

# Post-Fukushima Action Plan in Korea

WNU-SI 2011, August 11  
Christ Church, Oxford

# Contents

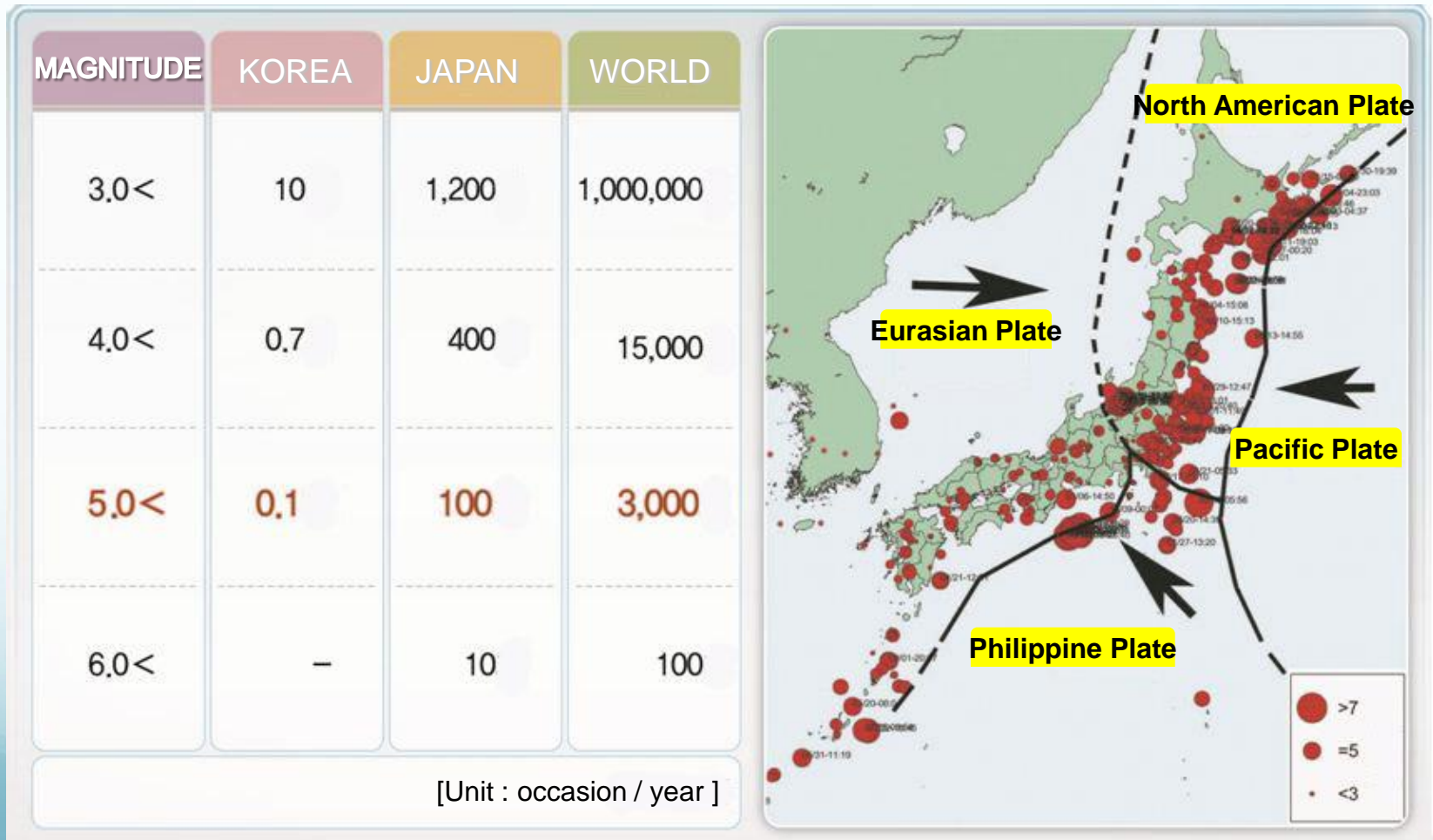
- **Korean nuclear overview** **BK Kim**
- **Government action plan** **BS Jeong**
- **Post-Fukushima action plan** **MK Jo**



Nuclear Power Plants in the Silk Road Countries (2010)

# Geological Features of Korea

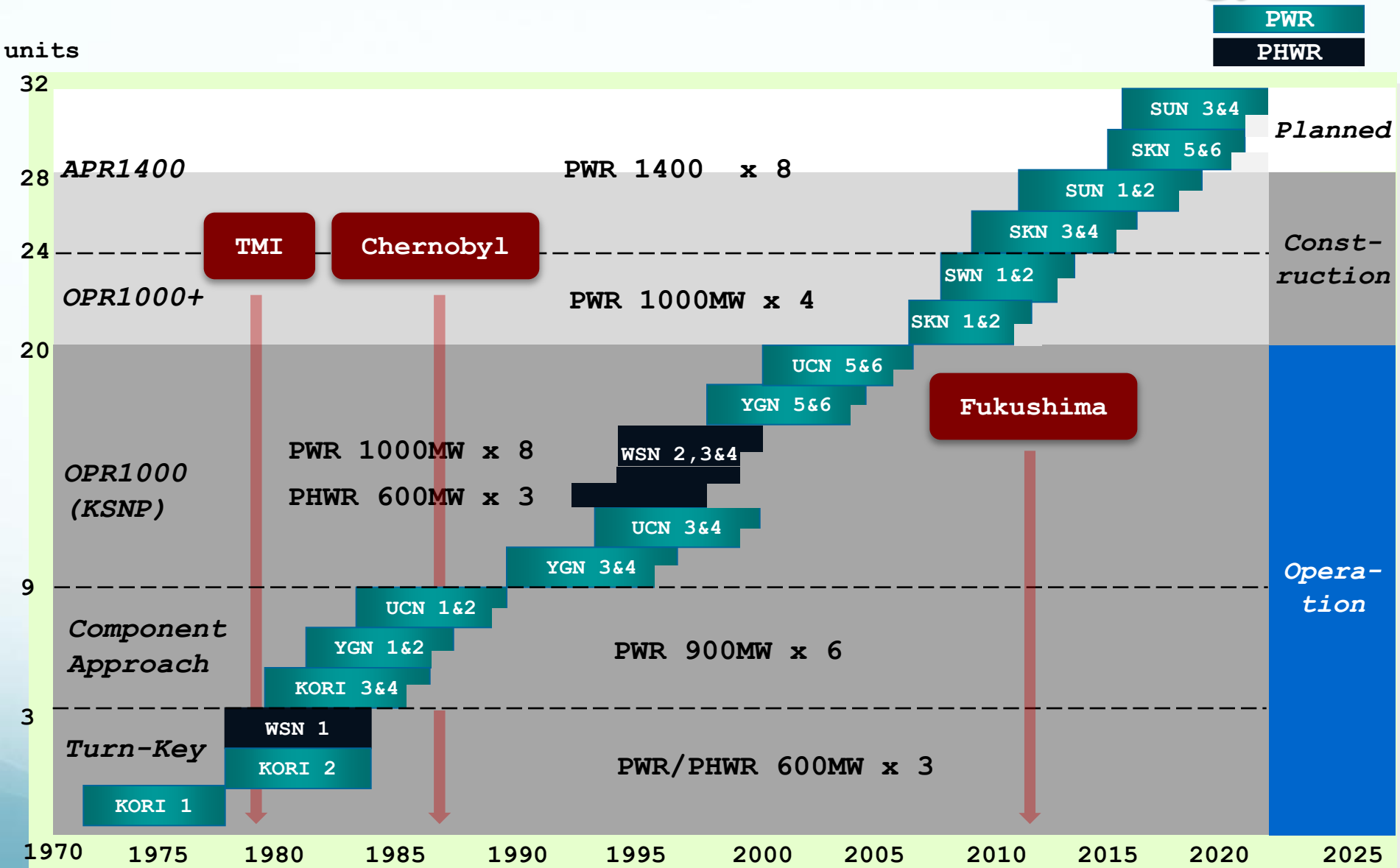
## Earthquake Frequency in Korea, Japan and the world





Nuclear Map of Korea

# Korean Nuclear Power Plants Chronology



This book is intended for international readers who may want to better understand the South Korean nuclear industrial success story. The news of the UAE nuclear power plant contract to the Korean consortium in 2009 gave a compelling reason to the author to write the book. South Korea is a striking example of how the power of technology and the imagination of leaders have combined first to achieve sustainable development with the use of nuclear power to cover domestic electricity needs, then reaching out to the export market. In the dawn of the first turnkey nuclear export project from Korea, the international community might learn from South Korea's hard work. Somehow, little-known Korean nuclear entities managed to put their name on the map for the first time, which seemed unlikely, if not impossible, just a mere twenty-five years ago. Written as a testament to what a poor, developing country can do when pressed to excel, Kim focuses particular attention on the localization process of nuclear power technology in the 1980s. Ultimately, his benchmark memoir may shed light for other nations as they enter the brave new and peaceful-nuclear world. After all, history repeats itself as new technologies travel the Silk Road, crossing civilizations.



Kim Byung-koo ("BK") studied at the Seoul National University and the University of Michigan before receiving his doctorate in applied mechanics from the California Institute of Technology. Upon graduation, Dr. Kim worked as a test engineer at Jet Propulsion Laboratory in Pasadena, California until he returned to Korea, where he, among other duties, served as the project manager of the nation's first nuclear power reactor system design project at the Korea Atomic Energy Research Institute. He then served as a Director of Technical Cooperation at the International Atomic Energy Agency in Vienna assisting many developing countries to promote their peaceful uses of nuclear energy. He currently lives in Daejeon, Korea. *Nuclear Silk Road* is his first book.



NUCLEAR SILK ROAD

KIM BYUNG-KOO

# NUCLEAR SILK ROAD

THE "KOREANIZATION" OF  
NUCLEAR POWER TECHNOLOGY

KIM BYUNG-KOO

طريق الحرير النووي

원자력비단길

核之絲綢路

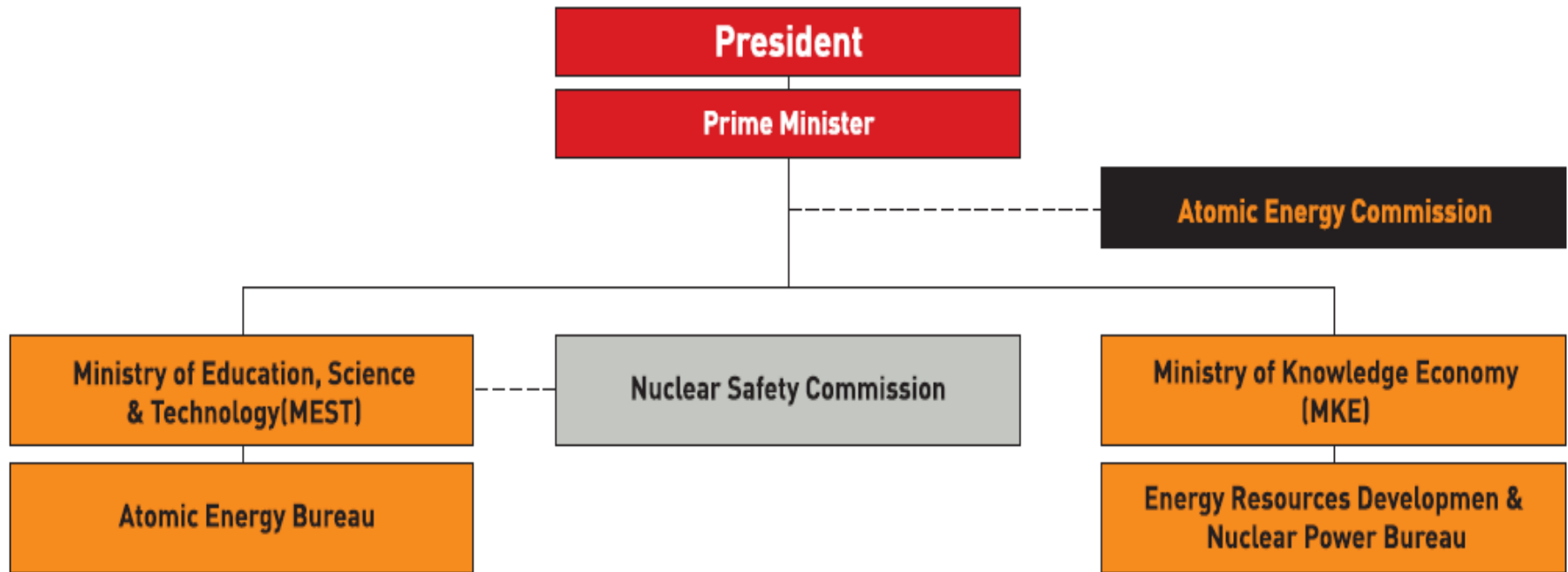
# **Government Action Plan**

**BS Jeong**



# Nuclear Regulatory Infrastructure in Korea

## Before Fukushima



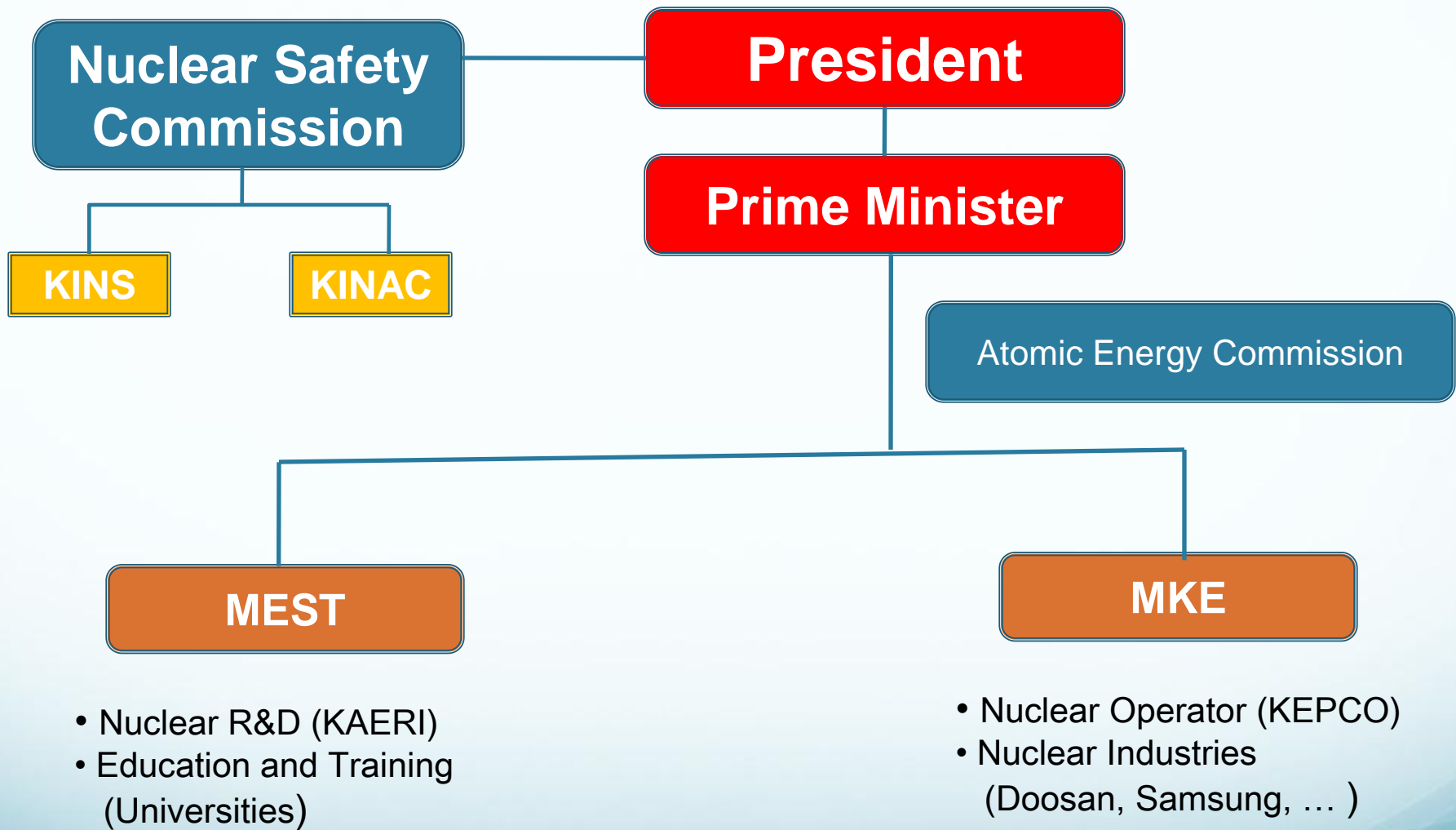
- Nuclear Safety and Regulation (KINS)
- Nuclear Basic R&D (KAERI)
- Nuclear Control (KINAC)
- Radiation R&D & Application
- International Cooperation
- Education and Training

- Nuclear Industry
- Radioactive Waste Management

# Recent changes

- The National Assembly passed the revised Nuclear Act, Nuclear Safety Act on June 29, 2011.
- The Nuclear Safety Commission moved out of MEST, placed directly under the President.
- NSC chairman – minister's rank
- The nuclear regulatory agencies (KINS and KINAC) reports directly to the NSC.

# After Fukushima



# Post-Fukushima Action Plan

**MK Jo**

# Overview

## BACKGROUND

- Fukushima Accident(11, Mar) ⇒ **increased public concern**
- **Sudden Shutdown of KORI #1** : 12<sup>th</sup> Apr
  - Aging NPP, Continuing Operation(licenced at Dec, 2007)



デジタルグローブ社が14日に撮影した福島第一原発の衛星写真(ISI提供)



# Immediate follow-ups (“stress tests”)

## Urgent Safety-Inspection

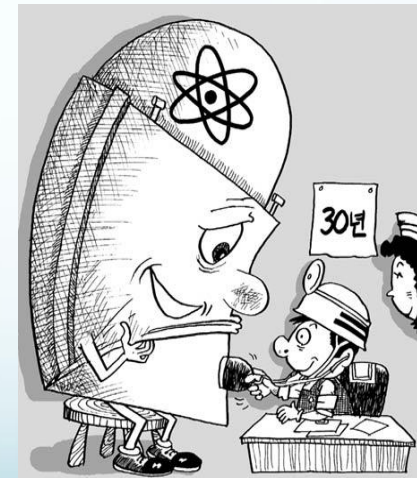
- 16 Mar ~ 18 Mar (3 days)
- 21 Units in Operation
- 44 Experts in KHNP, KEPCO E&C, KNFC
- Areas
  - Impact on ON/OFFsite Power
  - Integrity of core cooling system
  - Integrity of RV
  - Integrity of RadWaste Storage Tk

## Safety-Inspection By Gov.

- 28 Mar ~ 13 Apr (17 days)
- 21 Units in Operation
- MEST\*(KINS\*)
- Areas : 27 Items in 6 Categories

## Safety-Inspection On Kori #1

- 22 Apr ~ 3 May (12 days)
- MEST(KINS)



\* MEST : Ministry of Education & Science Technology

\* KINS : Korea Institute of Nuclear Safety

# Immediate follow-ups (“stress tests”)

## Assumptions

Earthquake event → Big tsunami → Loss of electric power  
→ Severe nuclear accident

## Areas of SI

1	Safety of structures and equipment <b>against earthquake</b>
2	Safety of structures and equipment <b>against coastal flooding</b>
3	<b>Integrity of electric power, cooling, and fire protection systems</b> when inundation occurs
4	<b>Severe accident response</b>
5	<b>Emergency Response and Emergency Medical Systems</b>
6	<b>Long-term, in-Service NPPs</b>

# 1. Safety against earthquake

## Current Status

- Design Basis Earthquake : 0.2g
- Manually Shutdown

## Improvements

- **Installing automatic seismic trip system**
  - Shutdown > 0.18g, All NPPs, ~2012
- **Improving the seismic capacity of the Safe Shutdown System**
  - 0.3g, All NPPs, ~2014



## 2. Safety against coastal flooding

### Current Status

<Table> Possible maximum sea water level by the nuclear power plant's site and freeboard (m)

	Possible maximum coastal flooding		Maximum possible sea water level	Site elevation*	Freeboard
	Storm	Earthquake			
Kori NPP	2.5	0.3	7.2	7.5 (Kori #1-#2)	0.3
				9.5 (Kori #3-#4)	2.3
Weolsung NPP	2.0	0.5	7.2	12	4.8
Youngkwang NPP	2.3	-	8.4	10	1.6
Uljin NPP	0.9	3.0	5.7	10	4.3

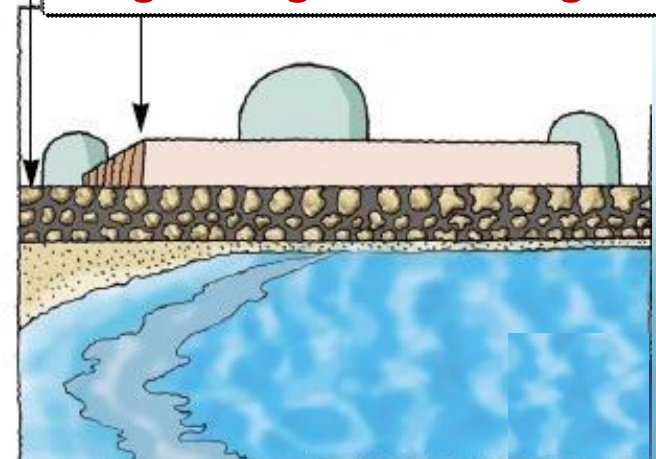
\* Kori Units 1 and 2: site elevation 5.8m + sea wall 1.7m

### Improvements

- **Extension of Sea Wall of Kori NPP**
  - +2.5m(equal to 10m), ~2012
- **Waterproof gate/drainage pump**
  - ~2014, All NPPs

#### Extension of Sea Wall

#### Heightening of Site Design



# 3. Integrity of power, cooling, fire protection system

## Current Status

## Improvements

### Electric Power System

- 2 EDGs / unit
  - Loss of offsite power
- 1 AAC DG / 2 or 4 units
  - Loss of cooling function(SBO)

- **movable vehicle** for generator and batteries
  - ~2014, All NPPs



### Cooling System

- Redundancy(2 trains)
- SFP has multiple sources

- **Prepare supplementary method**
  - **fire truck, etc.,**
  - ~2013, All NPPs

### Fire Protection System

- Fire hazards analysis /10 years
- Fire protection plans

- Improving the **firefighting plan**
- Improving fire protection facility
  - ~ 2015, All NPPs

# 4. Severe Accident Response

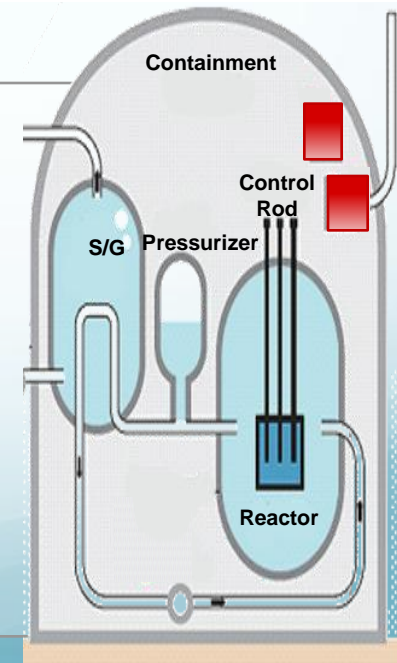
## Current Status

- TMI follow-up, Policy on Severe Accident (Aug. 2001)
- Hydrogen control facilities

Kori #1	Kori #2~#4, Youngkwang #1~#4, Uljin #1 #2	Weolsung #1	Weolsung #2~#4	Youngkwang #5~#6, Uljin #3~#6
Passive Hydrogen Recombiner, 34EA	Thermal Recombiner	None	Ignitor 44EA	Thermal Recombiner, Ignitor 18~20EA

## Improvements

- **passive hydrogen removal equipment**
  - ~2013
- **ventilation or depressurizing facilities in RCB**
  - ~2015, All NPPs
- **Install conduits for injecting nuclear reactor emergency cooling water from external sources**
  - ~2015, All NPPs



# 5. Emergency Response & Emergency Medical System

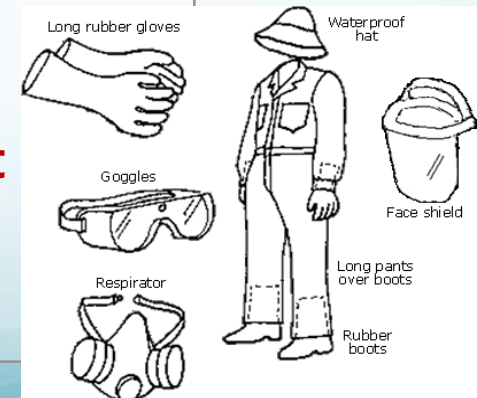
## Current Status

- Radiation emergency based on the "APPRE\*\*"
- Emergency response facilities : TSC, OSC, EOF
- Emergency exercises
- ERMS : 4hours without power



## Improvements

- **Amending the radiation emergency plan**
  - emergency alert at multiple units
  - ~2012, All NPPs
- **Securing additional rad-protection equipment**
  - protecting residents near NPP
  - ~2012, All NPPS



\* APPRE : The Act on Physical Protection and Radiological Emergency

TSC (Technical Support Center), OSC (Operating Support Center), EOF(Emergency Operation Facility)

# 6. Long Term, In Service NPP

## Current Status

**A long-term, in-service inspection plan is established**  
: confirm the integrity of the piping of major systems(RCS, etc)

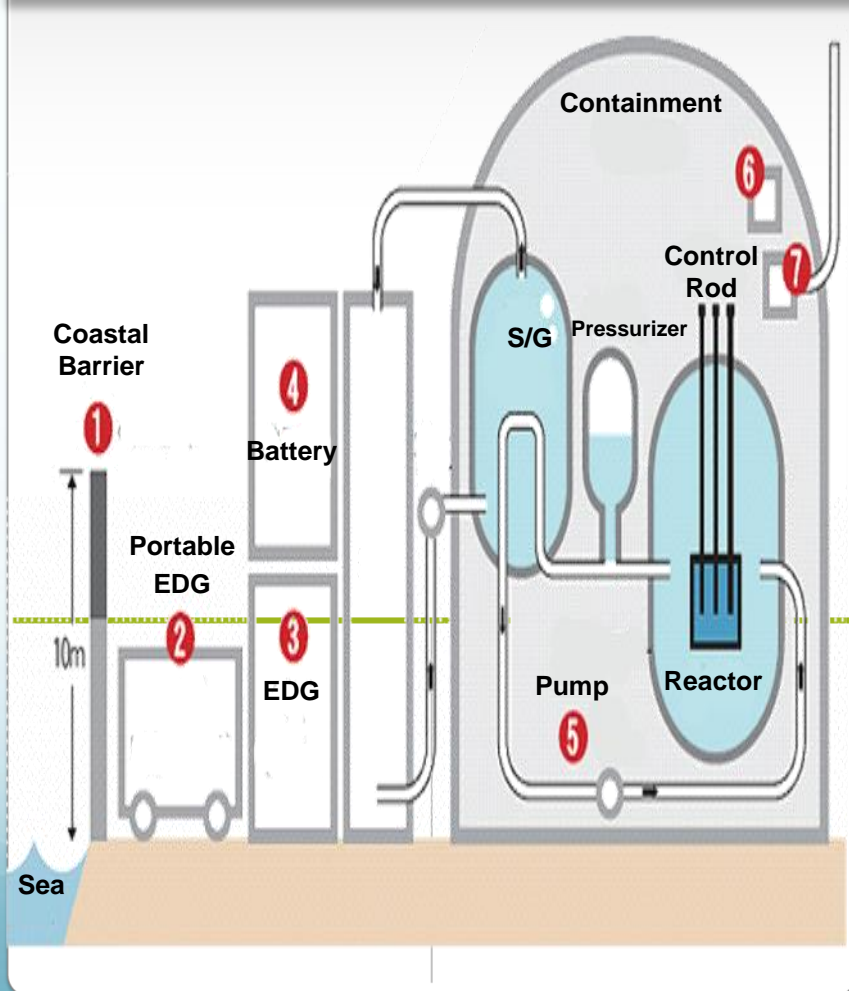
## Improvements

- **Drastically reinforcing the safety examinations**
  - Ex) regular examination
  - ~2012, 9 NPPs
- **Reinforcing management of components**
  - Safety related pumps, valves and pipes
  - ~2012, 8 NPPs



# Summary : Safety upgrades to be implemented

## Improvement for natural disasters



## 50 short and long term plans

- 1 Making the coastal barrier higher at Kori site
- 2 Preparing a vehicle with portable EDG at each site
- 3 Installing watertight doors at EDG Building
- 4 Securing the emergency battery power safe from flooding
- 5 Waterproofing pumps
- 6 Installing passive H<sub>2</sub> removal systems operating without electricity
- 7 Installing venting and decompression equipment

~\$1.1 billion investment over 5 years

# KHNP safety upgrades investment ( - 2015)

(Unit : million US Dollars)

No.	Categories	NPPs operating	NPPs under construction	Total
1	Safety of structures and equipment <b>against earthquake</b>	98	17	<b>115</b>
2	Safety of structures and equipment <b>against coastal flooding</b>	308	17	<b>325</b>
3	Integrity of <b>electric power, cooling, and fire protection</b> systems when inundation occurs	183	17	<b>200</b>
4	<b>Severe accident response</b>	405	37	<b>442</b>
5	<b>Emergency Response and Emergency Medical Systems</b>	22	0.3	<b>22</b>
6	<b>Long-term, in-Service NPP</b>	18	-	<b>18</b>
	<b>Total</b>	<b>1,034</b>	<b>88</b>	<b>1,123</b>

**Thank you**

**감사합니다**