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# Pre-Operational Inspection Experience in Korea

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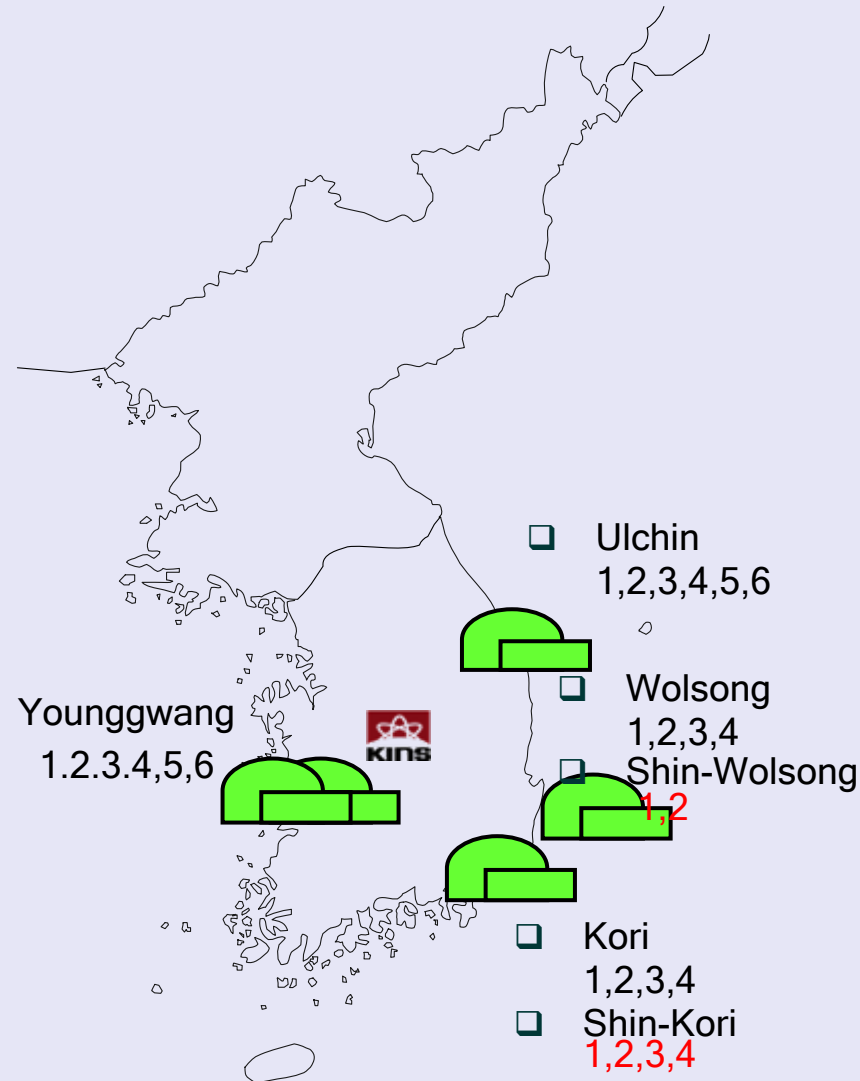
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# Introduction

## ❑ Current Status of NPPs in Korea

- **Single Utility : KHNP**
- **NPPs in Operation : 20 units**
  - **PWR : WH(6), FR(2), KSNP(8)**
  - **PHWR : CANDU(4)**
  - **1<sup>st</sup> Commercial Operation : Kori Unit 1 in 1978**
- **NPPs under Construction : 6 units (KSNP)**
- **NPPs in Planning : 2 units by 2014**



# Introduction (cont'd)

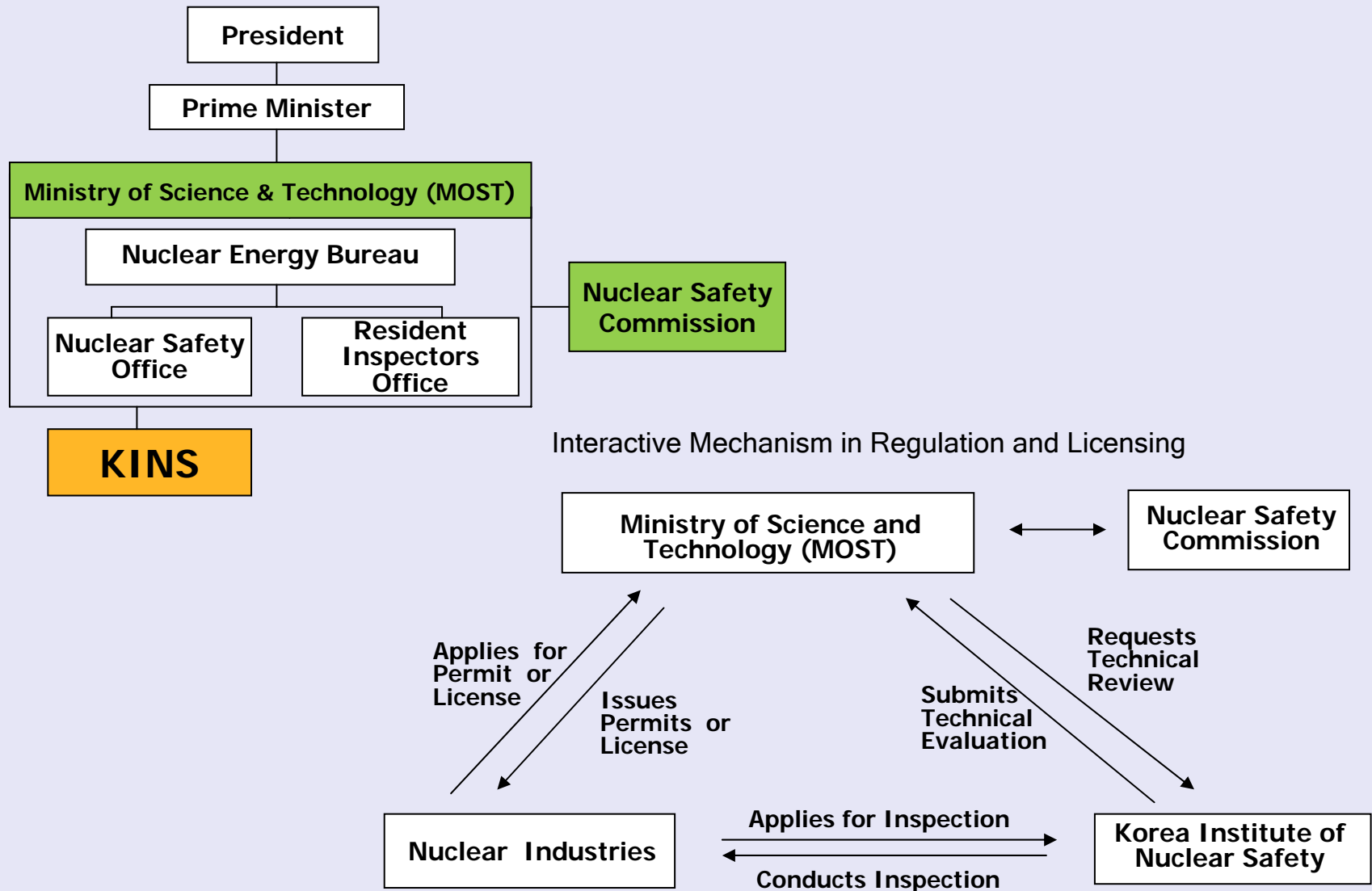
## Table of NPPs under Construction/Plan

Plant Name		Reactor Type	Capacity (Mwe)	Commercial Operation	Status
Shin-Kori	#1	PWR (KSNP+)	1,000	Dec. 2010	CP granted in July 2005
	#2			Dec. 2011	
Shin-Wolsong	#1	PWR (KSNP+)	1,000	Mar. 2011	CP review underway from Dec. 2002
	#2			Mar. 2012	
Shin-Kori	#3	PWR (APR1400)	1,400	June 2012	CP review underway from Sept. 2003
	#4			June 2013	
Shin-Uljin	#1	PWR (APR1400)	1,400	June 2013	In planning
	#2			June 2014	

KSNP+ : Improved KSNP (Korea Standard Nuclear Power Plant, 1000MW PWR Type)

APR1400 : Advanced Pressurized Reactor (1400MW PWR Type)

# Regulatory Framework of Korea



# Safety Inspection In Construction Phase

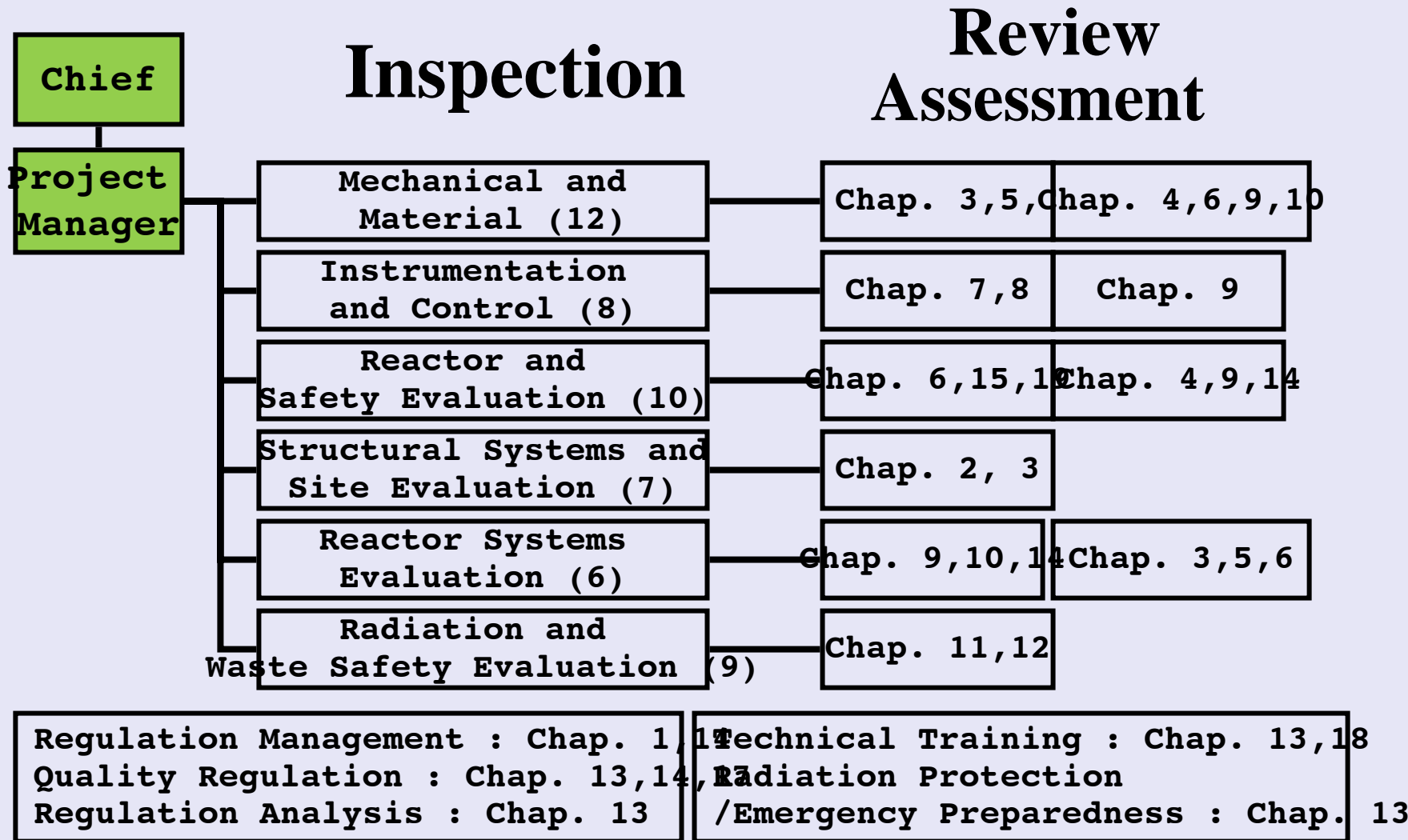
## ❑ Pre-Operational Inspection

- Defined as regulatory inspection prior to the operation of nuclear installations to verify that nuclear installations under construction comply with relevant safety assessments and safety analysis reports.
- Based on application for inspection by the licensee
  - Strength test for each main process of structure construction
  - Performance tests of reactor systems
  - Cold and hot functional tests
  - Nuclear fuel loading and demonstration tests
  - ❖ Additional items if inspector deems it necessary

## ❑ Pre-Operational Inspection Program

- A structured and pre-specified inspection program linked to applicant/licensee schedules
- Considerations :
  - Safety significance,
  - Licensee's overall performance,
  - Operational experience and lessons learned from events at other facilities,
  - Available regulatory inspection resources
- Observe and evaluate the ongoing safety activities to assess the effectiveness of licensee performance
- Strong linkage between inspection activity and document (SAR) assessment

# Safety Inspection In Construction Phase (cont'd)





# Safety Inspection In Construction Phase (cont'd)

## □ Inspection Stages of a Typical KSNP

Inspection Stage	1999	2000	2001	2002	2003	2004
Structure Inspection	CP				SIT ILIT	
Installation Inspection			RV			
CFT Inspection						
CHT & HFT Inspection					CHT	
Fuel Loading & Start-up Test Inspection					Initial Fuel Loading (OL)	

● CFT : Cold Functional Test, CHT : Cold Hydrostatic Test, HFT : Hot Functional Test

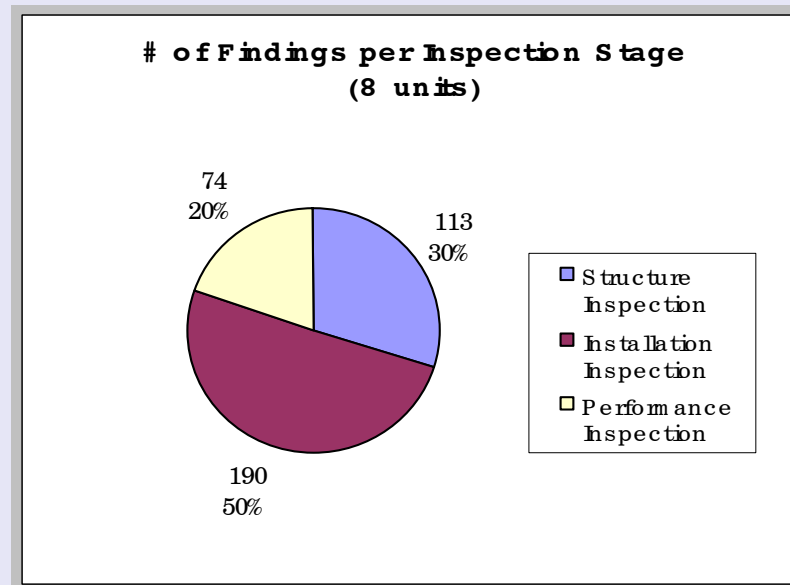
# Safety Inspection In Construction Phase (cont'd)

## ❑ Manpower used for Inspection of a typical KSNP

Inspection Stage (# of Inspection Items)	# of Inspectors	Man-Hours (Onsite Inspection)	Remarks
Structure Inspection (19)	12	1,408 (for 2 Units) *excluding SIT/ILRT (213,)	Inspectors usually participated in more than one stage of inspection.  Total # of inspectors was 83.
Installation Inspection (52)	65	3,661 *including Piping (1,373)	
CFT Inspection (77)	55	1,510	
CHT & HFT Inspection (25)	35	1,129 *including CHT (580)	
Fuel Loading & Start-up Test Inspection (33)	26	533	

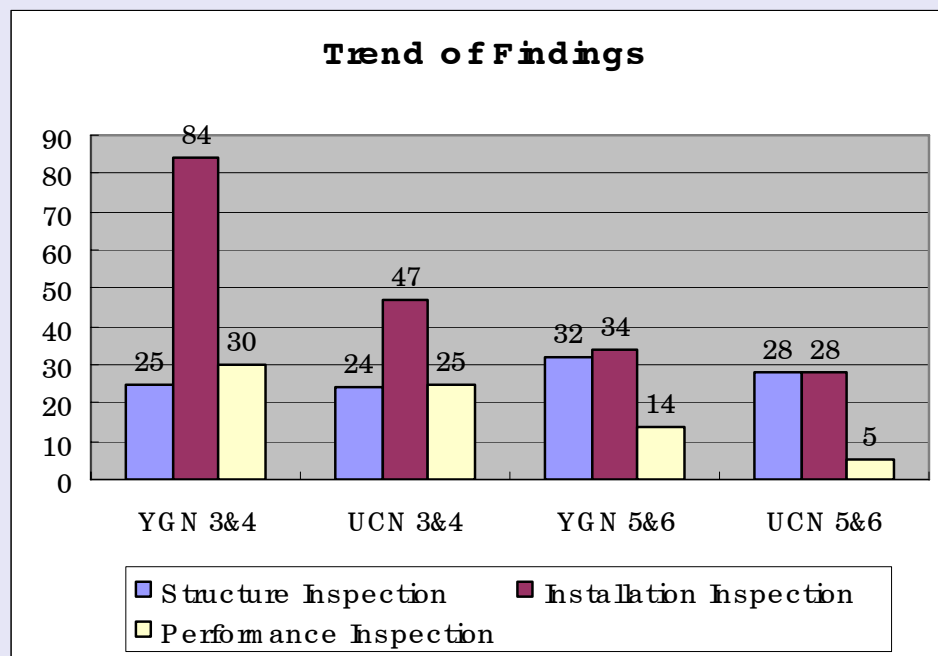
# Pre-Operational Inspection Experience

- ❑ Analysis of inspection findings in eight NPPs constructed in recent years (YGN # 3,4,5,6 UCN #3,4,5,6)
  - Among 377 findings, installation (190) and structure (113) findings occupy major part
  - Most findings were nonconformance to the requirements of industrial standards for the construction materials, manufacturing, fabrication, installation, and inspection of SSCs



# Pre-Operational Inspection Experience (cont'd)

- With repeated construction of plants of same type, the number of findings decreased considerably
- For installation and performance inspection, decreased tendency is likely due to use of the similar procedures
- In case of structure inspection, the number of findings are similar
  - This is likely due to the characteristics of the construction work which is highly dependent on the worker, work environments, etc.



# Pre-Operational Inspection Experience (cont'd)

- ❑ Structure inspection findings (examples)
  - Containment concrete creep test procedure (sealed specimen)
  - Bending locations of vertical reinforcing bars
  - Concrete pouring (free fall height, horizontal flow distance)
- ❑ Installation inspection findings (examples)
  - Welding procedure (pre-heat)
  - Welding material procurement specifications & welding controls
  - Identification of the safety and non-safety classes for power terminal block nameplate, cableway, instrument, and indicator
  - Separation gap between electrical channels
- ❑ Performance inspection findings (examples)
  - Performance criteria and procedure
  - Instrument calibration

# Pre-Operational Inspection Experience (cont'd)

- ❑ Major events during pre-operational inspections
  - Re-evaluation of site stability due to the fault found during foundation excavation
  - Containment liner plate bulge and grease leakage during grease filling into the tendon duct
  - Unidentified piping weld zones near containment penetrations
  - Thermal sleeve separation from safety injection nozzle
  - Excessive vibration of building structure when emergency diesel generator operating
  - Mal-function of digital plant control system due to wrong set of CPU reset signal

# Concluding Remarks

- ❑ Korean Regulatory body continues to improve the Pre-Operational Inspection program by implementing lessons learned from inspection findings and operating experiences
- ❑ Current considerations for planning inspection program are:
  - Strengthening inspection of secondary system
    - Add inspection items for secondary system (turbine/generator) previously conducted by other government office
  - Increased QA inspection of major component manufacturing
    - Include electrical components such as safety class cables and batteries in a manufacturing process
  - Feedback of QA inspection results
    - Follow-up the inspection findings issued during manufacturing stage of major components
  - Use of risk information
    - Allocate appropriate inspection resource based on risk measures from PSA