



Regulatory Activities on I&C, Electricity System in Korea

*2013 IAEA/ANSN ETTG Workshop on
Nuclear Safety Tailored for Regulators
(17~21 June, 2013)
Int. Nuclear Safety School, KINS, Korea*



한국원자력안전기술원

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우리의 자연은 원자력이 지키고
원자력의 안전은 한국원자력안전기술원이 지키고 있습니다.
<http://www.kins.re.kr>



KINS

I. Introduction to KINS & ICE Department in KINS



Establishment, Legal Status, Mission of KINS

글로벌 원자력안전의 중심



Establishment of KINS

- Nuclear Safety Center (Dec. 1981)
- Korea Institute of Nuclear Safety (Feb. 1990)

Legal Status

Independent and stand-alone regulatory expert organization entrusted by the NSSC

Mission

To protect the public health and environment from potential radiation hazards



**“Asia No.1,
Global Top 3,
Safety Together,
Better Tomorrow”
(Dec. 5th, 2011)**

KINS President, Dr. Yun Won Park

B.M.E. from Seoul National Univ., Korea

Ph.D of Mechanical Eng. from Ecole Centrale Univ., France



Regulatory Activities of KINS



Safety Assessment

- Reactor Core
- Site and Structural System
- System Performance
- Mechanical Equipment and Materials
- I&C and Electrical Power Systems
- Radiation, Radioactive Wastes and Radiological Environment

Research on Safety Regulation

- Development of Nuclear Safety Regulation Technologies
- Development of Technical Standards

Safety Review

Review for Standard Design Approval
Review for Early Site Approval
Review for Construction Permit
Review for Operating License
Periodic Safety Review
Review of Licensing Amendment

Safety Inspection

Pre-operational Inspection
Periodical Inspection
Quality Assurance Inspection
Daily Inspection by Resident Inspectors
Inspection of Radiation Sources

Safety Management

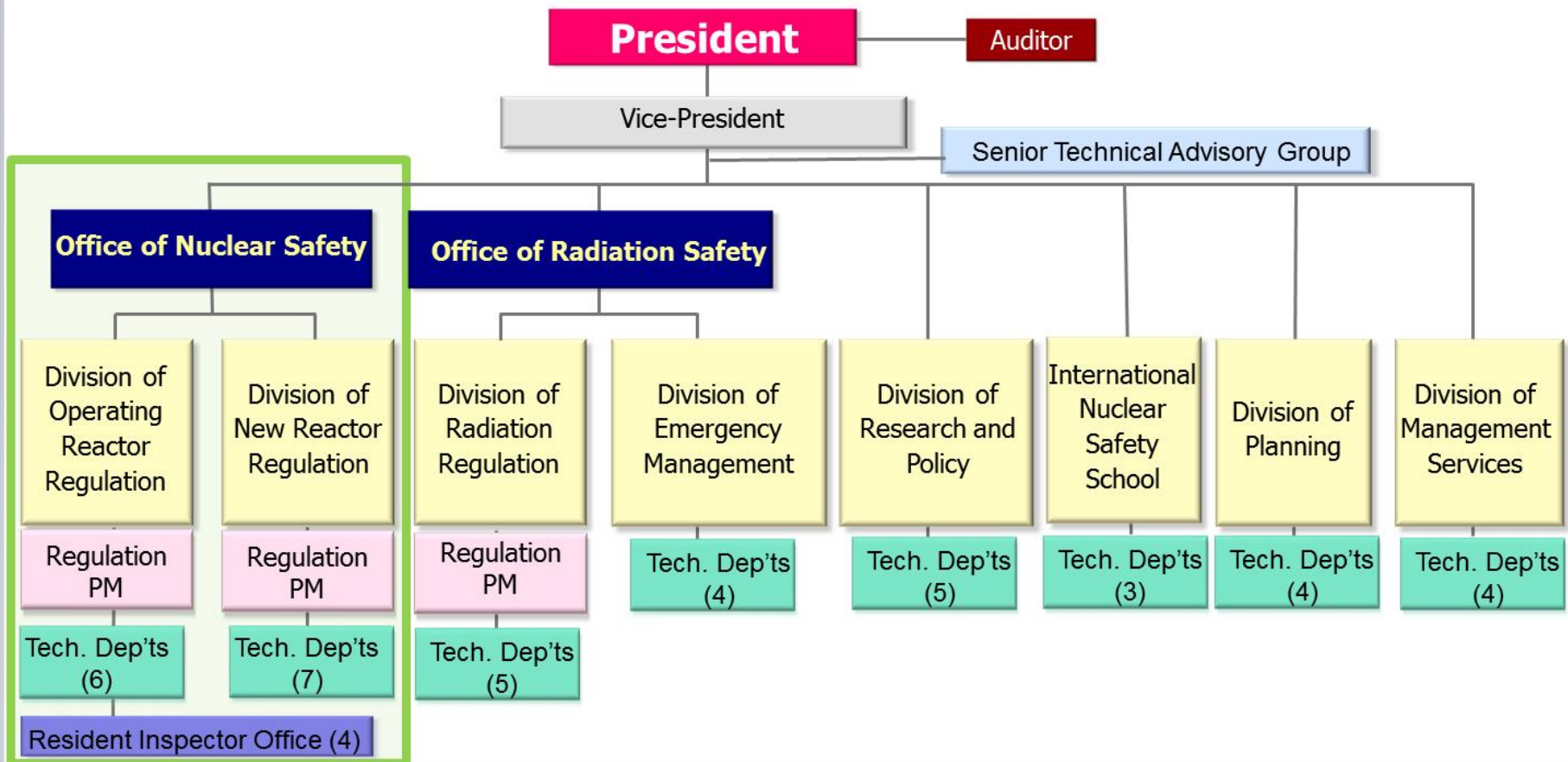
Nuclear Emergency Preparedness
Monitoring of Environmental Radiation

Organizational Structure of KINS

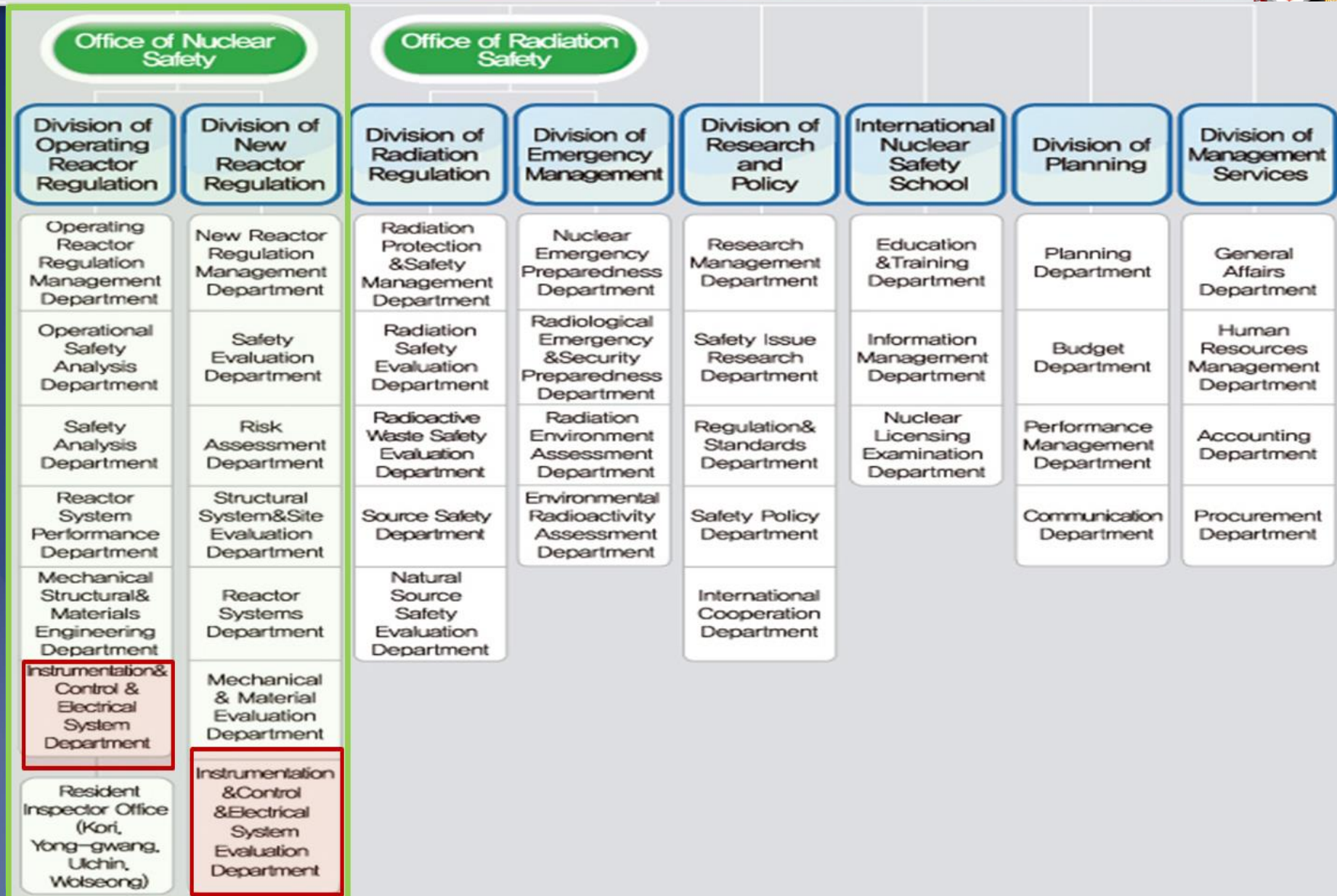


□ Organizational Structure and Human Resources (2012.11)

- Total 418 staff members : 2 Offices, 8 Divisions, 44 Departments
 - ✓ 88.2% are technical staffs (369)
 - ✓ 82.5% are Ph.D. (187) and Master's degree (158) holders.



Organizational Structure of KINS



Staffs of I&C and Electricity Departments



ICE E. Dep. of NRR Div. (14 Staffs)



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KINS

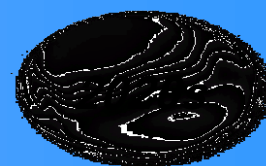
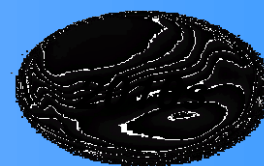
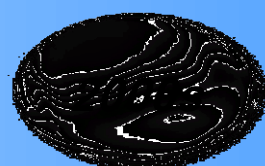
II. Current Regulatory Activities on I&C and Electrical Systems





Nuclear Power Program in Korea

□ Nuclear Power Reactor Development Program



*Introduction of
Nuclear Power*



*Construction
of Kori #1 ('74~'78)*

*Promotion of
Localization*



*Establishment of
Localization Plan ('84)*

*Technology
Self-reliance*



*OPR1000
Development ('95)*

*Development of
Advanced Reactor*



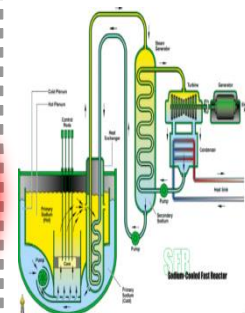
*APR1400
Development ('01)*

*Improvement of
Advanced Reactor*



*APR1400+
SMART*

*Development of
Future Reactor*



*Gen IV Systems
(SFR, VHTR etc.)*

*OPR1000 (Optimized Power Reactor 1,000) is new name for the former KSNP



Current Status of NPPs in Korea



In operation

23 units
(20,716 MW)



Under construction

7 units
(9,400 MW)



Under planning

8 units
(12,600 MW)



Radioactive Waste Disposal Facility
(Under construction)



Ulchin Site (8)



Ulchin 1,2,3,4,5,6



Shin Ulchin 1,2



Wolsong Site (6)



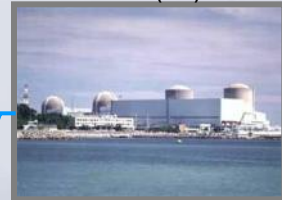
Wolsong 1,2,3,4



Shin Wolsong 1,2



Kori Site (10)



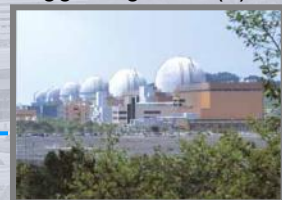
Kori 1,2,3,4



Shin Kori 1,2,3,4,5,6



Yonggwang Site (6)



YGN 1,2,3,4,5,6



 In Operation

 Under Construction



❑ Construction Permit

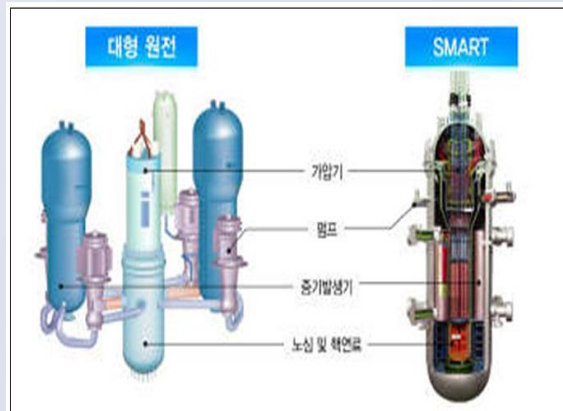
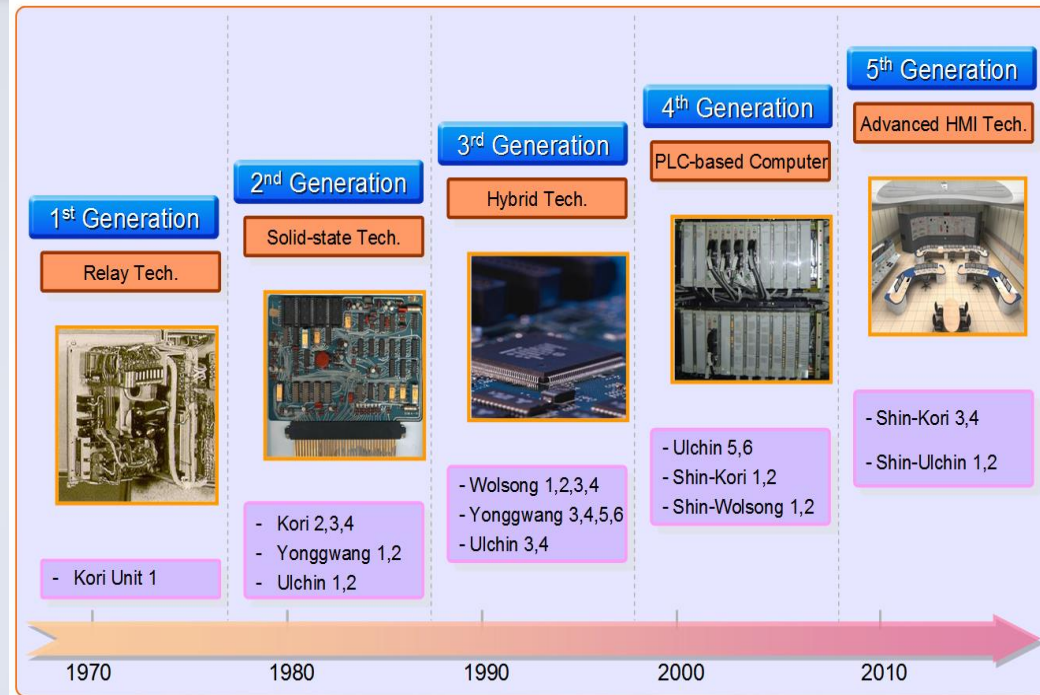
- SUC 1&2 [APR1400]
 - ✓ permitted on Dec. 4, 2011
- SKR 5&6 [APR1400]
 - ✓ applied on Sep. 26, 2012

❑ Operating License

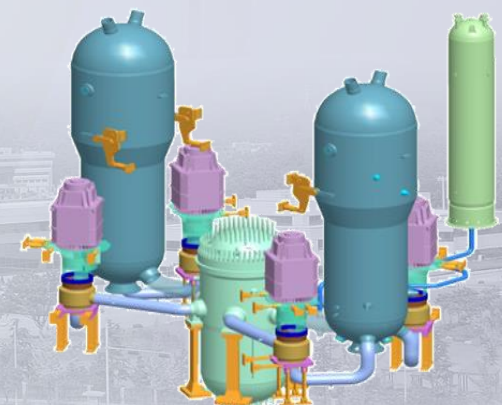
- SKR 2, SWS 1 [OPR1000]
 - ✓ licensed on Dec. 4, 2011
- SWS 2 [OPR1000]
 - ✓ applied in 2011
- SKR 3&4 [APR1400]
 - ✓ applied in 2011

❑ Standard DC

- SMART (100MW)
 - ✓ certified on July 4, 2012
- APR+ [1,500MW]
 - ✓ applied on Jan. 11, 2012



SMART Reactor



APR+ [1,500MW]



❑ UAE Braka CP

- MOU & special agreement between KINS-FANR(May & Jul. 2010)
- KINS-FANR cooperation meeting (4 times), workshop (2 times)
- Secondment of KINS staff to FANR (Jan. 2011~)
- Supporting safety review through RFI (Jun. 2011~)
- **permitted on July 18, 2012**



Ground-breaking ceremony of Braka NPP
- ROK President M.B. Lee
- UAE Abu Dhabi Princess Royal, Mohammed

❑ Jordan JRTR CP

- Reactor Capacity : 5MW (Up-gradable to 10MW)
- Applicant: JAEC (Jordan Atomic Energy Commission)
- Site Location: Inside of JUST (Irbid, Jordan)
- Applied Aug. 1, 2010
- **Just before being permitted by JNRC**



▲ 이명박 대통령(좌 5번째)과 홍석우 지식경제부 장관(좌 3번째)이 아랍에미리트 관계자들과 UAE 한국형 원전 건설현장에서 기념촬영 하고 있다. [Today Energy News, Nov.22, 2012]

Pre-Operational Inspection



❑ Purpose

- Performed during the construction (Installation, CHT, HFT, PFLT)
- To confirm the adequacy of materials & SSCs, as well as construction related activities, processes, procedures and personnel competence

❑ Post Fuel Loading Test (PFLT)

- Shin Kori 2 : Dec. 4, 2011 ~ July 20, 2012
- Shin Wolsung 1 : Dec. 4, 2011 ~ July 31, 2012

❑ Hot Functional Test (HFT)

- Shin Wolsung 2 : Feb. 1, 2012 ~
- **Shin Kori 3 : Nov. 20, 2012 ~**

❑ Cold Functional Test (HFT)

- Shin Kori 3 : Nov. 1, 2011 ~

❑ Installation Inspection

- Shin Kori 3, 4 : Jun. 1, 2010 ~



“Shin Kori 3 starts HFT!”, MBC news (Nov. 17, 2012)

Audits for SKN 3&4 Licensing Review(1/2)

글로벌 원자력안전의 중심



□ Audit for NSSS MMIS Designer

➤ Purpose :

- ✓ To confirm the adequacy of Quality Assurance Activities for Safety Related I&C Systems (PPS, ESF-CCS, CPCS, QIAS-P, DPS)

➤ Place and Date: KEPCO E&C (S/D), Taejeon, April 4, 2012

➤ Participants :

- ✓ KINS (4) : C.H. Jeong, S.H. Ji, Y.M. Kim, K.Y. Park
- ✓ Advisor (2) : Prof. S.R. Oh (Dankook Univ.), Prof. H.S. Kim (Choongnam Univ.)



➤ Results (5 Action Items)

- ✓ Requesting Prompt Submission of Licensing Document (MMIS SW QA Documents, Reliability Analysis Report of PPS, Setpoint Analysis, etc)
- ✓ Requesting RTM(Requirement Traceability Matrix) for PPS

Audits for SKN 3&4 Licensing Review(2/2)

글로벌 원자력안전의 중심



□ Audit for NSSS MMIS Manufacturer

➤ Purpose

- ✓ To confirm the appropriateness of activities performed during the development process

➤ Place : WEC, Pittsburgh, Penn., USA

➤ Date : July 15~22, 2012

➤ Participants : S.H. Ji, D.H. Lee, Y.M. Kim

➤ Results [Action Items] :

- ✓ WEC to provide justification for not fulfilling the acceptance criteria of several tests
- ✓ Evaluation of the documentation regarding the open items raised during the development process
- ✓ WEC to submit the hardcopy of EQ documents to KINS related to NSSS MMIS



II. PPS Design Features

Please, explain the following design features are designed adequately in PPS.

1. Two BPLs for
a. Software dev
b. How to con
2. Two LCLs for
a. Explain abo
3. Signal quality
a. Explain abo
b. Show all the
4. PPS design co
a. Explain the
b. Explain the
c. In case, the
5. Self-diagnos
a. Explain the
modules, ind
b. Explain the
6. Test Injection
a. Explain the
01335-SHIN
b. Is Bistable F
7. Bistable Part
a. What is the
what circuit
b. Explain the
manual part
8. Software exe
a. Software ex
response us
execution ti

TECHNICAL QUESTIONNAIRE

on
PPS/ESF-CCS/MTP/ITP, QIAS-P and Soft Control
for SKN 3&4

July 2012

KOREA INSTITUTE OF NUCLEAR SAFETY



❑ Continued Operation

- Wolsung 1(CANDU, 677MW)
 - ✓ Commercial Operation : Nov. 20, 1982
 - ✓ Applied Continued Operation : Dec. 20, 2009

❑ Modification of Permitted Matters

- Kori 1 “EDG Replacement”
- Kori 1, “MCR Modernization”
- WSN 1 “ITS(Improved Tech. Spec)”
- YGN 5,6 “CEDMCS Improvement”
- All plants “ASTS Installation
- Ulchin 1,2 “NIS Improvement”



Performance of Anti-Nuclear Party

Atomic Energy Safety Act, Article 20 (Operation Permission)

(1) A person who wishes to operate a nuclear power reactor and related facilities shall **obtain permission from the Minister** as provided by the Presidential Decree.

The same shall apply to a case where he/she wishes to modify any **permitted matters**: *Provided*, that if he/she wishes to modify **minor matters** prescribed by the Ordinance of the Nuclear Safety and Security Commission, he/she shall **report it**.

Periodic Inspection for Operation Plants



❑ Purpose

- Performed during the plant outage period
- To ensure that the performance of reactor facility is maintained in the state of the pre-operational inspection, for re-criticality after plant overhaul

❑ 2012 Periodic Inspection Plan

Site	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kori (KRN)	1												
	2												
	3												
S. Kori (SKN)	1												
Yong-Gwang (YGN)	1												
	3												
	4												
	5												
	6												
Wolsung (WSN)	1												
	2												
	3												
Ulchin (UCN)	1												
	3												
	6												

Investigation of Events & Accidents



❑ Kori unit 1 SBO

- Feb. 9, 2012, 8:34pm ~ 8:46pm (12 minutes)
- Due to loss of offsite power and fail to start EDG
- IAEA INES rating : Level 2
(Up-rated considering deficiency of safety culture)
- Violation of Regulatory Requirement
 - ✓ Did not declare emergency action level upon SBO
 - ✓ Did not report SBO to regulatory
 - ✓ Did not keep record of SBO and subsequent EDG "B" test failure
 - ✓ Moved fuel while both EDGs were unavailable



❑ Parts scandal (Nov. 6, 2012)

퓨즈	온도 스위치	저항기(Resistor)	다이오드(Diode)	냉각팬	압력 조절기
					
과전류발생시 설비보호	온도이상시 경보·신호 제공	제어신호 흐름의 조절	일방향 신호전달	전기 부품의 냉각	필요한 공기 압력조절
전기 차단기 등	급수펌프 연전 등	전자기만에 설치	전자기관	전기설비류에 설치	배수밸브 등에 설치

		Uncertified parts of NPPs					
		KRN	WSN	UCN		YGN	
				#3	#1/#2	#3/#4	#5/#6
bought	Item	19	3	9	10	24	172
	product	75	18	268	59	141	7,121
used	Item	0	0	2	0	13	121
	product	0	0	45	0	31/20	2,457/2,590
Total							

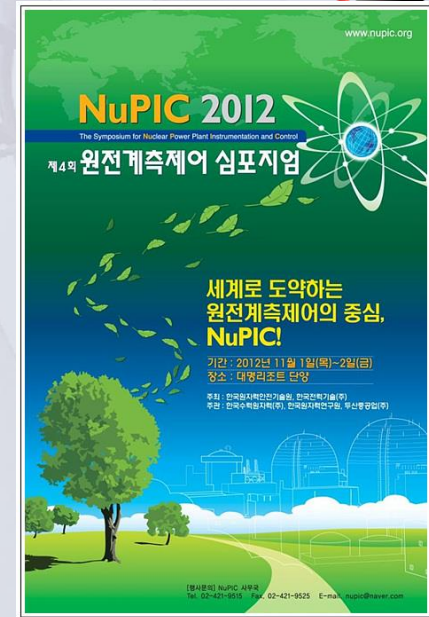
❑ Reactor Trips

- Shin Wolsung 1, Reactor Trip (March 3, 2012)
 - ✓ Due to RCP trip because of 13.8kV Circuit Breaker Open (Cause : PCS malfunction)
- Shin Kori 2, Shin Wolsung 1, Channel Trips (Dec. 30, 2011 ~ Mar. 23, 2012)
 - ✓ Due to ENFMS signal hunting
- The Other 9 reactor trips related with I&C and Electrical system and components



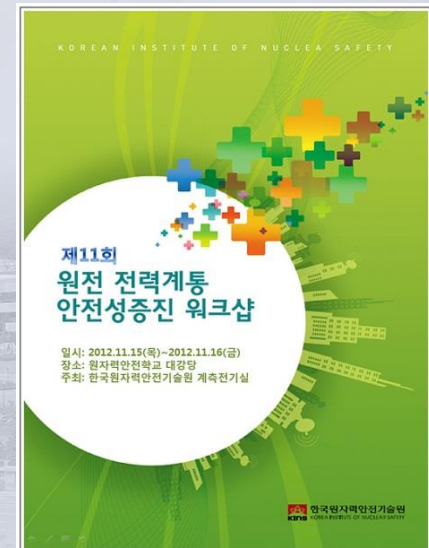
□ NUPIC 2012

- 4th Symposium for Nuclear Power Plant Instrumentation and Control
- Nov 1 ~ 2, 2012, Danyang City
- Hosted by KEPCO E&C/KINS
- 450 participants from KINS, KHNP, other Nuclear Industries
- presented total 60 topics in 8 session such as Regulatory Position, New Technology, Design, Operation, HE, Cyber Security, etc.



□ Workshop on Electrical System

- 11th Workshop for Safety Improvement of Elect. System
- Nov 15~16, 2012, International Nuclear Safety School, KINS
- Hosted by KINS
- 150 participants from KINS, KHNP, other Nuclear Industries
- presented total 14 topics in 3 session such as Regulatory Position, Post Fukushima, etc.



Managing of Working Group & Annual Meeting

글로벌 원자력안전의 중심



❑ WG–NICCS

- 20 cyber security experts from KINS, KHNP, KEPCO E&C, KAERI, Doosan, POSCON–ICT, Woori Tech., BNF Tech., Formal Works, etc

❑ KINS–JNES Annual Meeting

- 4th Workshop (JNES, Tokyo, Nov. 28~29, 2011)
- 5th Workshop (KINS, Daejeon, Nov. 28~29, 2012)
- 6th Workshop (JNES, Tokyo, Nov. ??~??, 2013)



10:00 to 12:00 Technical Presentations I

Digital I&C I

Chair: Choong-Heui Jeong (KINS)

1. Regulatory status of I&C and human factors in Korea (Choong-Heui Jeong, KINS)
2. Japan's new nuclear regulatory organization; Nuclear regulation authority and related organizations (Masami Takita, JNES)
3. Activity of IEC 45A working group for IEC-62765 "management of ageing of pressure transmitters, important to safety in nuclear power plant" (Oon-Pyo Zhu, KINS)
4. Present situation of Japan's new safety guidelines and ministry orders (Nobumichi Watanabe, JNES)

12:00 to 13:00 Lunch

13:00 to 15:00 Technical Presentations II

Human Factors I

Chair: Hidekazu Yoshikawa (Kyoto University)

1. Experience and prospect on human factors regulation of Korean NPP (Yun-Hyung Chung, KINS)
2. Key HOF related topics from investigation reports and the situation of progress in and around the Fukushima site (Ryuji Kubota, JNES)
3. Nuclear safety resources management for organizational safety in Korea (Yong-Hee Lee, KAERI)

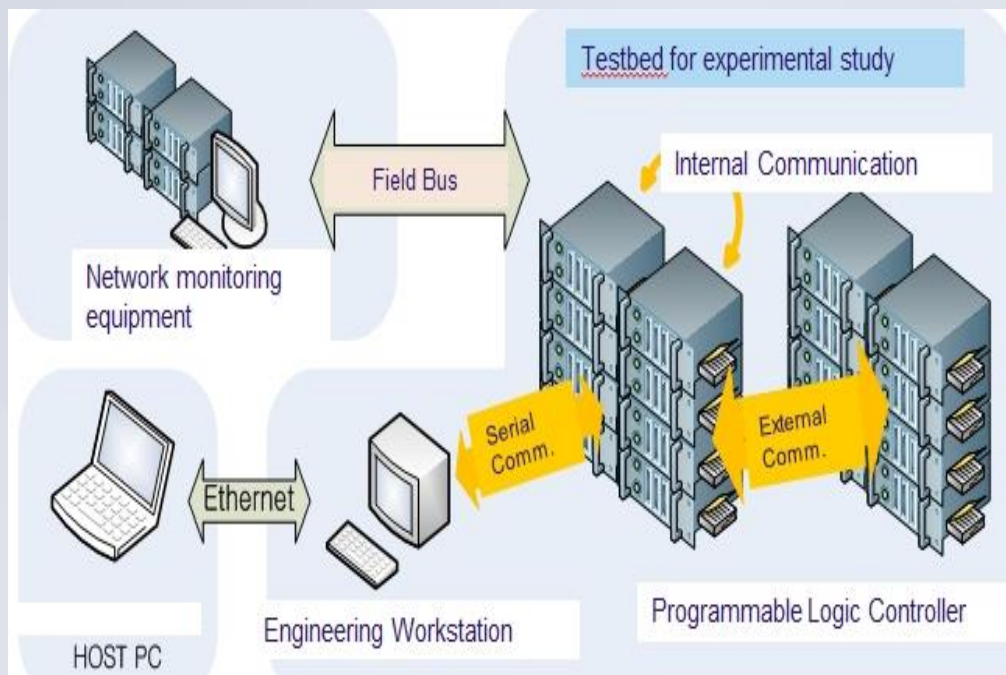


❑ Long-Term Research Project

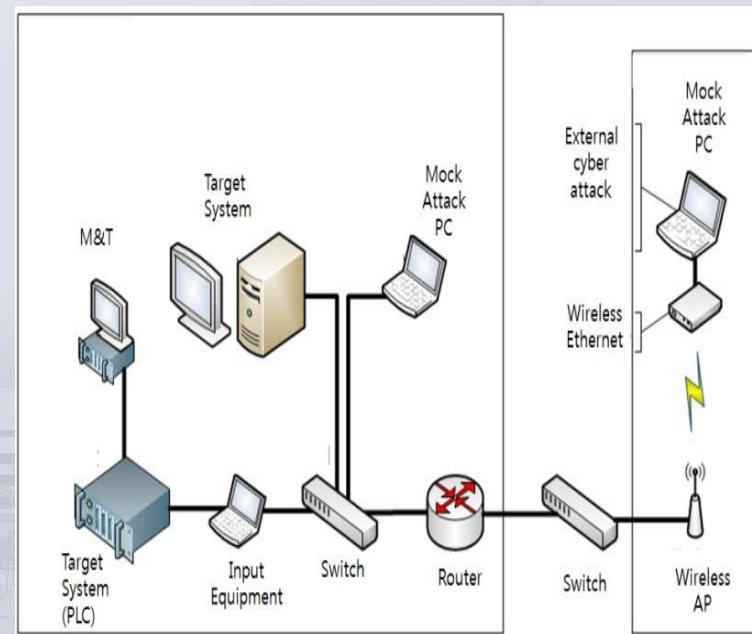
- Development of Proof Test Model and Safety Evaluation Techniques for Digital I&C System

❑ Short-Term Research Project for Issue

- Establishing of Test bed for Cyber Security Evaluation of Digital I&C System [NSE]



[Proof Test Model for Digital I&C System]



[Test bed for Cyber Security]

Always we keep watching
our Atomic Power

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E-mail : chjeong@kins.re.kr



Thank You



한국원자력안전기술원
KOREA INSTITUTE OF NUCLEAR SAFETY