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)

한국원자력안전기술원
KINS KOREA INSTITUTE OF NUCLEAR SAFETY

Status of Nuclear Power Plant Operation in Korea

In operation
23 units
(20,716 MW)

Under construction
5 units
(6,600 MW)

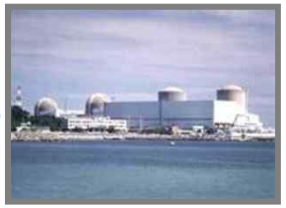
Under planning
10 units
(15,400 MW)

(As of November 2014)

Radioactive Waste Disposal Facility
(Under construction)

Ulchin 6 units
Shin-Ulchin 2 units

Wolsong 4 units
Shin-Wolseong 2 units



Kori 4 units
Shin-Kori 4 units

Yonggwang
6 units

In Operation
Under Construction

Status of New Builds

Shin-Kori units 1&2

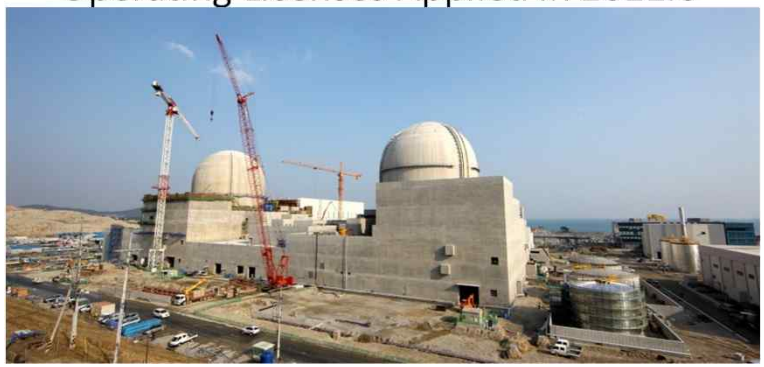
- 1,000 MWe OPRs (Korean Standard)
- Construction Permit in 2005.7
- Operating Licenses in 2010.5 & 2011.12

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

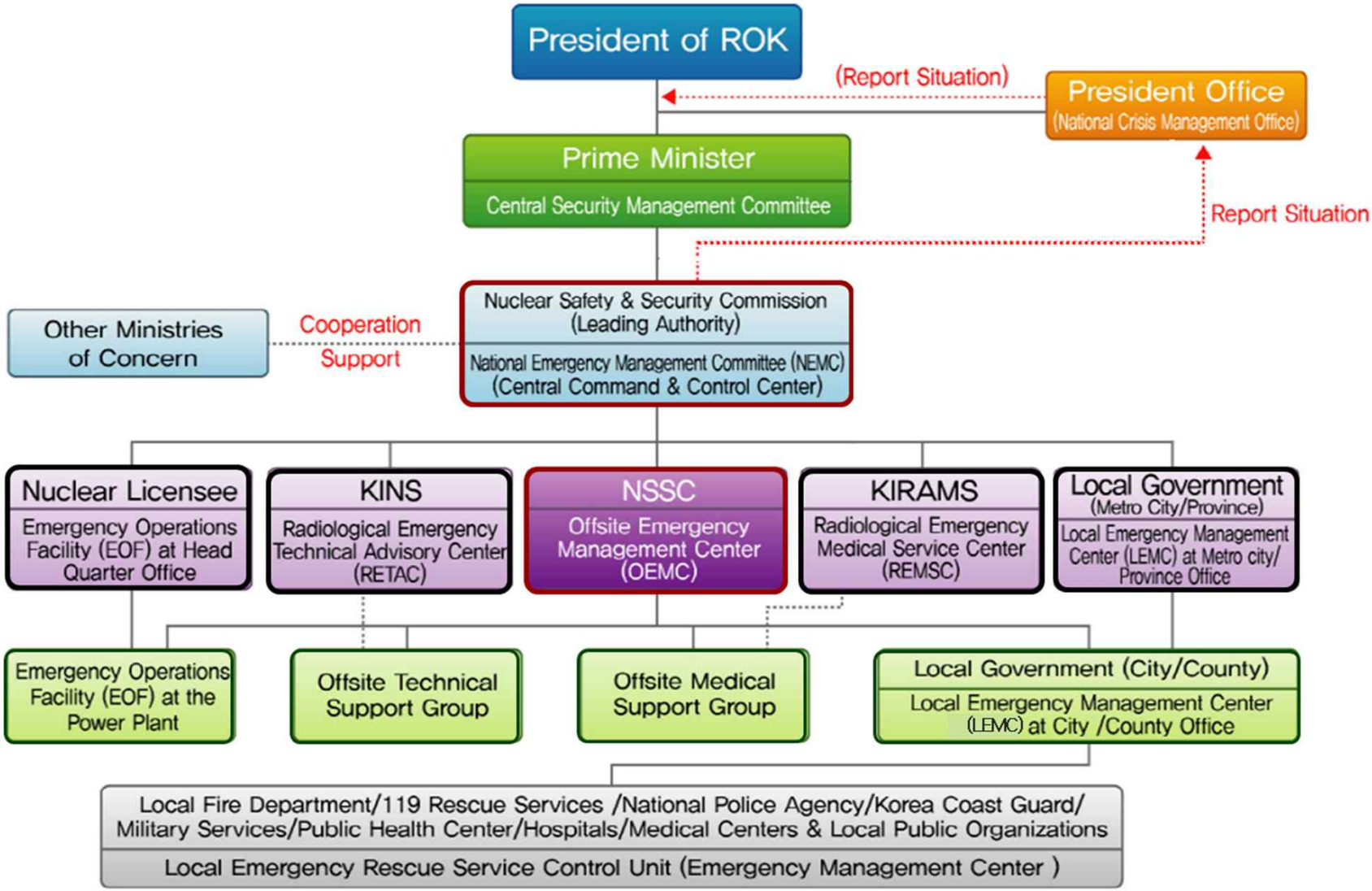
- 1,400 MWe APRs
- Construction Permit in 2008.4
- Operating Licenses Applied in 2011.6



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



Emergency Response Steps

President

Prime Minister

Nuclear Emergency Management Committee (NEMC-NSSC)

Disaster Declaration
Disaster Cancellation
(Advised by the head of RETAC)

Licensee Emergency Report

Emergency Report

Emergency Report

Protective Action Measure Order

OEMC (NSSC)
Off-site Emergency Management Center

Information Dispatch

RETAC (KINS)

Decision of Protective Action
- Site-area emergency
- General emergency

OEMCAC
Advise

JPIC
Joint Public information Center

Dispatch

REMSC (KIRAMS)

LEMC

JRMC
(Civil, Official. Military)
Environ. Monitoring

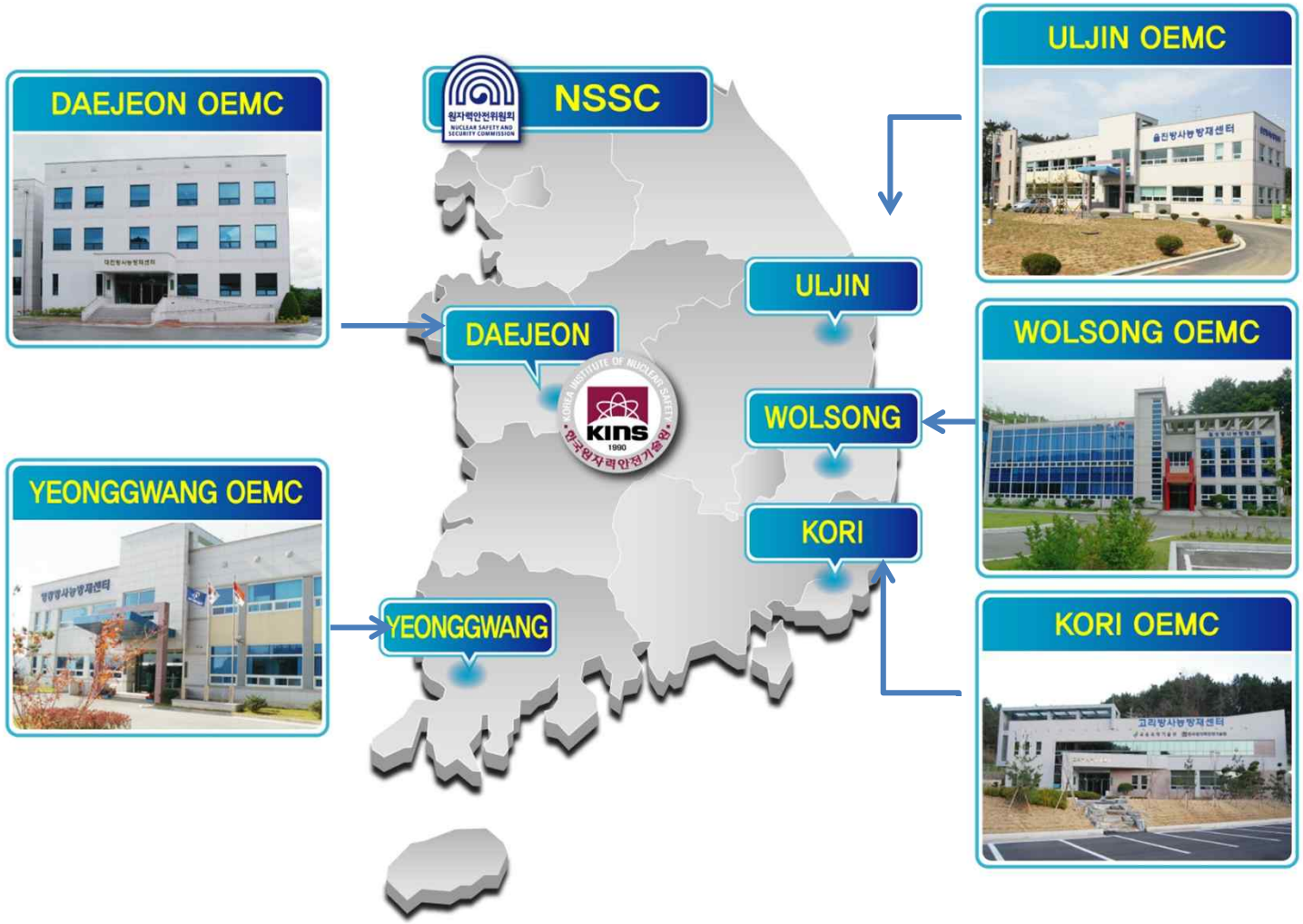
JREMSC
(Primary,/Secondary Hospital

- Emer. Notification
- Direct Sheltering etc.

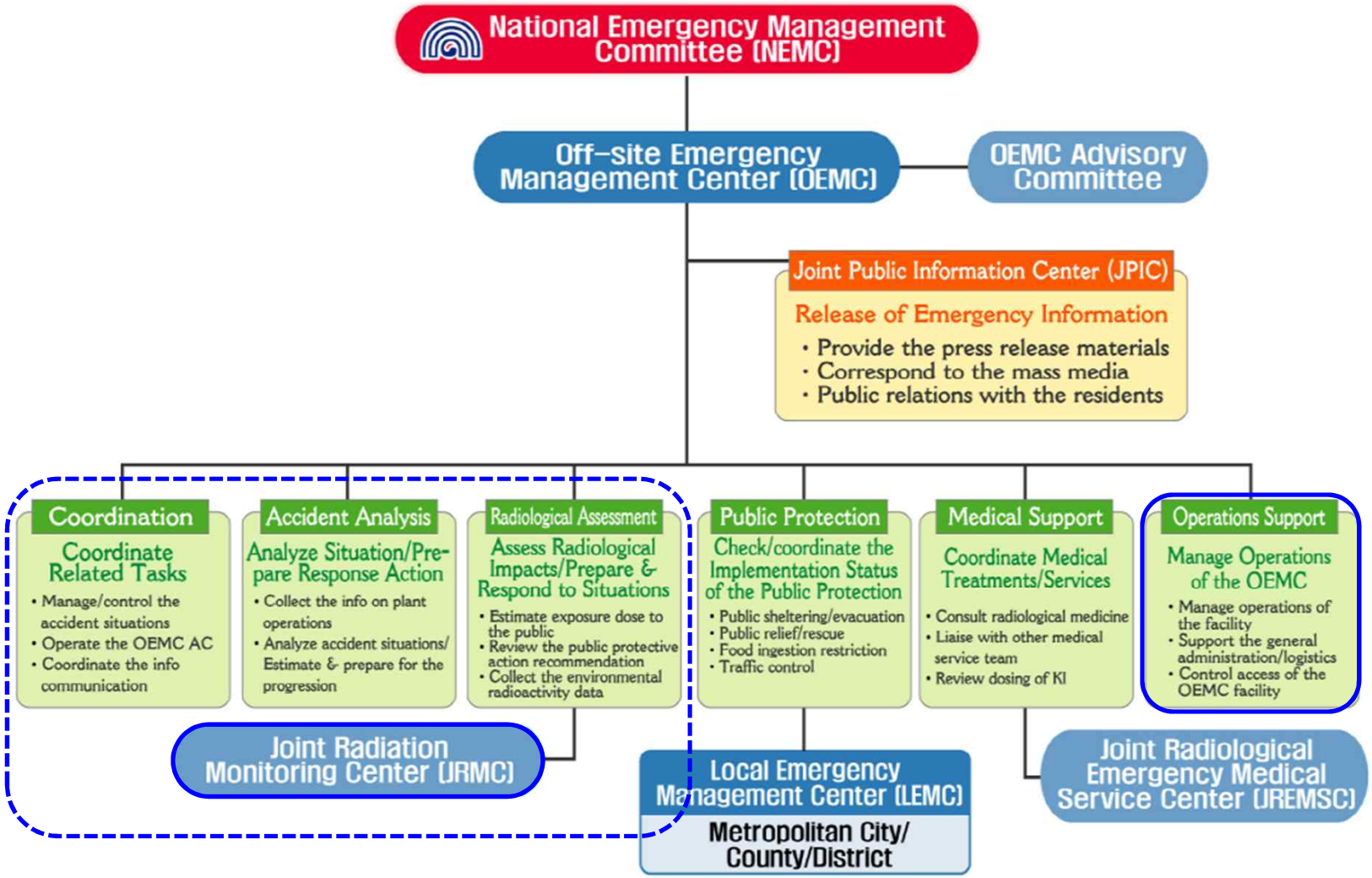
Residents

Emerge eration Facility nsee)

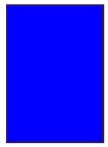
Off-Site Emergency Center (NSSC-OEMC)



Emergency Management Center (NEMC/OEMC)



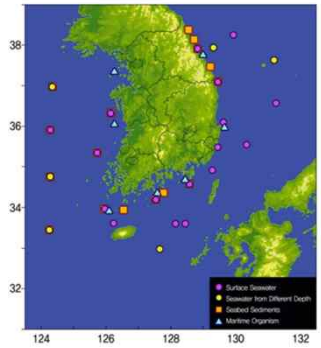
Emergency Classification Criteria

EAL	Criteria	PPA
Facility emergency 	• 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	Pre-NEMC Pre-OEMC Pre-LEMC Pre-RETAC Pre-REMSC
Site-area emergency 	• 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	NEMC OEMC LEMC EOF RETAC REMSC
General emergency 	• 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	PAZ Evacuation, Assessment Prognosis, Environmental Monitoring,

EAL: Emergency Action Level

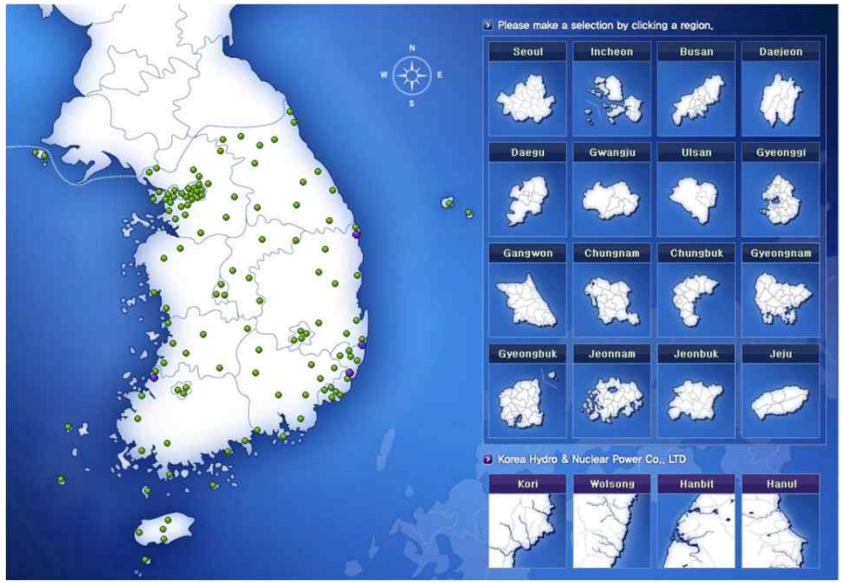
Environmental Radiation Monitoring

- **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/



eRAD@NOW

Radiological Emergency Technical Advisory Center (KINS-RETAC)

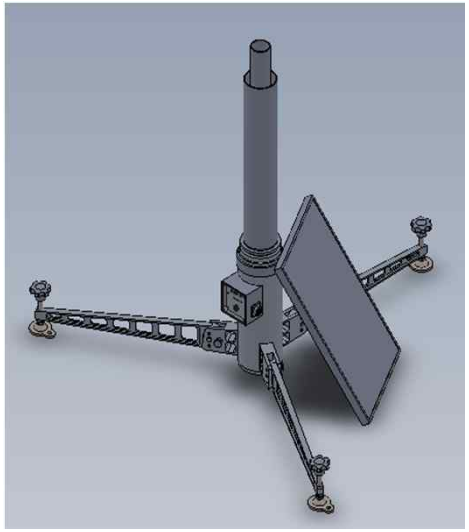
- Technical Advice on Emergency Management
- Off-Site Radiological Monitoring and Evaluation Support
- Makes recommendation for emergency response measures
- Operates the Nuclear Emergency Management System (AtomCARE)

Joint Radiological Environmental Monitoring

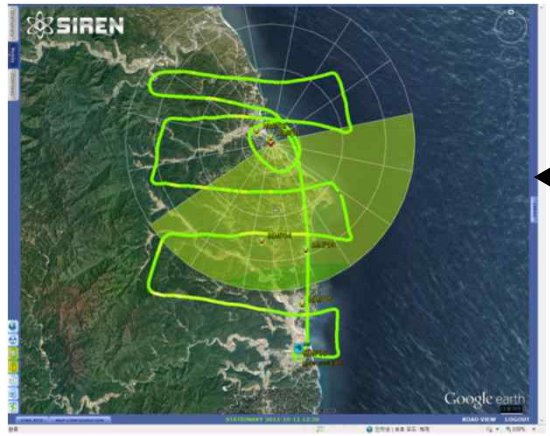
Aerial Survey

Radioactive Airborne Dust Sampling

Car-borne Survey



Mobile Monitoring Post



SIREN

In Situ Gamma Spectroscopy

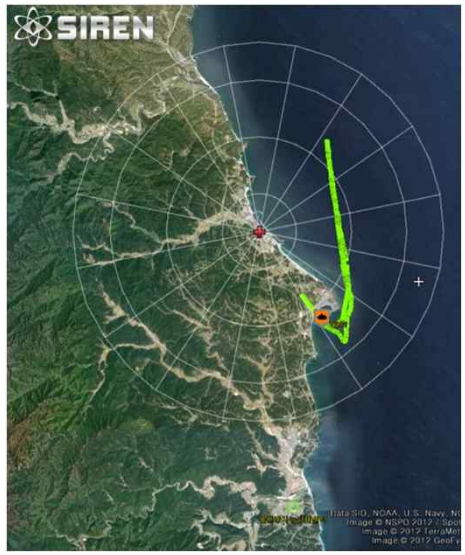
SIREN (System for Identifying Radiation in Environments Nationwide)

Environmental Monitoring Activity

By car

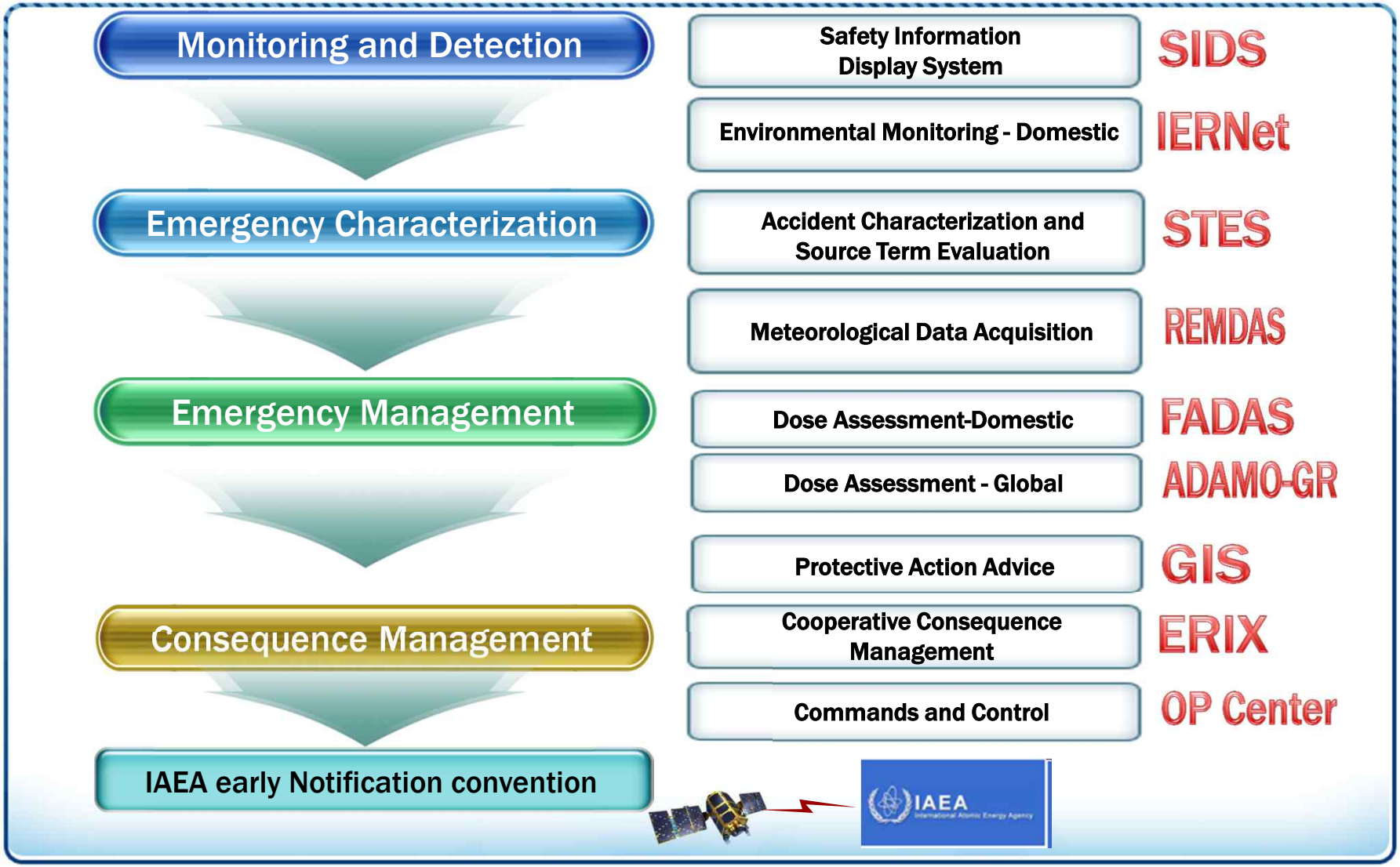
By helicopter

By ship



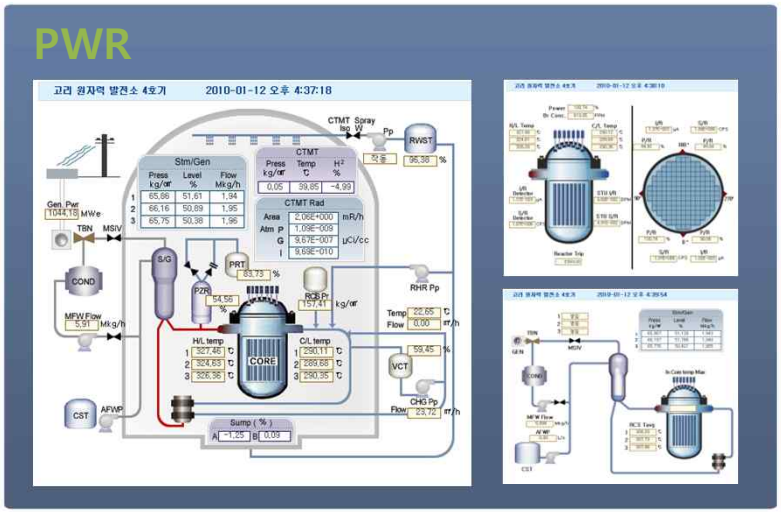
Functions of Emergency Response System

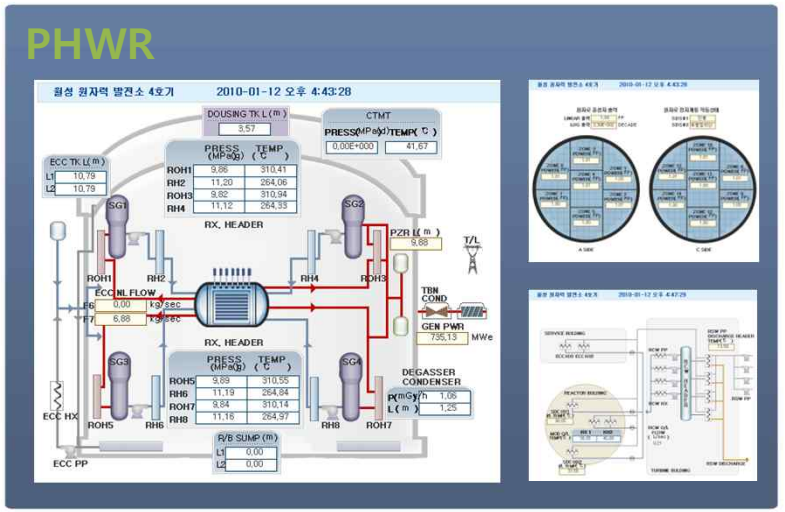
- **Assess status of safety functions of the nuclear power reactors on a real-time basis**
- **Provide recommendations for the public protective measures to the government**



SIDS & STES

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





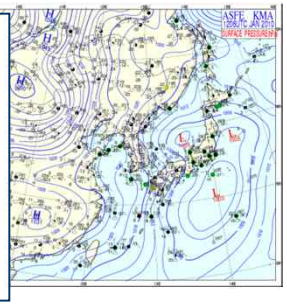
- **STES: Estimates the Radiation Source Term of an accident**
  - **Assesses the degree of reactor core damage**
  - **Estimates the reduction factor & pathways of radioactive materials**
  - **Estimates the amount of released radioactive materials**

REMDAS

● Collects Meteorological Information

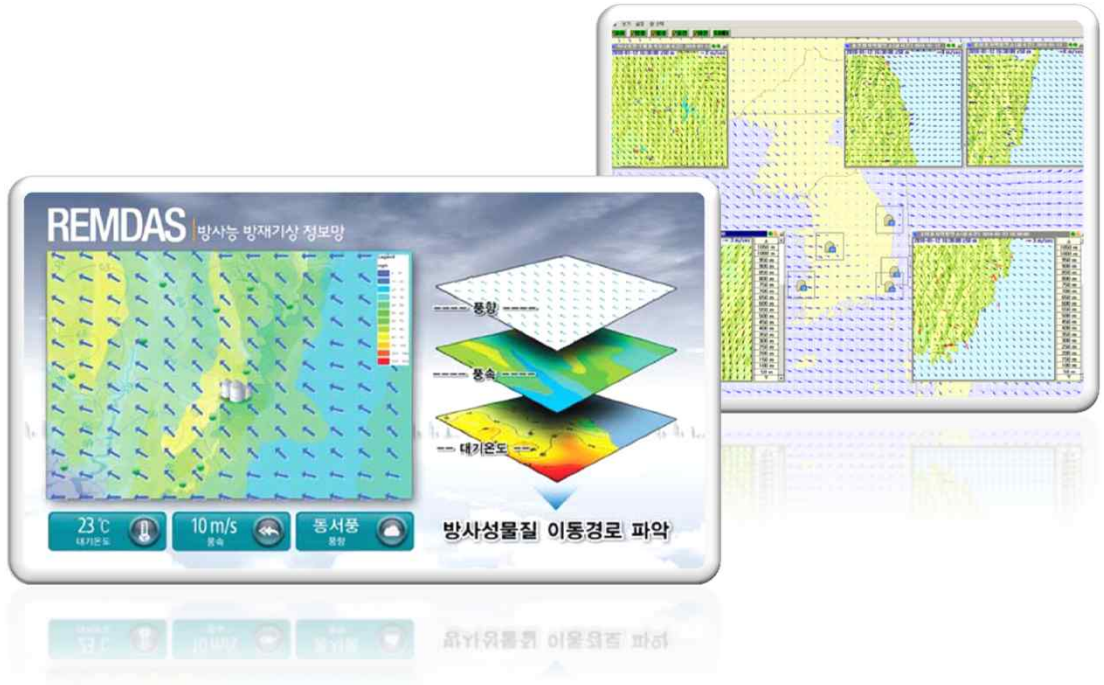


- Automatic weather stations in each NPP site
- AWS weather information every 10 minutes from KMA (about 600 site)
- Numerical Weather Prediction data every 6 hours from KMA (horizontal res. 100, 12, 1.5km)

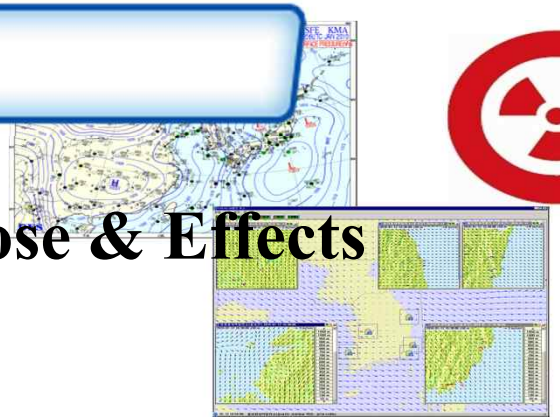


● Generates 3-D Wind Fields

- Altitudinal Range: 50 ~ 1500 m
- Numerical Weather Prediction Data from KMA

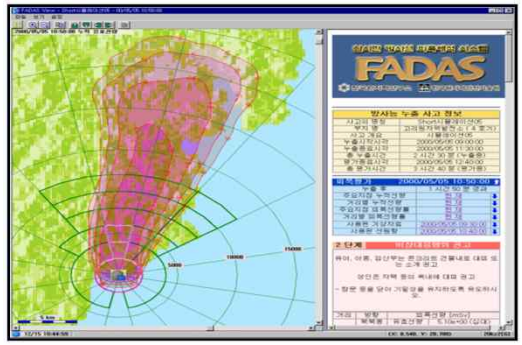


FADAS & ADAMO-GR



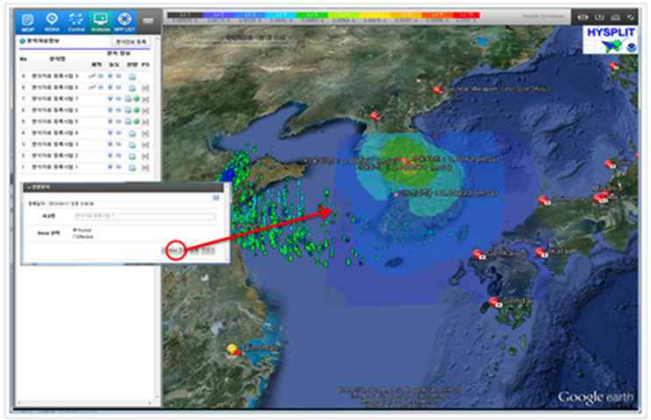
- **FADAS : Evaluates the Resultant Dose & Effects**

  - Dose assessment in domestic region
  - Predicts the size of an affected area
  - Evaluates the radiation dose for the public



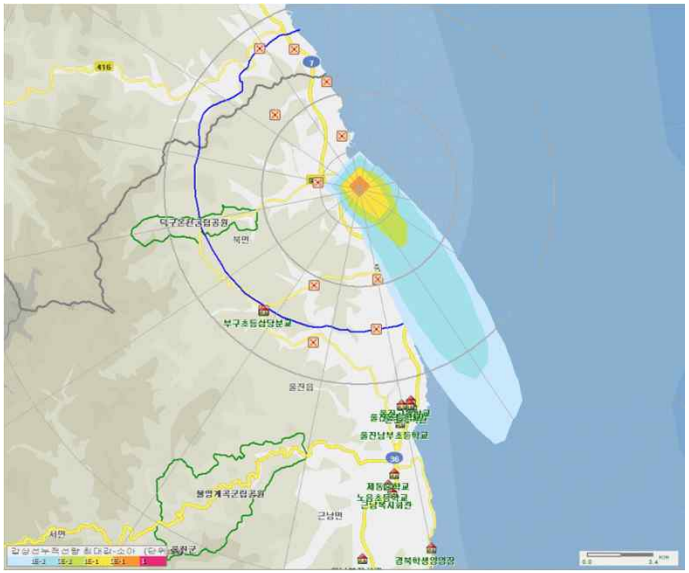
- **ADAMO-GR**

  - 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.

Urgent Public Protective Action	Determination Standards
Sheltering	10 mSv
Evacuation	50 mSv
Distribution of Iodine Prophylaxis	100 mGy
Temporary Relocation	30 mSv/first one month 10 mSv/next one month
Permanent Resettlement	1 Sv/lifetime

Standards for Restriction on the Ingestion of Food

Classification			Meat/ Fish/ Crops (Bq/kg)	Vegetable /Fruit (Bq/kg)	Water/ Milk (Bq/L)	Infant Food (Bq/kg)
Radionuclide	Group 1	^{134}Cs, ^{137}Cs, ^{103}Ru, ^{103}Ru, ^{89}Sr	2,000	1,000	200	100
	Group 2	^{131}I, ^{90}Sr	1,000	500	100	10
	Group 3	^{235}U, ^{238}U	100	100	20	10
	Group 4	^{241}Am, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu	10	10	10	1
	Group 5	^{3}H	100 kBq/L			

Communication (ERIX, Video Conference)

- **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

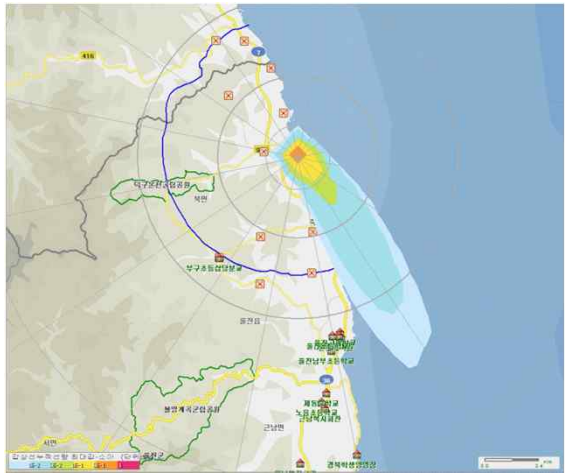
- **Unified Emergency Exercise**
  - The Chairman NSSC conducts a radiological emergency exercise involving the central administrative agencies concerned every five years

- **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

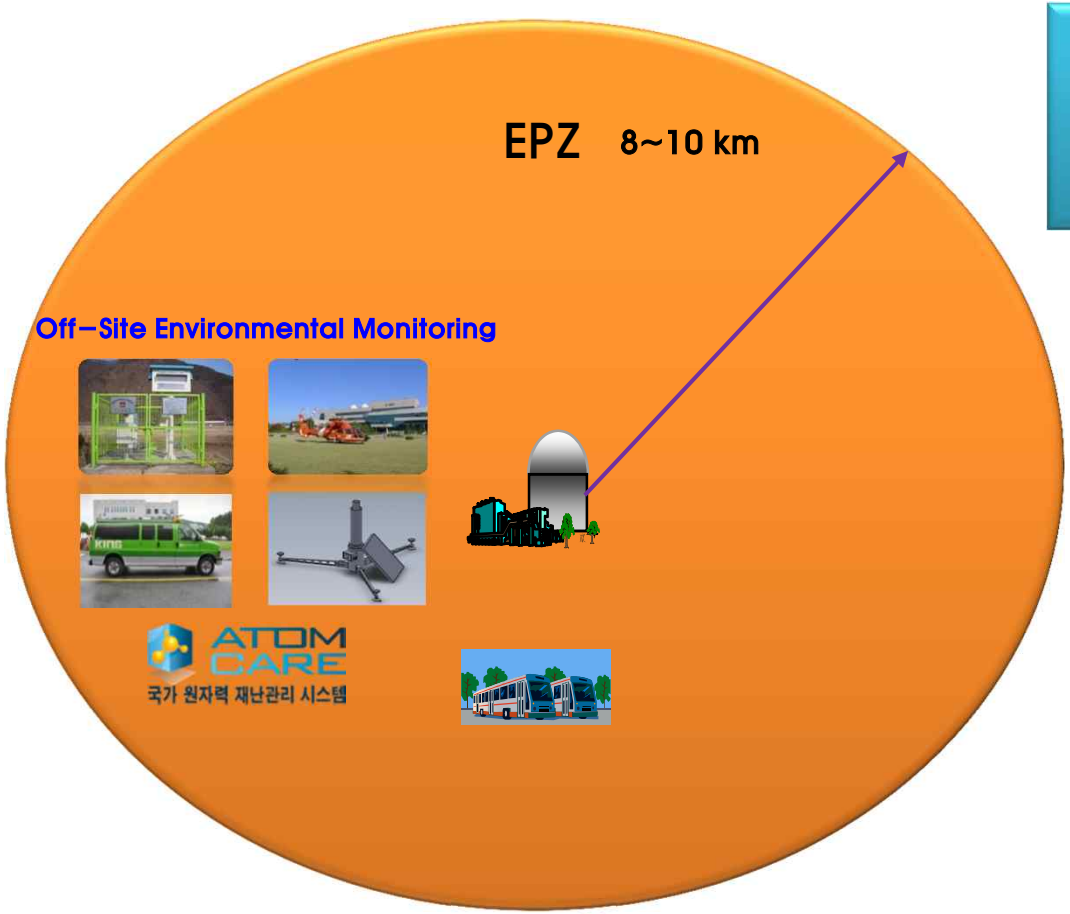
- **Medical treatment of contaminated persons**

  - Rescue, triage, decontamination and emergency transfer

Major Items of Improvements after Fukushima Accident

Accident Scenario	Major Items of Improvement	
Occurrence of Earthquake	• Installing an Automatic Seismic Trip System	• Completed by 2013 - Installed at 20 units (as of 2013.4)
Occurrence of Tsunami	• Extension of Sea Wall Height for Kori NPPs	• Completed in 2012
Station Blackout	• Stand-by Unit of a Mobile Electricity Generating Vehicle	• Completed by 2014 - Installed at Wolseong & Kori site (as of 2013.4)
Loss of Cooling of Reactor and SFP	• Installing Conduits for Injecting from External Water Sources • Ensuring Coolability When Loss of the Cooling Function of SFP Occurs	• Completed by 2015 - Installation under way at Kori Unit 1&2 • Completed in 2012
Hydrogen Explosion	• Installing Passive Hydrogen Removal Equipment (PARs)	• Completed by 2013 - Installed at 8 units including Kori Unit 1
Containment Pressurization & Release of Radioactive Material	• Installing Containment Building Filtered Ventilation or Depression Systems • Securing Additional Radiological Protection Equipment for Residents	• Completed by 2015 - Installation under way at Wolseong Unit 1 • Completed in 2012

Emergency Planning Zone (Before)



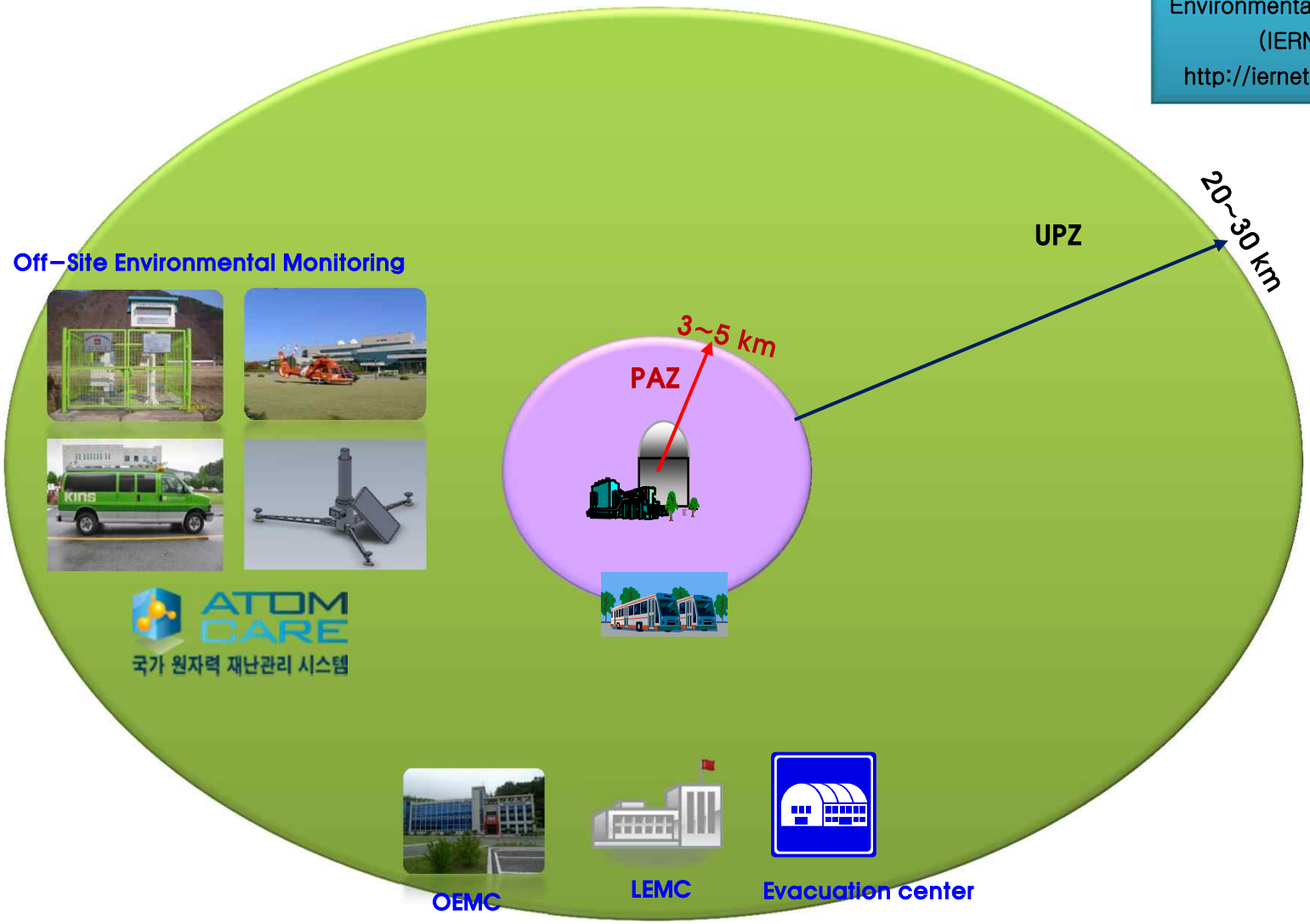
National

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

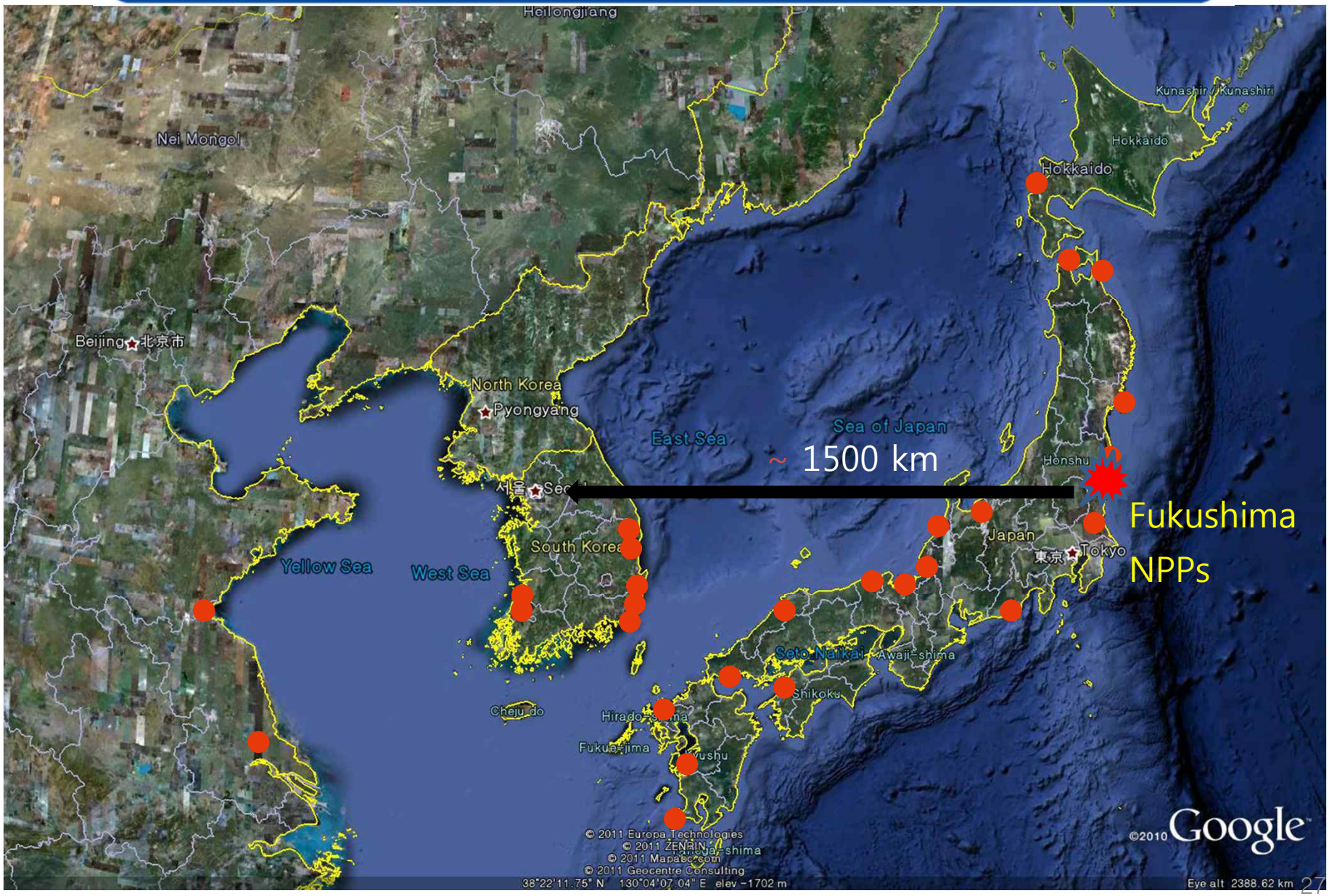
New Emergency Planning Zone (May, 2014))

National

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



Geographical Location



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

Category	Range of radioactivity				Unit
	^{131}I	^{137}Cs	^{134}Cs	$^{239+240}Pu$	
Tap water	<MDA	<MDA	-	-	Bq/L
Rainfall	ND~2.81	ND~2.02	ND~1.67		Bq/L
Seawater	< 0.495	< 4.37	< 4.42	<0.00197~0.00414	mBq/kg
Marine organisms	< 0.422	0.0927~0.253	< 0.191	Waiting the results	Bq/kg
Soil	< 4.44	1.45~16.0	< 4.16	<0.00869~0.477	Bq/kg
Bottom sediment	Waiting the results	Waiting the results	Waiting the results	Waiting the results	Bq/kg·dry
Air borne dust	ND~0.458	ND~0.164	ND~0.169	-	mBq/m^3

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), $^{239+2401}Pu$: 4 April(Soil); ^{133}Xe: 23 March

Radiation Monitoring Posts at International Seaports

10 monitoring units are installed at 7 major ports in 2014

Incheon : 6

Pohang : 1

Pyeongtaek : 7

Busan : 6

Ulsan : 4

Mokpo : 3

Kwangyang : 6

Thank you for your attention!