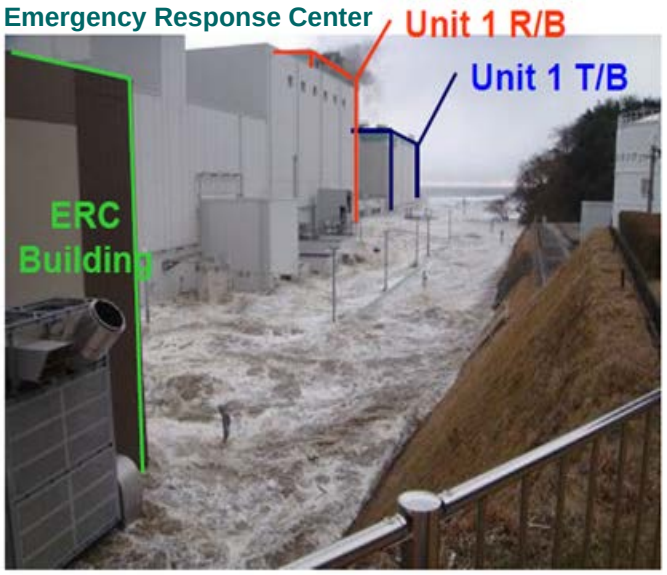
I. 안전기준이 강화되고 있다.



■ Post-Fukushima Safety Enhancements

✓ Mitigation of Beyond Design Basis Events (MBDBE) such as aircraft impact, large-scale external hazards, natural disasters, …
✓ Enhanced DID (Plant Capability DiD + Programmatic DiD)
✓ Accident Analysis + Risk Analysis

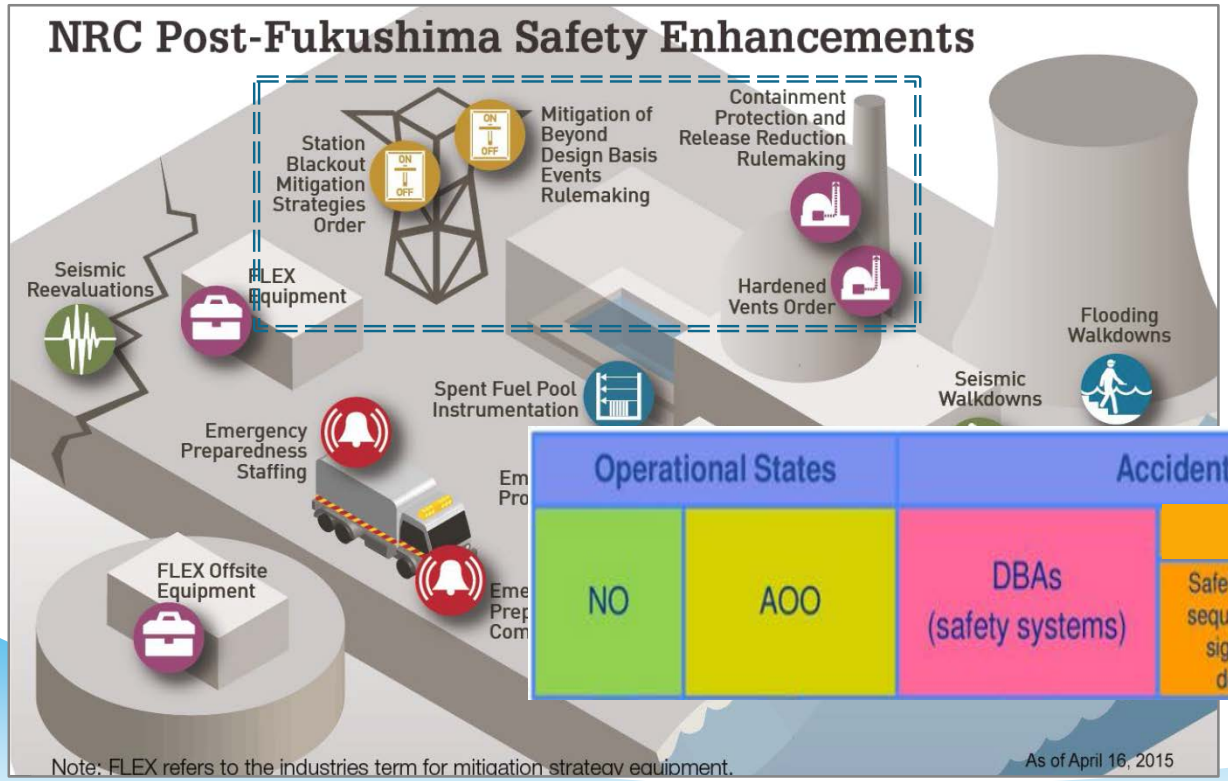
가동 및 신규 원전의 안전성 강화

■ Post-Fukushima (CMA and LER) Safety Enhancements

✓ **가동원전 : 리스크 저감** (Risk Reduction), Hazard Analysis, Risk Assessment, Emergency Rresponse …

✓ **신규원전 : 설계 강화** (Design Extension Conditions), Eliminate Large and Early Radioactive Release (LER) Events

- Prevent the CDF and LERF : Simplified, Passive, Inherent, Modularity (small size and inventory), …
- Mitigate the LER events through the enhanced DID strategy



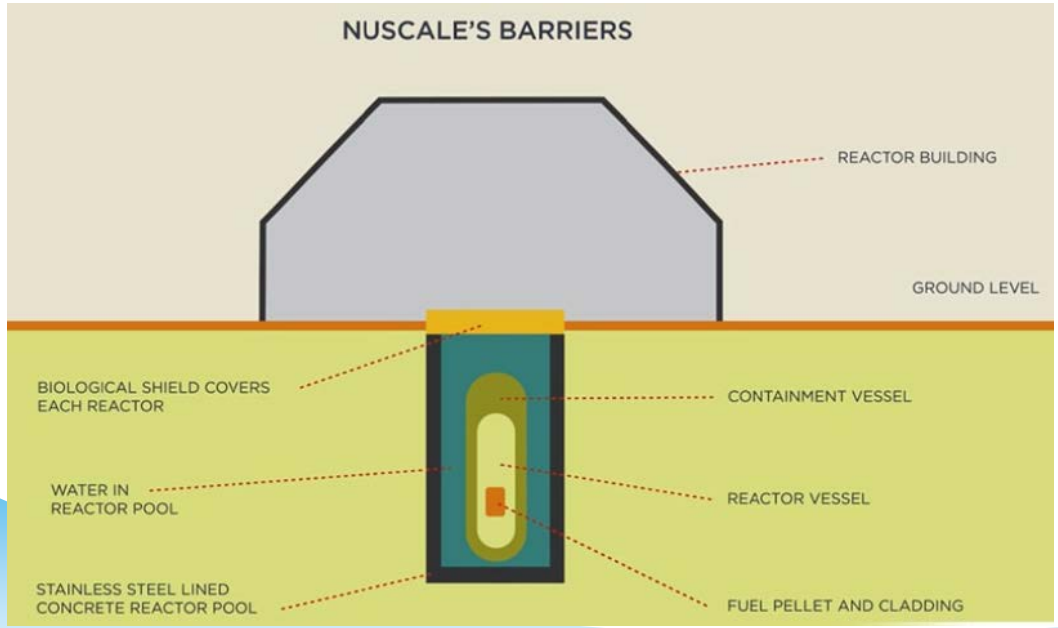
■ IAEA Safety Series

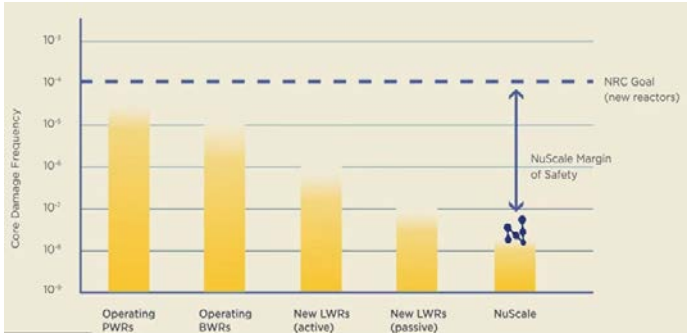
✓ Enhanced DID : Beyond DBAs (DECs), LER events

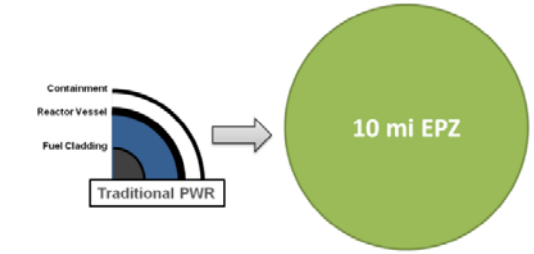
DiD Strategy, Seven Barriers of NuScale Power Module™

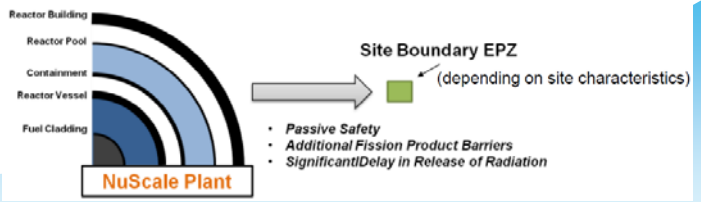
- NPM 7 Barriers with Reactor Pool : Fuel Pellet-**Cladding**→ **RPV**→ **CNV**→ **Reactor Water Pool**→ Stainless Steel lined-**Concrete Wall**→ **Shield Covers**→ **Reactor Building**
  - ✓ CDF significantly reduced up to 10^{-8} /my for extremely unlikely events
  - ✓ LERF during LBEs significantly reduced, so EPZ reduced to site boundary

- Design Safety : All CMA Sequences leading to Large and Early Radioactive Releases must be practically eliminated









미국 신형원자로 개발 및 인허가 현황 : LWR Designs

- TMI-2/Chernobyl/Fukushima **사고 이후 더 안전한 신형원자로 개발, 운영** (Gen III+, SMR)

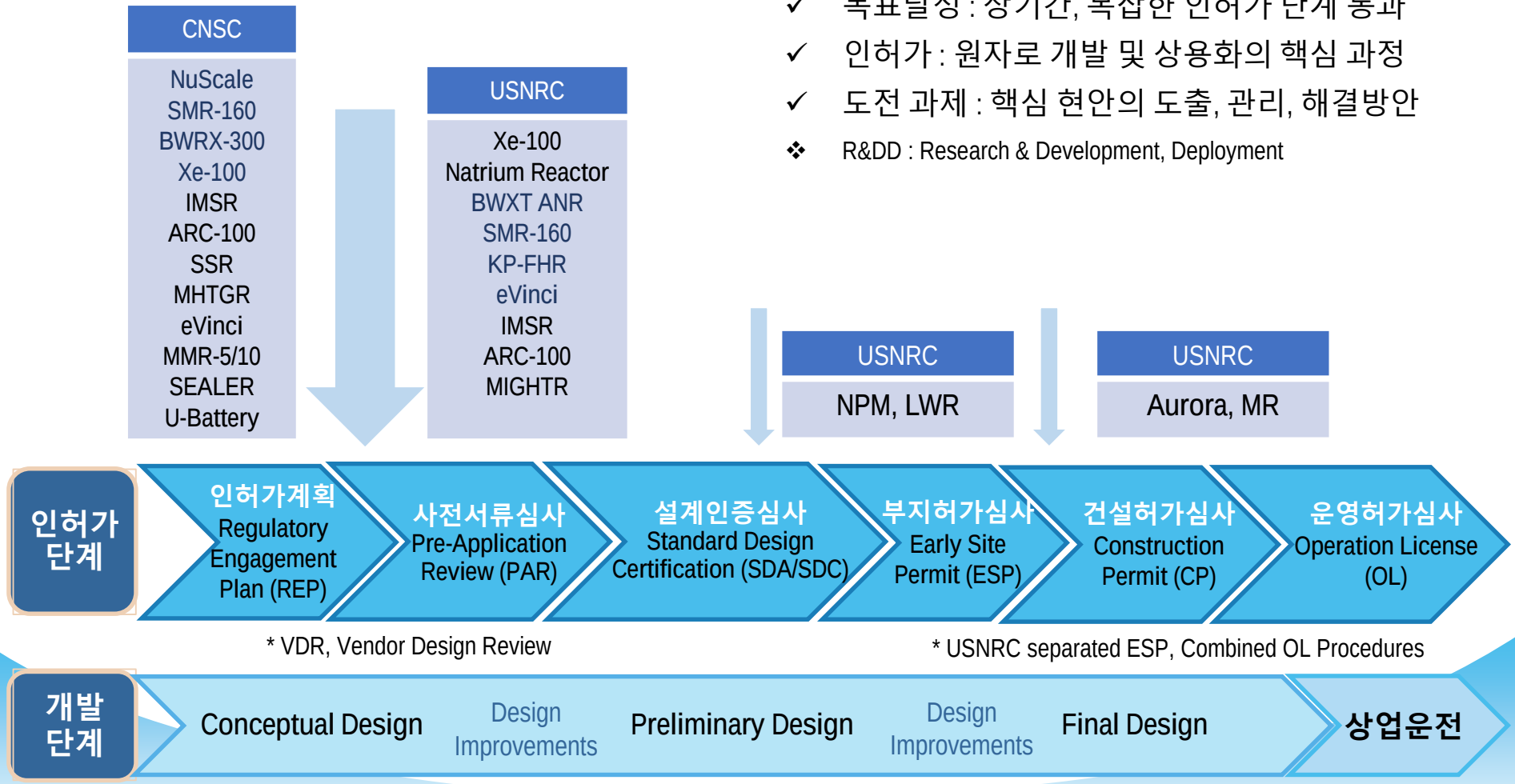
Designs	Application Types	Applicants
Advanced BWR	DC Issued, May 12, 1997 (App. A, amended)	General Electric (GE) Nuclear Energy
System 80+	DC Issued, May 1997 (App. B)	Westinghouse Electric Co.(ABB-CE)
Advanced Passive 600 (AP 600)	DC Issued, Dec. 1999 (App. C)	Westinghouse Electric Co.
Advanced Passive 1000 (AP 1000)	DC Issued, Jan. 27, 2006 (App. D, amended)	WHE, Sanmen1/2, Haiyang1/2, Vogtle3/4, …
Economic Simplified BWR (1520)	DC Issued, Oct. 15, 2014 (App. E)	GE-Hitachi(GEH) Nuclear Energy
APR 1400	DC Issued, Aug. 26, 2019 (App. F, 10 CFR Part 52)	KEPCo, and KHNP Co. Shingori3/4, ShinUljin1/2, Barakah1/4
US APWR 1700	DC, Under Review	Mitsubishi Heavy Industries
US EPR 1600	DC, Suspended	AREVA,Taishan1/2, Olkiluto 3, Flamanville 3
NuScale (60)	DC Issued, 2020 (App. x), no site-specific	NuScale Power, LLC
NuScale 720	SDA, pre-application, submittal in 4Q 2021	NuScale Power, LLC
mPower™(iPWR), 180	Pre-Application, (suspended in 2014)	BWXT mPower, Inc.
SMR-160	Pre-Application, under review	SMR, LLC. Holtec International
BWRX-300 (ESBWR)	Pre-Application, under review of LTRs	GE-Hitachi(GEH) Nuclear Energy

II. 상용화를 목표로 하는 혁신 SMRs

❖ **상용화를 목표 (R&DD)로 하는 SMRs**

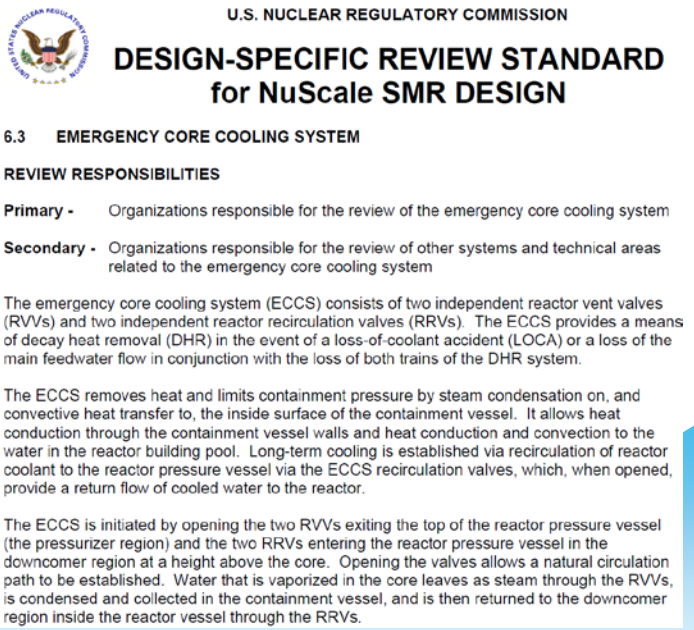
- ✓ 목표달성 : 장기간, 복잡한 인허가 단계 통과
- ✓ 인허가 : 원자로 개발 및 상용화의 핵심 과정
- ✓ 도전 과제 : 핵심 현안의 도출, 관리, 해결방안

❖ R&DD : Research & Development, Deployment



NPM 인허가 심사 현황 : Applications and Review Standard

- NPM Pre-Application Review : (2008~2016)
  - ✓ NRC developed the NuScale Design-Specific Review Standard (DSRS), based on the SRP (NUREG-0800)
- NPM Submittals for DC Application, completed in 2020
  - ① General and Financial Information
  - ② Final Safety Analysis Report (FSAR) ; including Topical and Technical Reports
    - Tier 1 Certified Design Descriptions (CDD) and Inspections, Tests, Analyses, & Acceptance Criteria (ITAAC)
    - Tier 2 FSAR Chapter 1~21, Rev. 5
  - ③ Applicants Environmental Report - Standard Design Certification
  - ④ Generic Technical Specifications, Emergency Plans and Security Plans
  - ⑤ Exemptions and License Conditions
  - ⑥ Withheld Information and Quality Assurance Program Description
- US NRC Review : NuScale DSRS, Aug. 2016
  - ① FSAR and 14 Topical Reports, referencing 33 Technical Reports
  - ② about 2,000 DCA RAIs and about 400 TR RAIs, during 41 months
  - ③ Final Safety Evaluation Report (FSER) and DC Rulemaking
- NPM 720 (12 modules) and 250 MWt (77MWe) SDA Applications
  - ✓ Power up of NPM DC Design, reflecting on the lessons learned



U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD for NuScale SMR DESIGN

6.3 EMERGENCY CORE COOLING SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organizations responsible for the review of the emergency core cooling system

Secondary - Organizations responsible for the review of other systems and technical areas related to the emergency core cooling system

The emergency core cooling system (ECCS) consists of two independent reactor vent valves (RVVs) and two independent reactor recirculation valves (RRVs). The ECCS provides a means of decay heat removal (DHR) in the event of a loss-of-coolant accident (LOCA) or a loss of the main feedwater flow in conjunction with the loss of both trains of the DHR system.

The ECCS removes heat and limits containment pressure by steam condensation on, and convective heat transfer to, the inside surface of the containment vessel. It allows heat conduction through the containment vessel walls and heat conduction and convection to the water in the reactor building pool. Long-term cooling is established via recirculation of reactor coolant to the reactor pressure vessel via the ECCS recirculation valves, which, when opened, provide a return flow of cooled water to the reactor.

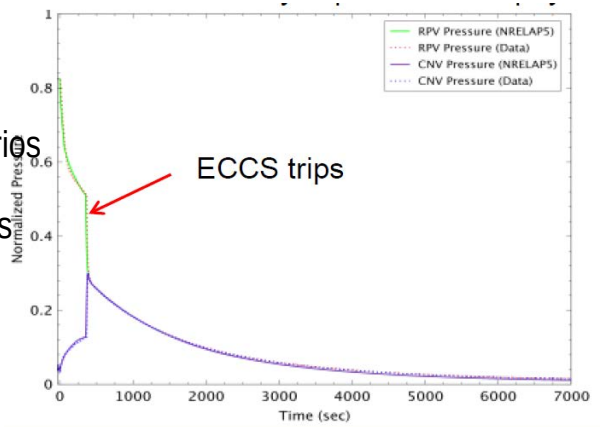
The ECCS is initiated by opening the two RVVs exiting the top of the reactor pressure vessel (the pressurizer region) and the two RRVs entering the reactor pressure vessel in the downcomer region at a height above the core. Opening the valves allows a natural circulation path to be established. Water that is vaporized in the core leaves as steam through the RVVs, is condensed and collected in the containment vessel, and is then returned to the downcomer region inside the reactor vessel through the RRVs.

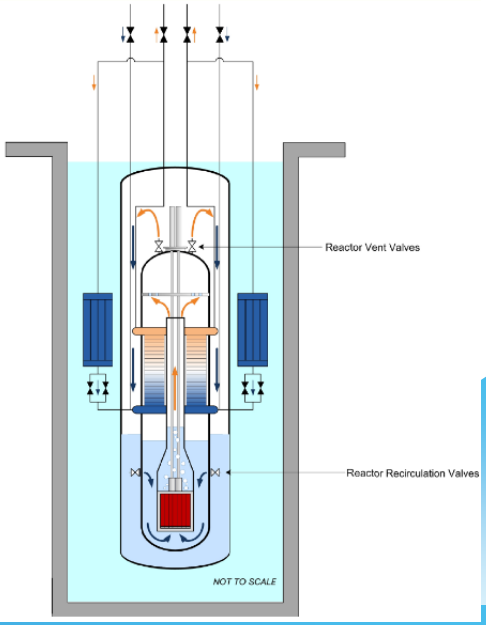
Key Technologies of NPM, 14 Topical Reports

	Topical Report Number	Topical Report Title	Submittal Date	FSAR Chapter
1	TR-0116-20825-NP-A, Rev.1	Applicability of AREVA Fuel Methodology for the NuScale Design	Feb. 2018	4
2	TR-0716-50351-NP-A, Rev.1	Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces	May 2020	4
3	TR-0616-48793-NP-A, Rev.1	Nuclear Analysis Codes and Methods Qualification	Dec. 2018	4
4	TR-0915-17564-NP-A, Rev.2	Subchannel Analysis Methodology	Mar. 2019	4
5	TR-0516-49417-NP-A, Rev.1	Evaluation Methodology for Stability Analysis of the NPM	Mar. 2020	4
6	TR-0116-21012-NP-A, Rev.1	NuScale Power Critical Heat Flux Correlations	Dec. 2018	4
7	TR-1015-18653-NP-A, Rev.2	Design of the Highly Integrated Protection System Platform	Sep. 2017	7, 15
8	TR-0815-16497-NP-A, Rev.1	Safety Classification of Passive NPP Electrical Systems	Feb. 2018	8, 15
9	TR-0516-49422-NP-A, Rev.2	Loss-of-Coolant Accident Evaluation Model	Jul. 2020	15
10	TR-0516-49416-NP-A, Rev.3	Non-Loss-of-Coolant Accident Analysis Methodology	Jul. 2020	15
11	TR-0716-50350-NP-A, Rev.1	Rod Ejection Accident Methodology	Jun. 2020	15
12	TR-0915-17565-NP-A, Rev.4	Accident Source Term Methodology	Feb. 2020	3. 12, 15
13	TR-0515-13952-NP-A, Rev.0	Risk Significance Determination	Oct. 2016	17, 19
14	TR-1010-859-NP-A, Rev.5	Quality Assurance Program Description for the NuScale NPP	Jun. 2020	17
	TR-0920-71621-NP, Rev.0	Building Design and Analysis Methodology for Safety-Related Structures	Dec. 2020	
	TR-0118-58005-NP-A, Rev.2	Improvements in Frequency Domain Soil-Structure-Fluid Interaction Analysis	Dec. 2020	
		… (developing)		

NPM, Accident Analysis Methodology

- Additional Design Basis Events (DBEs)
  - ✓ Loss of containment vacuum, Inadvertent operation of the DHRS and an ECCS valve, …
- Transient and Accident Analysis Codes
  - ① PIM : to demonstrate system stability at steady-state operation and AOOs
  - ② NRELAP5 : modification of INL RELAP5-3D, for LOCA, non-LOCA, LTC scenarios
  - ③ CASMO5/SIMULATE5 : reactor core physics during rod ejection accident
  - ④ VIPRE-01 : with the NuScale-specific CHF correlations, for subchannel analyses
  - ⑤ RADTRAD : for DBA radiological consequence analyses
- Testing Programs for V&V of unique design features
  - ① Critical Heat Flux Testing - Preliminary Fuel Design, NuFuel HTP2™ Fuel Design
  - ② SIET TF1~2, Helical SG Thermal-Hydraulic Performance Testing
  - ③ NuScale Integral System Test Program (NIST)
  - ④ Other Separate Effect Tests (KAIST high-pressure condensation tests, …)





- LOCA EM (conservative), NRELAP5 v1.4, modeling the Helical coil SGs, CNV, …
  - Critical heat flux is not exceeded, Collapsed liquid level remains above the top of core
  - Containment peak temp. and pressure remain below the design limits (in case of inadvertent opening of an ECCS valve), …
- NRC Independent Confirmatory Analysis, using TRACE code

III. 혁신 SMRs, 규제 철학이 바뀌고 있다.

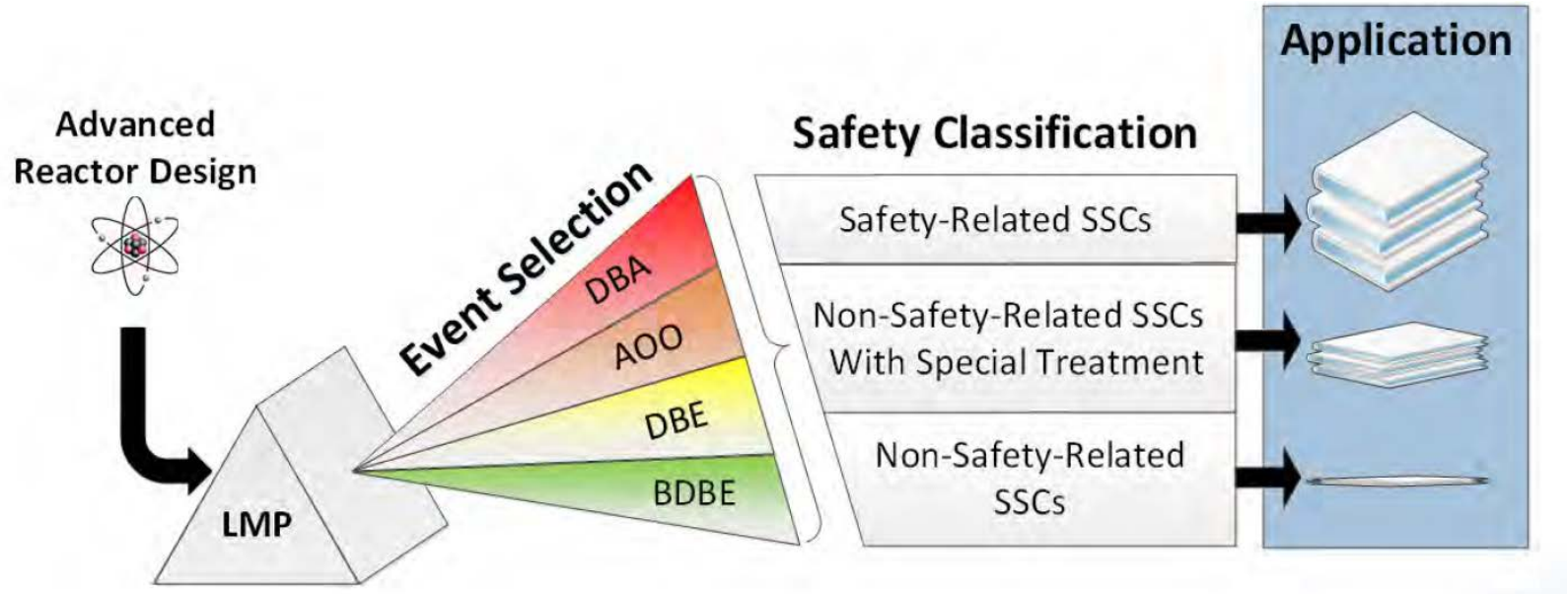
- (**개발**) Private Sector-led **혁신 원자로 개발**, Public Sector **법적 지원** : National Programs
  - ✓ DOE, **연구혁신법**, **원자력에너지 혁신역량법** (NEICA, RIA, ...)
  - ✓ NRC, **원자력에너지 혁신 및 현대화법** (NEIMA)

- (**규제 체제**) **인허가 체제의 현대화** : Licensing Modernization for Advanced Reactors
  - ✓ LWR-based SMRs **규제 체제** : Case-by-Case Licensing
  - ✓ Non-LWR-based ARs **규제 체제** : New Licensing Framework, 10 CFR Part 53

- (**규제 기준 및 방법론**) **체계적인 안전 기준** (F-C Target) **및 규제 방법론** (TI-RIPB)
  - ✓ **새로운 안전기준 및 설계기준** : F-C Target for Acceptable Risk
  - ✓ **새로운 규제 및 설계 방법론** : Technology-inclusive, RIPB methodology

❖ TI-RIPB regulation : Technology-Inclusive Risk-informed, Performance-based Regulatory Framework
❖ F-C Target : Frequency-Consequence target for AR Design and Licensing Review
❖ RG 1.233, Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based (TI-RIPB) Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-LWRs," June 9, 2020

TI-RIPB Regulation (from USNRC Documents)

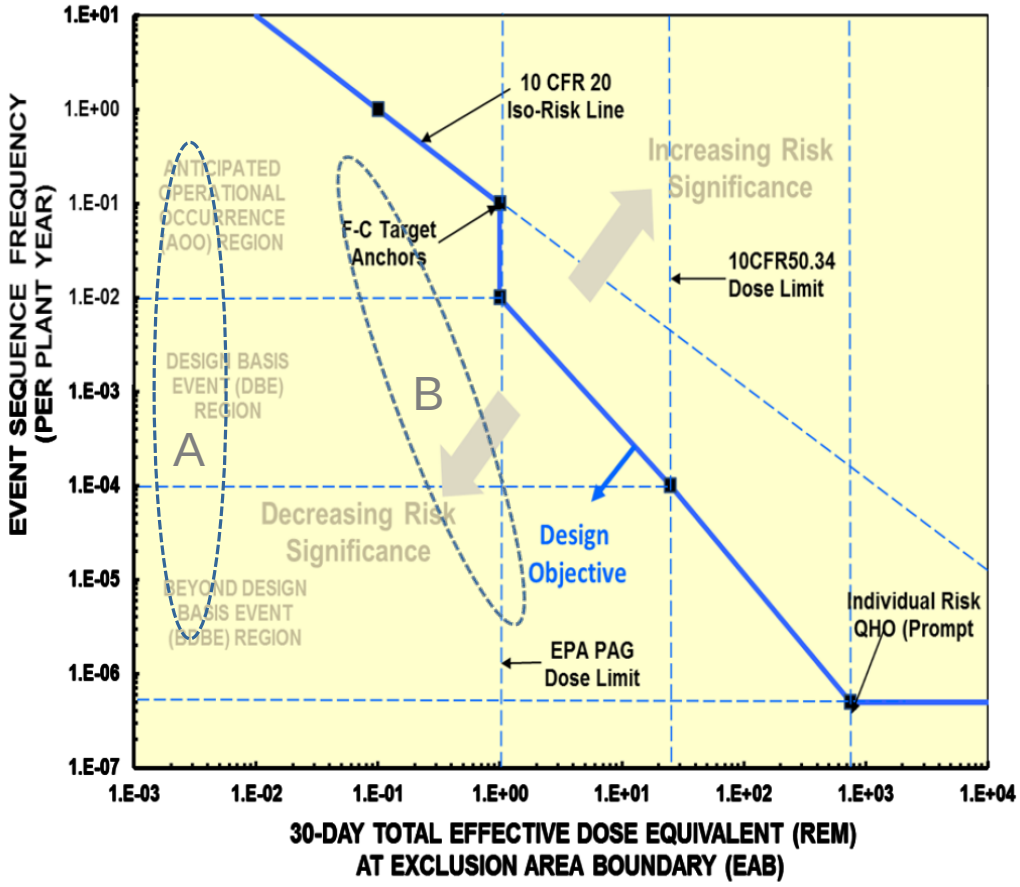


- TI-RIPB : Technology-Inclusive, Risk-Informed, and Performance-Based Methodology
  (Design Safety Case) (F-C Target) (ER, EP EPZ size determination)
- LMP : Licensing Modernization Project to evaluate the RG 1.233 Applicability to AR designs

- NRC, RG 1.233, Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based (TI-RIPB) Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-LWRs," June 9, 2020, (DG-1353, May, 2019)
- Southern Company, "Modernization of Technical Requirements for Licensing of Advanced Non-LWRs : Westinghouse eVinci™ Micro-Reactor LMP Demonstration", Aug. 2019, ……

Frequency-Consequence Target (from USNRC Documents)

- F-C Target (Design Objective), based on TI-RIPB Approach to prevent and mitigate the LBEs
  (NEI 18-04, Rev.1, 2019, DG-1353, May 2019, RG 1.233, June 2020)



- ✓ AOOs: frequency > 10^{-2} /plant-year
- ✓ DBEs: 10^{-2} /y > f > 10^{-4} /y
- ✓ Beyond DBEs: 10^{-4} /y > f > 5×10^{-7} /y
- ✓ No Cliff edge effects: < 5×10^{-7} /y
- ✓ QHO < 0.1% of societal risk ≈ equivalent CDF of 5×10^{-7} /y

- ✓ Annual exposure limit (10CFR20) < 0.1rem
- ✓ EPA PAG dose limit < 1rem for AOOs
- ✓ EAB dose limit < 25rem for DBEs (CFR50.34)
- ✓ IRQHO < 750rem for BDBEs

❖ Frequency-Dose Evaluation line :

❖ Environmental Protection Agency (EPA) Protective Action Guide (PAG), Exclusion Area Boundary (EAB), Individual Risk Quantitative Health Objective (IRQHO, AR safety goal)

미국, 신형원자로 규제 요건 개발 프로그램 (from USNRC Documents)

- Regulatory Activities on Implementation Action Plan (IAP) of USNRC Vision and Strategy

	Titles of Implementation Action Plan (IAP)	Statu
IAP 1	Proposed 10 CFR Part 53 Rulemaking	Processing
IAP 2	Industry-led Licensing Modernization Project (LMP)	Almost Comp
IAP 3	Selection and Evaluation of Licensing Basis Events (LBEs)	Completed
IAP 4	Safety Classification and Performance Criteria of SSCs	Completed
IAP 5	RIPB Evaluation of DiD Adequacy	Completed ?
IAP 6	AR General Design Criteria (GDC) and PDC	Developed
IAP 7	TICAP and ARCAP Development	Completed ?
IAP 8	Computer Codes and Review Tool Development	Plan and De
IAP 9	Industrial Codes and Standards (NRC Regulatory Forum)	Developing
IAP 10	Probabilistic Risk Asessment (PRA) Approach	Deve
IAP 11	Advanced Manufacturing Technology (AMP) Application Guide	Deve
IAP 12	Fuel Qualification Guideline (HALEU, TRISO, ...)	Deve
IAP 13	Generic Environmental Impact (GEI) Statement for ARs	Deve
IAP 14	Policy, Licensing, and Key Technical Issue Resolutions	Proce
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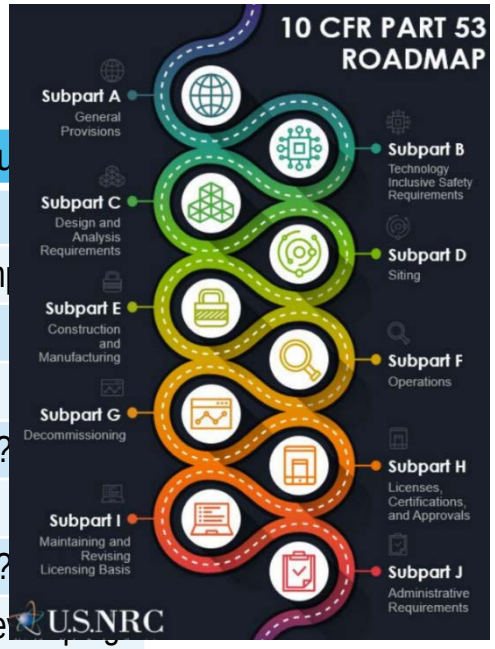
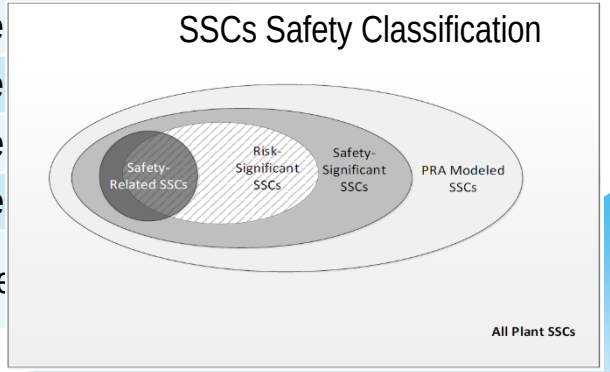




Ⅳ. 도전과 과제, 규제 현안들

■ AR 개발자가 개발 과정에서 하는 질문들?

- ✓ 개발 설계의 원형로 (Prototype Reactor) 건설이 필요한가?
- ✓ AR을 오지/극지 마을, 산업단지 근처에 설치, 운영할 수 있나?
- ✓ 소형모듈원전의 환경평가서류를 간소화할 수 없나?
- ✓ AR의 비상계획구역 (EPZ)을 줄일 수 없나?
- ✓ 현재 대형 원전의 격납건물 (Containment Building)이 꼭 필요한가?
- ✓ 신 설계로 현재 규제기준을 적용할 수 없다면 어떻게 하나?
- ✓ 개발 원자로의 인허가기준사고 (DBE)는 어떻게 선정하나?
- ✓ Beyond DBA SSC의 안전등급분류는 어떻게 하나?
- ✓ 심층방어 (DID) 전략을 어떻게 평가하나?
- ✓ 소형 AR의 운전원을 줄일 수 없나?
- ✓ 자동, 원격, 무인 운전에 대한 규제는 무엇인가?
- ✓ SSC 제작 방식이 바뀌면 어떻게 심사하나?
- ✓ Multi-module 운전 방식은 어떻게 운영허가 받나?
- ✓ 전력생산 이외에 열공급 목적의 원자로는 어떻게 허가 받나?
- ✓ 인허가 기간, 서류를 줄일 수 없나?
- ✓ ....

미국 SMRs/non-LWRs 인허가 현안

	Title of SECY-10-0034 and SECY-20-0093	Status
Licensing Process Issues for SMRs	1. License for Prototype Reactors (no requirement)	Regulatory Review Roadmap.
	2. License Structure for Multi-Module Facilities (license each module)	SECY-11-0079
	3. Manufacturing License Requirements for Future Reactors	Closed, no manufacturing license
Issues Concerning Design Requirements for SMRs	1. Functional Containment Performance Criteria for non-LWRs	(Policy Issue, non-LWRs)
	2. Implementation of Defense-In-Depth (DiD) Philosophy for ARs	RG 1.174 change
	3. Use of Probabilistic Risk Assessment in Licensing Process for SMRs	SRP 19.0
	4. Appropriate Source Term, Dose Calculations, and Siting for SMRs	(Policy Issue, non-LWRs)
	5. Key Component and System Design Issues for SMRs (e.g. Reactor pool)	Closed, Design-specific issue
Operational Issues for SMRs	1. Appropriate Requirements for Operator Staffing for Small or Multi-Module	Exemption
	2. Operational Programs for Small or Multi-Module Facilities	Closed, SECY-11-0112
	3. Installation of Reactor Modules During Operation of Multi-Module Facilities	Closed, SECY-11-0112
	4. Industrial Facilities using Nuclear-Generated Process Heat	Closed, SECY-11-0112
	5. Security and Safeguards Requirements for SMRs	(Policy Issue, non-LWRs)
	6. Aircraft Impact Assessments for SMRs	Closed, SECY-11-0112
	7. Offsite Emergency Planning Requirements for SMRs	(Policy Issue, non-LWRs)
Financial Issues for SMRs	1. Annual Fee for Multi-Module Facilities (variable annual fees structure)	Variable fee Rulemaking
	2. Insurance and Liability for SMRs	(Policy Issue, non-LWRs)
	3. Decommissioning Funding Assurance for SMRs	Closed, SECY-11-0181
Concerns for Micro-Reactors	1. Population-related Siting considerations, Environmental considerations	SECY-20-0093
	2. Emergency Preparedness (EP)	SECY-20-0093
	3. Staffing, Training, Qualification Requirements, Auto and Remote Operations	SECY-20-0093
	4. Regulatory Oversight, Manufacturing licenses and Transportation	SECY-20-0093
	5. Security Requirements, Aircraft Impact Assessment, …	SECY-20-0093

Exemption Requests

- **신개념 SMR의 설계/제작/시험/운영 등으로 현 규제 요건의 적용이 제한되는 경우**
  - ✓ 규제요건 적용면제 항목 도출, 타당성 제시 (Exemption Request) : 규제기관의 검토, 승인

- NPM SDA Application, 17**개 규제 요건에 대한** Exemption Requests
  - ✓ Simplified, Safety-related Passive Cooling Design : Active core cooling systems
  - ✓ Steel Containment Nuclear Vessel (CNV) as leak tight barrier : Pre-stressed steel, concrete containment building
  - ✓ Different Behaviors during LOCA, No Core Uncovery, no Borated Water Injection : no LBLOCA
  - ✓ Areva M5 alloy Fuel and Cladding : Zircaloy or ZIRLO, …

- Oklo MR COL Application, Exemption Requests to many Rules and Requirements
  - ✓ Non-LWR-based MR Design : COL Application under 10 CFR Part 52
  - ✓ (e.g.) 52.79(a)(38), Prevention and Mitigation of Severe Accidents for LWRs (G1 Not-applicability)
  - ✓ Many items such as GDC, ECCS, ATWS, SBO, PTS, Containment leak, Surveillance Program (G2 Exemptions)

- **원자로시설 등의 기술기준에 관한 규칙**,
  - ✓ 원자로시설의 사용목적, 원리적 차이 또는 설계의 특성상 당해 원자로시설에 그대로 적용할 수 없거나 적용하지 아니하더라도 안전상 지장이 없다고 원자력안전위원회가 인정하는 경우에는 일부규정을 적용하지 아니할 수 있다.

NPM DC, Exemption Request of 17 Requirements

	Exemption Requirements or Rules	Comments
1	10CFR50.46a and 10CFR50.34(f)(2)(vi) Reactor Coolant System Venting (RCSV)	meet the UPR without it
2	10CFR50.44 Combustible Gas Control (CGC)	N-Containment Vessel without CGCS
3	10CFR50.62(c)(1) Reduction of Risk from Anticipated Transients Without Scram (ATWS)	N-module protection system(MPS) design
4	10CFR50, App.A GDC 17 Electric Power Systems (EPS)	meet the UPR without it
5	10CFR50, App.A GDC 33 Reactor Coolant Makeup (RCM)	meet the UPR without it
6	10CFR50, App.A GDC 52 Containment Leakage Rate Testing (ILRT)	N-containment leakage integrity assurance
7	10CFR50, App.A GDC 40 Testing of Containment Heat Removal System	meet the UPR without it
8	10CFR50, App.A GDC 55, 56, and 57 Containment Isolation	N-proposed two CIVs outside containment
9	10CFR50.34(f)(2)(xiv)(E) Containment Evacuation System Isolation	meet the UPR without it
10	10CFR50, App.K Emergency Core Cooling System Evaluation Model (ECCS EM)	some phenomena are not encountered
11	10CFR50.46, Fuel Rod Cladding Material	Areva M5 alloy instead of zircaloy or ZIRLO
12	10CFR50, App.A GDC 27, Combined Reactivity Control Systems Capability	N-core cooling without boron injection
13	10CFR50.34(f)(2)(xx) Power Supplies for Pzr Relief Vlvs, Block Vlvs, and Level Indicators	meet the UPR without it
14	10CFR50.34(f)(2)(xiii) Pressurizer Heater Power Supplies	meet the UPR without it
15	10CFR50.34(f)(2)(viii) Post-Accident Sampling System (PASS)	N-radiation/T/H2 monitoring than sampling
16	10CFR50, App.A GDC 19 Control Room	N-proposed MPS equipment rooms
17	10CFR50.54(m) Control Room Staffing	N-proposed staffing requirements

UPR : Underlying intent or Purpose of Requirements

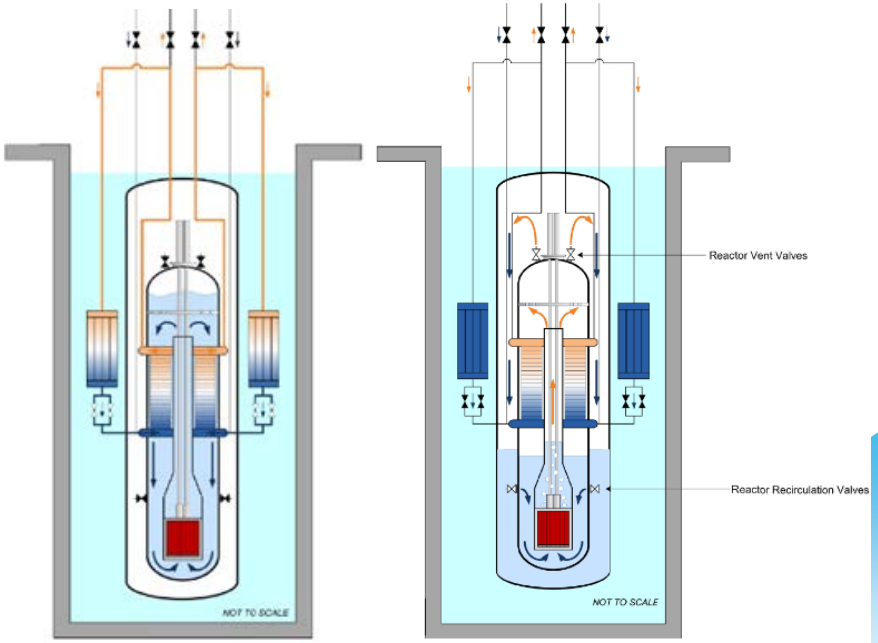
■ Exemption Request to 10 CFR 50, Appendix K, ECCS Evaluation Model (EM)

- ✓ Safety Systems : Passive Cooling with Steel Containment Vessel and Water Pool, no Coolant Water Injection, …
- ✓ Analysis Models : NRELAP5 without some models has no adverse impact on the ability of the LOCA EM
- ✓ Design Criteria : ① Critical heat flux is not exceeded; ② Collapsed liquid level remains above the top of core active fuel region, ③ Containment peak temperature and pressure remain below the design limits
- ✓ Exemptions Requests : Metal-Water Reaction Baker-Just equation, Swelling and Rupture of the Cladding, two-phase discharge Moody Model, Post-CHF Heat Transfer Correlations, and so on
- ✓ Underlying Purpose : to ensure that the consequences of LOCAs are conservatively calculated by the LOCA EM

❖ TR-0516-49422-NP-A, Rev.2 Loss-of-Coolant Accident Evaluation Model

■ Review : will meet the underlying intent or purpose (취지 및 목적) of the requirements or rules

- ✓ will not affect the performance or reliability of power operations,
- ✓ will not impact the consequences of any DBE
- ✓ will not create new accident precursors
- ✓ will meet the underlying intent or purpose of the requirements or rules



V. 결언 : Change is Chance.

■ 글로벌 원자력 에너지, (Affordable) CF 에너지(Carbon-Free Energy)의 하나로 인식

- ✓ Clean Energy (Green Energy) responding to Global Climate Change
- ✓ **최근, 원자력 선진국 중심으로** SMR **개발 및 인허가 수요 급증 추세** (SMR Race!)
- ✓ Integrated Energy System (IES) : hybrid energy system

■ 상용화 목표로 하는 SMR 개발, 인허가 획득을 통해 달성

- ✓ **최고 수준의** SMR **안전목표 설정, 달성 의지** (국제 경쟁력, 글로벌 수출 전략, ...)
- ✓ **개발분야, 설계 개발계획과 더불어 건설/운영 계획 함께** (부지, 시험/Demo 설비, 핵연료, ...)
- ✓ **규제분야,** SMR **인허가 대비 규제 체제 현대화 노력** (혁신 설계/운영/제작 등의 규제기준, ...)
- ✓ **개발자와 규제자의 조기 협력 중요** (조기 현안 도출/해결, ...)


감사합니다