Role of KINS for Emergency Preparedness and Response in Korea

Seung-Young Jeong, Ph.D
k504jsy@kins.re.kr
Korea Institute of Nuclear Safety (KINS)
Status of Nuclear Power Plant Operation in Korea

(As of November 2014)

In operation
23 units
(20,716 MW)

Under construction
5 units
(6,600 MW)

Under planning
10 units
(15,400 MW)

Radioactive Waste Disposal Facility
(Under construction)

Yonggwang
6 units

In Operation
Under Construction

Kori
4 units

Wolsong
4 units

Shin-Ulchín
2 units

Shin-Wolseong
2 units

Shin-Kori
4 units

Ulchín
6 units
Status of New Builds

**Shin-Kori units 1&2**
- 1,000 MWe OPRs (Korean Standard)
- Construction Permit in 2005.7
- Operating Licenses in 2010.5 & 2011.12

**Shin-Wolsong units 1&2**
- 1,000 MWe OPRs
- Construction Permit in 2007.6
- Operating License in 2011.12 (unit 1)

**Shin-Kori units 3&4**
- 1,400 MWe APRs
- Construction Permit in 2008.4
- Operating Licenses Applied in 2011.6

**Shin-Ulchin units 1&2**
- 1,400 MWe APRs
- Construction Permit in 2011.12
- Operation of 1st Unit in 2017
Radiological Emergency Preparedness/Response Organizations

President of ROK
  └ Report Situation
      └ President Office
          (National Crisis Management Office)

Prime Minister
  └ Central Security Management Committee

  Nuclear Safety & Security Commission (Leading Authority)
    └ National Emergency Management Committee (NEMC)
        (Central Command & Control Center)

  Other Ministries of Concern
  └ Cooperation Support

  Nuclear Licensee
    └ Emergency Operations Facility (EOF) at Head Quarter Office

  KINS
    └ Radiological Emergency Technical Advisory Center (RETAC)

  NSSC
    └ Offsite Emergency Management Center (OEMC)

  KIRAMS
    └ Radiological Emergency Medical Service Center (REMSC)

  Local Government (Metro City/Province)
    └ Local Emergency Management Center (LEMC) at Metro city/Province Office

  Emergency Operations Facility (EOF) at the Power Plant

  Offsite Technical Support Group

  Offsite Medical Support Group

  Local Government (City/County)
    └ Local Emergency Management Center (LEMC) at City/County Office

Local Fire Department/119 Rescue Services/National Police Agency/Korea Coast Guard/Military Services/Public Health Center/Hospitals/Medical Centers & Local Public Organizations

Local Emergency Rescue Service Control Unit (Emergency Management Center)
Emergency Response Steps

- **President**
  - **Prime Minister**

**Nuclear Emergency Management Committee (NEMC-NSSC)**

**OEMC (NSSC)**
- Off-site Emergency Management Center
- Decision of Protective Action
  - Site-area emergency
  - General emergency
- Information Dispatch: RETAC (KINS)
- Dispatch: REMSC (KIRAMS)
- Information Dispatch: JPIC

**LEMC**
- Emergency Report

**OEMCAC**
- Advise

**JPIC**
- Joint Public Information Center

**JRMC**
- Civil, Official, Military
- Environ. Monitoring

**JREMSC**
- Primary/Secondary Hospital

**Residents**
- Emer. Notification
- Direct Sheltering etc.

**Emergency Report**
- Protective Action Measure Order
Off-Site Emergency Center (NSSC-OEMC)
<table>
<thead>
<tr>
<th>EAL</th>
<th>Criteria</th>
<th>PPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility emergency</td>
<td>• An emergency of which radiological impact arising from leakage of radioactive materials is expected to be limited to the building of the nuclear facilities Ex) severe damages on the fuel claddings</td>
<td>Pre-NEMC, Pre-OEMC, Pre-LEMC, Pre-RETAC, Pre-REMSC</td>
</tr>
<tr>
<td>Site-area emergency</td>
<td>• An emergency of which radiological impact arising from leakage of radioactive materials is expected to be limited to the site of the nuclear facilities Ex) loss of coolant exceed the capacity of the charging pump</td>
<td>NEMC, OEMC, LEMC, EOF, RETAC, REMSC</td>
</tr>
<tr>
<td>General emergency</td>
<td>• An emergency of which radiological impact arising from leakage of radioactive materials is expected to reach the outside of the nuclear facilities Ex) massive release of radioactive materials into the environment</td>
<td>PAZ Evacuation, Assessment Prognosis, Environmental Monitoring,</td>
</tr>
</tbody>
</table>

EAL: Emergency Action Level
● **Collects Environmental Radiation Levels (National Wide & Marine)**
  - Real time monitoring of nationwide environmental radiation levels
  - 1 Central Monitoring Station / 14 Regional Monitoring Stations (CAMSNet)
  - 113 Unmanned Monitoring Posts
  - 3 Xenon Monitoring Station
    (meteorological monitoring posts, remote islands, army bases)

● **Detects any Abnormal Variations in Environmental Radiation Levels**

● **Open to public using web & mobile phone application**

  [http://IERNet.kins.re.kr/](http://IERNet.kins.re.kr/)
Radiological Emergency Technical Advisory Center (KINS-RETAC)

- Technical Advice on Emergency Management
- Off-Site Radiological Monitoring and Evaluation Support
- Makes recommendation for emergency response measures
- Operates the Nuclear Emergency Management System (AtomCARE)
Joint Radiological Environmental Monitoring

- Aerial Survey
- Radioactive Airborne Dust Sampling
- Car-borne Survey
- Mobile Monitoring Post
- SIREN
- In Situ Gamma Spectroscopy
SIREN (System for Identifying Radiation in Environments Nationwide)
Functions of Emergency Response System

- Assess status of safety functions of the nuclear power reactors on a real-time basis
- Provide recommendations for the public protective measures to the government

Monitoring and Detection:
- Safety Information Display System
- Environmental Monitoring - Domestic

Emergency Characterization:
- Accident Characterization and Source Term Evaluation
- Meteorological Data Acquisition

Emergency Management:
- Dose Assessment-Domestic
- Dose Assessment - Global
- Protective Action Advice
- Cooperative Consequence Management
- Commands and Control

Consequence Management:
- IAEA early Notification convention
**SIDS & STES**

- **SIDS**: Collects & Analyzes Operational Information
  - Displays real time safety parameter values of NPP & RR

- **STES**: Estimates the Radiation Source Term of an accident
  - Assesses the degree of reactor core damage
  - Estimates the reduction factor & pathways of radioactive materials
  - Estimates the amount of released radioactive materials
- Collects Meteorological Information
  - Automatic weather stations in each NPP site
  - AWS weather information every 10 minutes from KMA (about 600 site)
  - Numerical Weather Prediction data every 6 hours from KMA (horizontal res. 100, 12, 1.5km)

- Generates 3-D Wind Fields
  - Altitudinal Range: 50 ~ 1500 m
  - Numerical Weather Prediction Data from KMA
FADAS & ADAMO-GR

- **FADAS**: Evaluates the Resultant Dose & Effects
  - Dose assessment in domestic region
  - Predicts the size of an affected area
  - Evaluates the radiation dose for the public

- **ADAMO-GR**
  - Dose assessment in global region
  - Meteorological data
    - East Asia region: horizontal res. 12km
    - Global region: horizontal res. 100km
  - Source term data
    - NPP source term data of oversea
Drill Scenario Using FADAS

‘12 UlJin Unified Drill Scenario

‘13 Yeonggwang Integrated Drill
### Public Protective Action Level

- **Generic Intervention Level (GIL)**

#### Standards for Determining Sheltering, Evacuation, Iodine Prophylaxis Distribution, etc.

<table>
<thead>
<tr>
<th>Urgent Public Protective Action</th>
<th>Determination Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheltering</td>
<td>10 mSv</td>
</tr>
<tr>
<td>Evacuation</td>
<td>50 mSv</td>
</tr>
<tr>
<td>Distribution of Iodine Prophylaxis</td>
<td>100 mGy</td>
</tr>
<tr>
<td>Temporary Relocation</td>
<td>30 mSv/first one month</td>
</tr>
<tr>
<td></td>
<td>10 mSv/next one month</td>
</tr>
<tr>
<td>Permanent Resettlement</td>
<td>1 Sv/lifetime</td>
</tr>
</tbody>
</table>

#### Standards for Restriction on the Ingestion of Food

<table>
<thead>
<tr>
<th>Classification</th>
<th>Radionuclide</th>
<th>Meat/Fish/Crops (Bq/kg)</th>
<th>Vegetable/Fruit (Bq/kg)</th>
<th>Water/Milk (Bq/L)</th>
<th>Infant Food (Bq/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>$^{134}\text{Cs}$, $^{137}\text{Cs}$, $^{103}\text{Ru}$, $^{103}\text{Ru}$, $^{85}\text{Sr}$</td>
<td>2,000</td>
<td>1,000</td>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>Group 2</td>
<td>$^{131}\text{I}$, $^{90}\text{Sr}$</td>
<td>1,000</td>
<td>500</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Group 3</td>
<td>$^{235}\text{U}$, $^{238}\text{U}$</td>
<td>100</td>
<td>100</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Group 4</td>
<td>$^{241}\text{Am}$, $^{238}\text{Pu}$, $^{239}\text{Pu}$, $^{240}\text{Pu}$, $^{242}\text{Pu}$</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Group 5</td>
<td>$^{3}\text{H}$</td>
<td>100 kBq/L</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
● Web-based Interactive Emergency Response Information Sharing System
  - Exclusive access with an authentication process
  - On-line information sharing among the relevant organizations
  - Electronic document management function
  - Multi-user bulletin board function
  - Multi-message injection function

● Communication by Video Conference
Emergency Training & Exercise

● **Unified Emergency Exercise**
  - The Chairman NSSC conducts a radiological emergency exercise involving the central administrative agencies concerned *every five years*

● **Integrated Emergency Exercise**
  - The metropolitan city mayor/provincial governor and city mayor/county chief/district chief conduct a radiological emergency exercise *every four years*.

● **On-site Emergency Exercise**
  - Two units perform *once every year*

● **Drill**: Participation of each on-site emergency organization
  - One unit or Two units perform *once every quarter*

● **Initial exercise**
Unified Radiological Emergency Exercise

(2012.10.10~11), Ulchin NPP Site

- 700 Participants from 50 Organizations
- Preparedness and response of Korean emergency management to radiological emergency reflecting Fukushima lessons learned
- Exercise of Evacuation against the tsunami and NPP accident
Unified Drill Main Activities

- Evacuation against natural disaster & radiological accident
  - Evacuate the public and non-emergency workers of NPP using Alert

- Rapid recovery of emergency communication system

- Environmental Radiation Monitoring
  - Conduction of radioactive prospecting using vehicles, helicopters and ships
Unified Drill Main Activities

- **Fire Fighting & Life Saving**
  - Decision-making for urgent protective action, Operation of evacuee shelter

- **Medical treatment of contaminated persons**
  - Rescue, triage, decontamination and emergency transfer
<table>
<thead>
<tr>
<th>Accident Scenario</th>
<th>Major Items of Improvement</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occurrence of Earthquake</td>
<td>• Installing an Automatic Seismic Trip System</td>
<td>Completed by 2013 - Installed at 20 units (as of 2013.4)</td>
</tr>
<tr>
<td>Occurrence of Tsunami</td>
<td>• Extension of Sea Wall Height for Kori NPPs</td>
<td>Completed in 2012</td>
</tr>
<tr>
<td>Station Blackout</td>
<td>• Stand-by Unit of a Mobile Electricity Generating Vehicle</td>
<td>Completed by 2014 - Installed at Wolseong &amp; Kori site (as of 2013.4)</td>
</tr>
<tr>
<td>Loss of Cooling of Reactor and SFP</td>
<td>• Installing Conduits for Injecting from External Water Sources</td>
<td>Completed by 2015 - Installation under way at Kori Unit 1 &amp; 2</td>
</tr>
<tr>
<td></td>
<td>• Ensuring Coolability When Loss of the Cooling Function of SFP Occurs</td>
<td>Completed in 2012</td>
</tr>
<tr>
<td>Hydrogen Explosion</td>
<td>• Installing Passive Hydrogen Removal Equipment (PARs)</td>
<td>Completed by 2013 - Installed at 8 units including Kori Unit 1</td>
</tr>
<tr>
<td>Containment Pressurization &amp;</td>
<td>• Installing Containment Building Filtered Ventilation or Depression Systems</td>
<td>Completed by 2015 - Installation under way at Wolseong Unit 1</td>
</tr>
<tr>
<td>Release of Radioactive Material</td>
<td>• Securing Additional Radiological Protection Equipment for Residents</td>
<td>Completed in 2012</td>
</tr>
</tbody>
</table>
Emergency Planning Zone (Before)

EPZ 8~10 km

Off-Site Environmental Monitoring

National Environmental Monitoring (IERNet)
http://iernet.kins.re.kr/

OEMC
LEMC
Evacuation Center
New Emergency Planning Zone (May, 2014)

Off-Site Environmental Monitoring

National Environmental Monitoring (IERNet)
http://iernet.kins.re.kr/
Fukushima Catastrophic Earthquake

Activated Emergency Situation Management Operational Center right after 311 Fukushima Catastrophic Disaster

- To Monitor Japanese situation
  - Accident progression
  - Radiation environmental condition
  - Air Stream trajectory

- To Assess Domestic impact
  - Radiation environmental condition
  - Public Health impact
Fukushima Catastrophic Earthquake

Boarder radiation surveillance check for Immigrant from Japan at the international Airports and Seaports

- Radiation Portal Monitor surveillance (screening)
  - 4 international Airports, two international seaports
  - Around 400,000 immigrants were taken voluntarily

- Surface contamination Check
  - only few people were chosen for surface contamination check
### Results of Fukushima emergency monitoring around the Korea

<table>
<thead>
<tr>
<th>Category</th>
<th>Range of radioactivity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$^{131}I$</td>
<td>$^{137}Cs$</td>
</tr>
<tr>
<td>Tap water</td>
<td>&lt; MDA</td>
<td>&lt; MDA</td>
</tr>
<tr>
<td>Rainfall</td>
<td>ND~2.81</td>
<td>ND~2.02</td>
</tr>
<tr>
<td>Seawater</td>
<td>&lt; 0.495</td>
<td>&lt; 4.37</td>
</tr>
<tr>
<td>Marine organisms</td>
<td>&lt; 0.422</td>
<td>0.0927~0.253</td>
</tr>
<tr>
<td>Soil</td>
<td>&lt; 4.44</td>
<td>1.45~16.0</td>
</tr>
<tr>
<td>Bottom sediment</td>
<td>Waiting the results</td>
<td>Waiting the results</td>
</tr>
<tr>
<td>Air borne dust</td>
<td>ND~0.458</td>
<td>ND~0.164</td>
</tr>
</tbody>
</table>

**ND:** Not Detectable

**First Detection Date**

$^{131}I$: 24 March (Airborne dust), $^{137}Cs$ and $^{134}Cs$: 24 March (Airborne dust), $^{110m}Ag$: 31 March (Airborne dust), $^{239+240}Pu$: 4 April (Soil); $^{133}Xe$: 23 March
10 monitoring units are installed at 7 major ports in 2014.

- Incheon: 6
- Pyeongtaek: 7
- Mokpo: 3
- Kwangyang: 6
- Busan: 6
- Ulsan: 4
- Pohang: 1
Thank you for your attention!