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$E=mc^2$

Regulatory Framework and Experiences on PSR and CO of NPPs in Korea

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Current Status of NPPs and Regulatory Framework for Periodic Safety Review and Continued Operation

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Status of Korean NPPs and Service Lifetime

Operating Reactors

- 21 Units in Commercial Operation
- 17 PWRs and 4 PHWRs

Plant Service Lifetime

- ☐ Kori 1 in Continued Operation (CO) exceeding design life since 2008
- ☐ Wolsong 1 (PHWR) approaches its 30-year design life in 2012
- CO Application docketed in 2009 and under the KINS Review
- ☐ 9 units are in service over 20 years

New Reactors

- ☐ 6 Units in Construction
- 2 units in PAT with OL
- 2 units in OL Review
- 2 units with CP

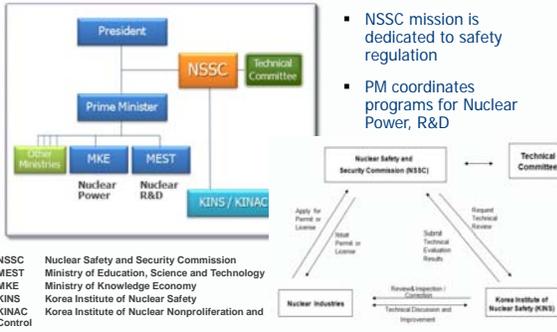


Site - Unit	MWe	NSSS Supplier	Commercial Operation
Kori	1 587	W	April 1978
	2 650	W	July 1983
	3 950	W	Sep 1985
	4 950	W	April 1986
Shin-Kori	1 1000	Doosan	April 2011
Wolsong	1 679	AECI	April 1983
	2 700	AECI	July 1997
	3 700	AECI/KHIC	July 1998
	4 700	AECI/KHIC	Oct. 1999
Yonggwang	1 950	W	Aug. 1986
	2 950	W	June 1987
	3 1000	KHIC/CE	Mar. 1995
	4 1000	KHIC/CE	Jan. 1996
	5 1000	KHIC	May 2002
	6 1000	KHIC	Dec. 2002
Uchin	1 950	Framatome	Sep. 1988
	2 950	Framatome	Sep. 1989
	3 1000	KHIC	Aug 1998
	4 1000	KHIC	Aug 1999
	5 1000	Doosan	July 2004
	6 1000	Doosan	Nov. 2004

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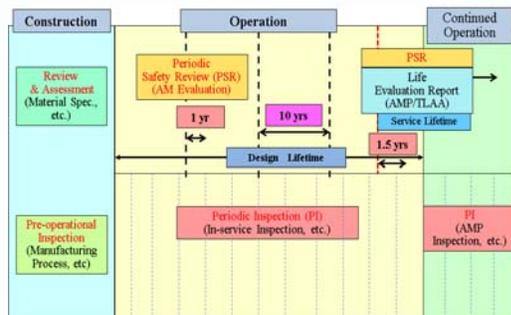
Regulatory Framework & Mechanism



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Framework for Periodic Safety Review (PSR) & Continued Operation (CO)



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Status of PSR Implementation and Regulatory Experience on PSR within Design Life

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PSR Scope and Review Areas - 11 Safety Factors & Contents of PSR Report

1	Physical Condition	1	Plant Status	General Site Characteristic
2	Safety Analysis	2	SSC	- Design Characteristic - Structure - Reactor, RCS, ESF, etc.
3	EQ	3	Radioactive Waste & Radiation Control	Wastage Control Radiation Protection Environmental Impact
4	Management of Aging	4	Safety Evaluation	- Safety Performance - Safety Analysis - Safety Design Review
5	Safety Performance	5	Plant Operation	Admin. & Staffing Procedure Human Engineering Emergency Planning
6	Use of Experience			
7	Procedure			
8	Organization & Administration			
9	Human Factor			
10	Emergency Planning			
11	Environmental Impact			

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PSR (Regulatory Review and Periodic Inspection)

- ❑ Regulatory Review on PSR for the Plants within Design Life
 - Through the PSR review, verify that aging of the SSCs is being effectively controlled to maintain the required safety margin and adequate aging management programs (AMPs) are in place for the safe operation for the next 10 year period.
 - Requirement [After 20 years operation, the measures to mitigate, and programs to manage the aging of SSCs shall be included.]
- ❑ Regulatory Inspection for the Plants within Design Life
 - In order to monitor and assess the degradation for performance and materials of safety-related SSCs due to aging, inspection on licensee's AMP such in-service inspection (ISI) is performed .
 - Periodically inspect to verify if the surveillance, improvement and replacement of relevant SSCs are properly performed

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Status of the PSR Implementation (1)

- ❑ 1st round PSR completion: 16 NPPs (exceeding 10 years Operation)
 - No serious safety-related issues were identified so far.
- ❑ 11 Safety Factors of the PSR (IAEA SG 50-SG-12)
 - PSA (Probabilistic Safety Assessment) safety factor has been separately covered since the year 2001 by implementing the Severe Accident Policy.
- ❑ 211 Safety Improvement Action Items (SIAs) requiring either some appropriate follow-up actions or corrective measures for safety improvement were identified through the evaluations of the 1st round PSR reports for the 16 NPPs.
 - Appropriate follow-up actions for 87 items of the 211 Safety Improvement Items have been taken (completed for the oldest unit - Kori 1).
- ❑ Legislation to amend current PSR rules for incorporating 14 Safety Factors of IAEA Safety Guide, No. NS-G-2.10 will be done.

Status of the PSR Implementation (2)

Safety Improvement Action Items (SIAs)

- 10 PSRs of 16 NPPs have been completed.

NPP	Review Period	Safety Improvement Action Items				Remark
		FAC	Op. Enhance.	Safety Eval.	Total	
Kori 1	'02.12-'03.11	8	15	17	40	
WS 1	'03.07-'04.06	7	10	10	27	
Kori 2	'04.01-'04.12	2	10	11	23	
Kori 3,4	'04.07-'05.06	2	12	8	22	
YGN 1,2	'05.07-'06.06	0	15	10	25	
YGN 3,4	'06.03-'07.02	0	7	10	16	
UCN 1,2	'07.01-'08.06	0	7	11	18	
WS 2	'08.05-'09.09	1	9	2	12	
UCN 3,4	'09.05-'10.05	0	8	7	15	
WS 3,4	'10.06-'10.08	2	7	4	13	

Sample SIAs Lists of Plant (UCN 3,4)

Code	Safety Factor	Safety Improvement Action Items(SIAs)	Type
PC-01	Physical Condition	Evaluation of the shielding capacity for radiation	Safety Eval.
PC-02	Physical Condition	Enhancement of the control system for Respiratory	Op. Enhance.
SA-03	Safety Analysis	Reflection of current Atmos. diff. factor on FSAR	Safety Eval.
SA-04	Safety Analysis	Analysis of Groundwater flow within site	Safety Eval.
EQ-05	Eq. Qualification	Maintaining Procedure for Seismic Qualification	Op. Enhance.
AG-06	Aging	Performance Management Plan for Heat Exchanger	Op. Enhance.
AG-07	Aging	Managing Plan for Aging of Safety SSC	Op. Enhance.
AG-08	Aging	Managing Plan for Aging of Seismic Gap Filler	Op. Enhance.
AG-09	Aging	Managing Program for PWSCC of RPV head penetration	Op. Enhance.
SP-10	Safety Perform'	Determining the Inducing source of nuclides	Safety Eval.
OE-11	Op Experience	Monitoring Plan for Protective Coatings of Cont'	Op. Enhance.
OE-12	Op Experience	Enhancing Performance of Recirculating Surge Tank	Safety Eval.
HF-13	Human Factor	Testing Program of Control Room Habitability	Op. Enhance.
EI-14	Environ' Influence	Enhancing of MCR and Procedures reflecting HFs	Safety Eval.
EI-15	Environ' Influence	Verifying effectiveness of Environ' Dilution Factor	Safety Eval.



Regulatory Experience on Continued Operation (CO) Review and Inspection

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Intensive PSR for CO in Korea

Ref) Dr. Katona T J, Practical Issues of PSR (IAEA Workshop, 9/29/09)

Normal PSR

- Physical condition
- Safety assessment
- Equipment qualification
- Aging effect
- Safety Performance
- Use of operation experience & research results
- O&M procedure
- Organization & administration
- Human factors
- Emergency plan
- Environmental effects

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Additional Req. beyond design life

- Time-limited aging analysis
- Aging management program
- Radiation environmental effects
- On-site inspection
- Backfitting
- Newly assessed regulatory requirements at international level



Intensive PSR

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Continued Operation (Application)

- Latest PSR report
 - PSR report covering the 11 safety factors with the follow-up corrective actions taken or the plans made for the resolution of the safety-related issues and findings identified in the process of evaluation.
- Safety related SSCs' operational service life evaluation report
 - Covering aging management for the CO period and including the followings:
 - Classification and selection of the SSCs subjected to life evaluation
 - Analysis of impact on the SSCs' life
 - Life evaluation of the SSCs in consideration of the surrounding environment
- Radiological environmental impact analysis report
 - Updated version addressing all the changes since the OL was issued as,
 - Variation in the site characteristics and the environment around the site
 - Major design changes on the systems related to radioactive waste treatment
 - Impact of the continued plant operation on the surrounding environment
 - Environmental monitoring plan

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Continued Operation (Review and Inspection)

- ❑ Regulatory Review for the Application Continued Operation
 - In addition to typical PSR review, the evaluation of life for major SSCs to ensure function properly during the periods of CO and the method for determining the SSCs within the scope of aging evaluation as well as identified lists of selected SSCs and relevant AMPs will be reviewed.
 - Review new FSAR chapter, as required, is that incorporate the description on the matters related to the AMP, time-limited aging analysis (TLAA), and operating experience & research results specified in the regulatory requirements .
 - on-site regulatory inspection can be carried out to confirm if the corrective measures and follow-up actions are taken as described in the evaluation reports.
- ❑ Regulatory Inspection the Plants beyond Design Life
 - Implementation of new AMPs not linked with existing AMPs under the periodic inspection is verified to determine licensee's activities are performed in accordance with the description of FSAR new chapter and commitments during CO review

Experience on CO Review/Inspection for Kori 1

- ❑ Kori unit 1 CO Application (June 2006) : Periodic Safety Review (PSR) Report, Lifetime Evaluation Report [AMPs, TLAAs, etc.], Radiological Environmental Impact Assessment Report
- ❑ KINS Review Period (June 2006 – Dec. 2007) includes 3 stages of request for additional information(RAIs) and responses, and 3 on-site inspections
- ❑ IAEA Peer Review SALTO Missions (July 2007) – 2 Suggestion & 3 Recommendation were identified and confirmed in the Follow-up Mission(May 2010)
- ❑ CO Application approved for 10 years based on KINS review results (Dec. 2007) with licensee commitment to implement the safety improvement actions items
- ❑ KINS has been performed AMP Inspection after the CO approval and recommended to supplement the AMP implementation, follow-up actions are under discussion.

Experience on CO Review for Wolsong 1

- ❑ 2nd CO Application for Wolsung unit 1(CANDU, design life - Nov. 2012) is docketed in December 2009 and the regulatory review of the application is in progress.
 - Pressure tube replacement was done for 2 years until March 2011.
- ❑ Major reasons for the delay are the application of latest code in the safety analysis under the framework of Periodic Safety Review (PSR) and how to incorporate in the Fukushima issue.
- ❑ Regulatory Review will focusing on the Safety Analysis, Hydrogen Control, Technical Specification, Aging management, Time Limited Aging Analysis (TLAA), Fire Protection, Lessons Learned from Fukushima Accident, etc.
- ❑ Based on the review, the licensing issues for CO will be discussed between KINS and Applicant (KHNP).
- ❑ IAEA Peer Review SALTO Mission is scheduled in May 2012

AMP Inspection for Kori 1 in CO Period

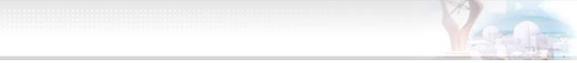
- ❑ Regulatory inspection for the AMP implementation is performed as part of the KINS periodic inspection.
- ❑ KINS issued following recommendation and the follow-up actions are under discussion with the licensee.
 - Establish "Integrated General Guideline" for AMP implementation including the process of periodic AMP review and the needed changes
 - Determine if the AMP is needed to change due to design modification, etc.
 - Develop newly-identified AMP and supplement existing AMPs based on OE
 - Through the Post-Fukushima accident inspection (April ~ May 2011), NSSC/KINS recommended the establishment of dedicated organization within licensee's organization for the plant in CO to perform the actions for AMP implementation.

Status of AMP Implementation

- ❑ Effective AMP implementation for Plants in CO is under discussion with industry as part of follow-up actions
 - Establish the "Integrated General Guideline" for AMP implementation
 - Periodic Review and Revision: aging evaluation for the newly-identified SSCs through the operation experience feedback and design changes , and develop relevant AMPs and TLAAs, if necessary
 - Develop the AMP program documents and its implementation procedure
 - Establish a dedicated organization for AMP Implementation per recommendation from special inspection after the Fukushima accident
- ❑ Regulatory oversight for the AMP will be designed for the its effectiveness

Summary

- ❑ Regulatory framework and experiences for periodic safety review (PSR) within design life and continued operation(CO) for the operation beyond design life was briefly explained. Specific experience using the intensive PSR including the life evaluation and others has been used for CO in Korea was provided.
- ❑ PSR is a systematic and comprehensive tool to evaluate the safety of the operating plants and has been played a key role for the continued operation.
- ❑ Systematic efforts to incorporate lesson-learned from domestic/international operating and regulatory experiences related to the failure due to aging and old design issue for maintaining the safety with the long term operation is needed. Continuous information exchange and productive discussion to improve in the regulatory framework and practices, and operational management for effective aging management program (AMP) implementation is needed.



Thank you for your attention

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