



한국원자력안전기술원
KOREA INSTITUTE OF NUCLEAR SAFETY

NATIONAL RADIOLOGICAL EPR FRAMEWORK AND RADIATION EMERGENCY TECHNICAL ADVICE IN KOREA

*IAEA-KINS WORKSHOP ON THE EMERGENCY PREPAREDNESS AND RESPONSES TO
NUCLEAR OR RADIOLOGICAL EMERGENCIES*

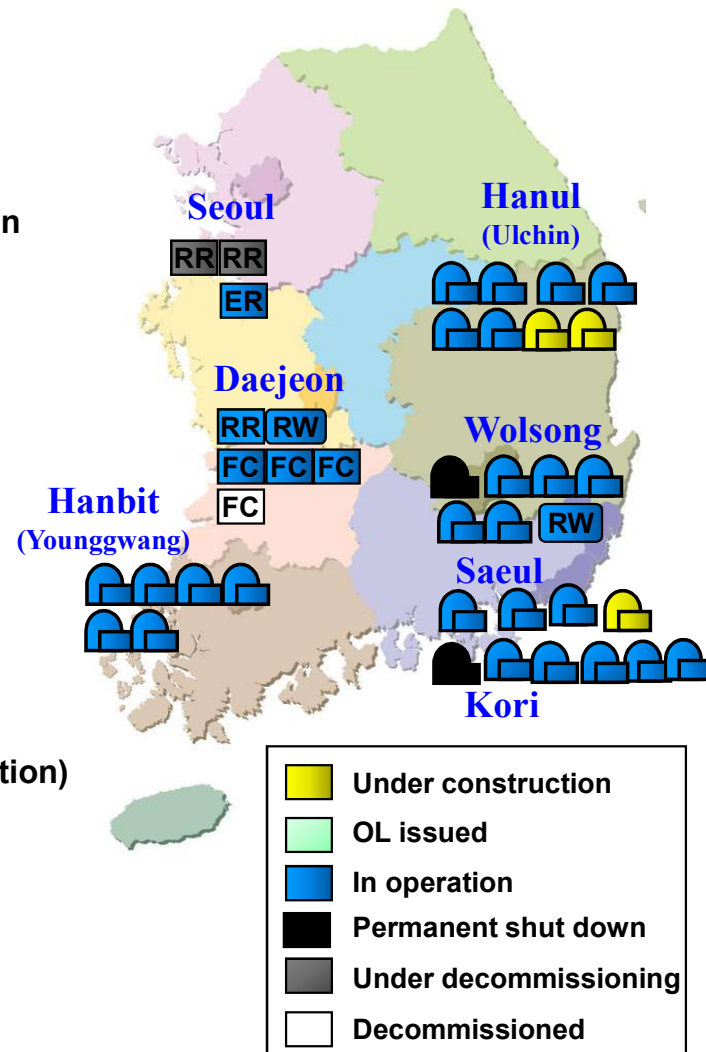
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Nuclear Facilities in Korea

- ✓ **Nuclear Power Plant (NPP)**
 - 25 units in operation and 3 units under construction
 - 2 unit permanent shut down
- ✓ **Research Reactor (RR) / Education Reactor (ER)**
 - HANARO (RR)
 - KRR 1 and 2 (RR, **under decommissioning**)
 - AGN (ER)
- ✓ **Nuclear Fuel Cycle Facility (FC)**
 - Fuel Fabrication Plant for NPP
 - Fuel Fabrication Facility for RR
 - Post-Irradiation Examination Facility (PIEF)
 - Uranium Conversion Facility (released from regulation)
- ✓ **Radioactive Waste Management Facilities (RW)**
 - RI Waste Management Facility
 - Wolsong LILW Disposal Center (WLDC)
 - in operation since 2015





Nuclear Facilities under EPR regulation in Korea

- Nuclear Power Plants
 - ✓ 25 NPPs in operation as of May 2023
 - ✓ 2 NPPs after permanent cessation of operations and removal of fuel from the reactor vessel
- Reactors for Research
 - ✓ HANARO(at KAERI) : Research reactor
- Fuel Cycle Facilities
 - ✓ KEPCO-NF: LWR & HWR fuel fabrication facility
 - ✓ KAERI : Research Reactor fuel fabrication facility, spent fuel research & storage facility
- Other Facilities
 - ✓ Repository facility for intermediate and low level radioactive waste
 - ✓ Irradiators

Comparison of the Threat Categorization System of the IAEA and Korean Practice

IAEA			Korean Case			
Threat Category	GS-R-2	GS-G-2.1	Category	Facilities/Activities	Criteria	Provisions and Measures
I	e.g. NPPs On-site events (including very low probability events) are postulated that could give rise to severe deterministic health effects off the site, or such events have occurred in similar facilities	> 100 MWth	I	All NPPs (>> 100 MWth)	All NPPs	1. Emergency Plan: YES 2. Responsibility of licensee: YES 3. Basic PAZ-5 km 4. EALs - FSAR Ch. 15: Safety Analysis - External event (earthquake etc) - Barriers, symptoms 5. Inspection (1 per year) 6. Exercise - Unified, Integrated, On-site, Drill - Initial exercise (before commissioning) 7. Manuals
II	e.g. Research Reactors On-site events are postulated that could give rise to doses to people off the site that warrant urgent protective action, or such events have occurred in similar facilities	2 to 100 MWth	II	HANARO (30 MWth)	Research Reactor	1. Emergency Plan: YES 2. Responsibility of licensee: YES 3. Basic UPZ: 4. EALs - FSAR Ch. 15: Safety Analysis - External event (earthquake etc) - Barriers, symptoms 5. Inspection: 1 per 2 years 6. Exercise - Unified, Integrated, On-site, Drill - Initial exercise (before commissioning) 7. Manuals

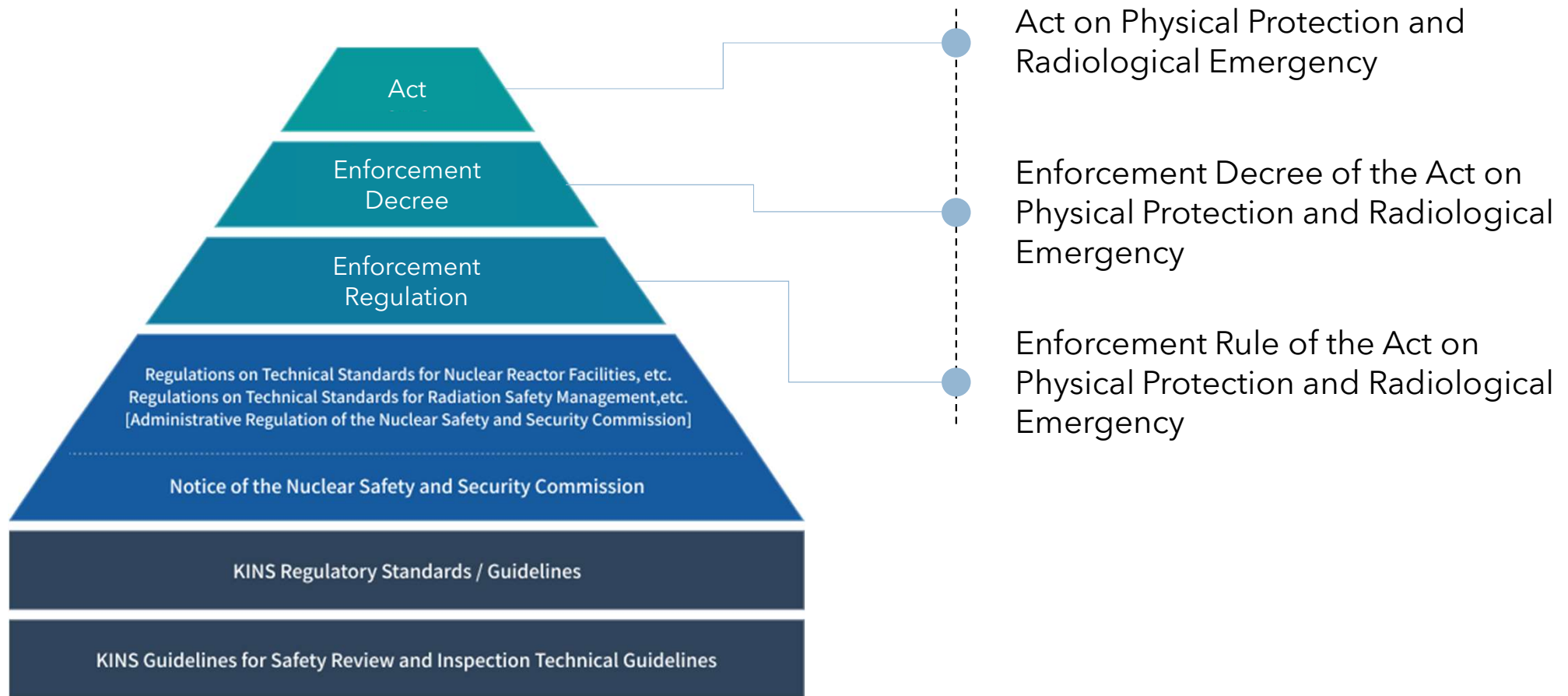
Comparison of the Threat Categorization System of the IAEA and Korean Practice

IAEA			Korean Practice			
Threat Category	GS-R-2	GS-G-2.1	Category	Facilities/Activities	Criteria	Provisions and Measures
III	e.g. Industrial Irradiation Facilities On-site events are postulated that could give rise to doses that warrant or contamination that warrants urgent protective action on the site, or such events have occurred in similar facilities	Potential uncontrolled criticality more than 0.5 km from the off-site boundary	IIIA	RR Fuel Fabrication Plant	U-235 > 5%, > 700g	1. Emergency Plan: YES 2. Responsibility of licensee: YES 3. Basic EPZ: Site Boundary 4. EALS 5. Inspection: 1 per 2 years 6. Exercise – Unified, Integrated, On-site, Drill – Initial exercise (before commissioning) 7. Manuals
		> 100 mGy/h at 1 m, without shielding	IIIB	Large-scale Irradiation Facilities	RI User > 18.5 PBq	1. Emergency Plan: YES 2. Responsibility of licensee: Partial Exemption from exclusive – ERF, Emergency organization 3. Basic EPZ: Site Boundary 4. EALS 5. Inspection: 1 per 2 years 6. Exercise – On-site, Drill – Initial exercise (before commissioning) 7. Manuals
			IIIC	PIEF	Research/Test Purpose	1. Emergency Plan : YES 2. Responsibility of licensee: Partial exemption – ERF, Emergency organization 3. Basic UPZ: Site Boundary 4. EALS 5. Inspection: 1 per 2 years 6. Exercise – On-site, Drill – Initial exercise (before commissioning) 7. Manuals
				KNF	Refine: Nat. U Fab.: U < 5%	
				LILW Repository	–	
				RI Waste Facility Fuel Materials Licensee	–	

Comparison of the Threat Categorization System of the IAEA and Korean Practice

IAEA			Korean Practice			
Threat Category	GS-R-2	GS-G-2.1	Category	Facilities/Activities	Criteria	Provisions and Measures
III		RR < 2MWth	IIIC	Fuel Materials Licensee	U-235 > 5%, < 700g U-235 < 5%, < 1200g	1. Emergency Plan : YES 2. Responsibility of licensee: Partial exemption - ERF, Emergency organization 3. Basic UPZ: Site Boundary 4. EALs 5. Inspection: 1 per 2 years 6. Exercise - On-site, Drill - Initial exercise (before commissioning) 7. Manuals
			IIID	KHU (Educational Reactor) (0.1 → 10 W)	Not applicable APPRE < 100 W	1. Emergency Plan: Yes (Based on AEA) - own preparedness (SAR 12.6) - operator and radiation management group

LEGAL FRAMEWORK FOR EMERGENCY PREPAREDNESS AND RESPONSE



Regulatory Framework for EPR in Korea

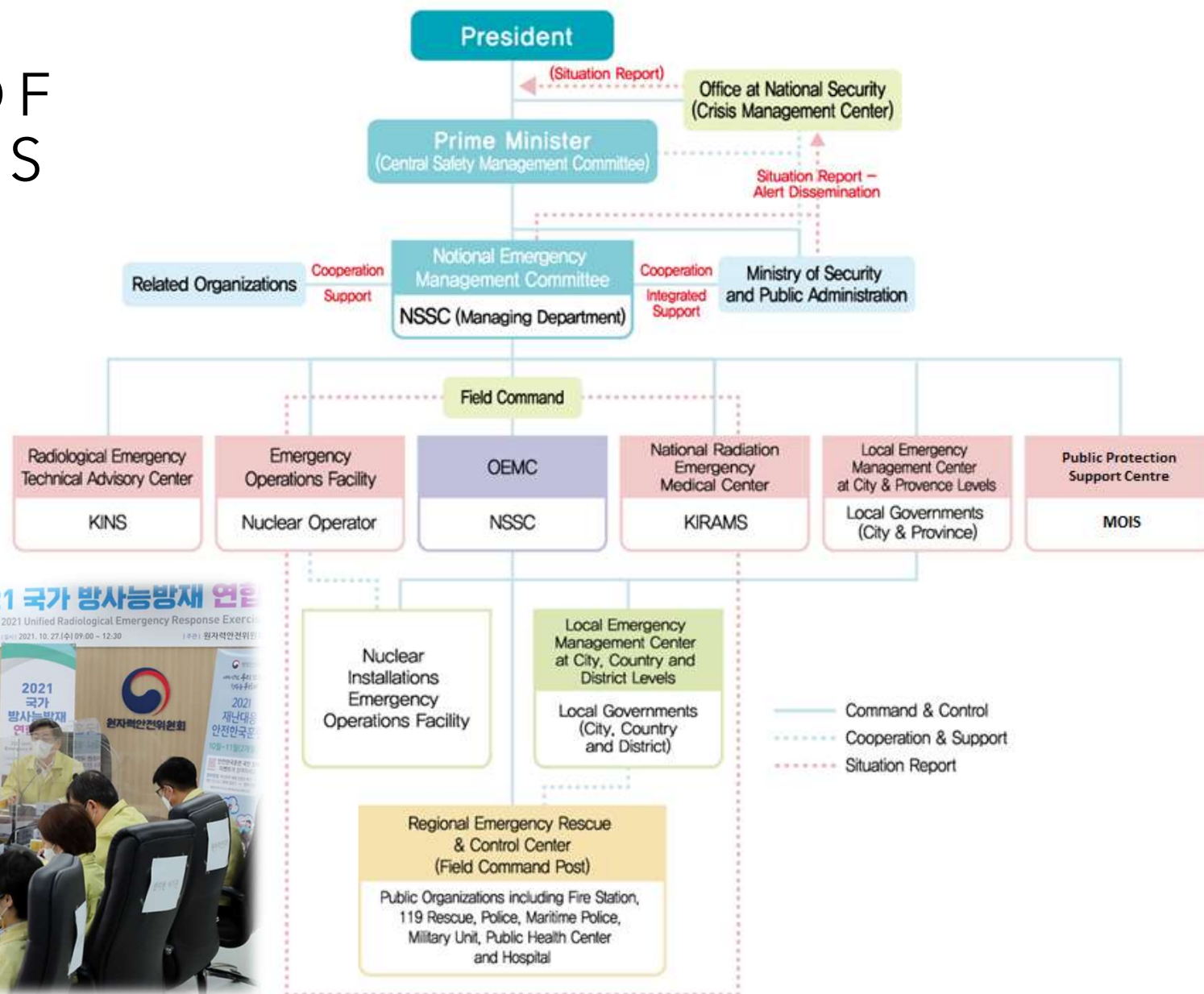
- The Regulatory Framework for EPR in Korea is established as follows. it provides appropriate governmental, legal and regulatory frameworks for EPR

Act	Fundamental principles of nuclear security and EPR regulation “Act on Physical Protection and Radiological Emergency” - Article 20(Emergency plan for Licensee), Article 38(Inspection)	NSSC
Enforcement Decree	Particulars entrusted by the Act - Enforcement Decree of the Act on Physical Protection and Radiological Emergency - Article 22(application of EP)	
Enforcement regulation	Particulars entrusted by the Act and/or the Decree and necessary for their enforcement “Enforcement Regulation of the Act on Physical Protection and Radiological Emergency” - Article 10(Application of EP), Article 11(Change of EP), Article 13(Detailed requirement)	
NSSC Notice	Details on technical criteria, procedures and formats as delegated by the Act, Decree and/or Regulation “Regulation on Radiological Emergency Preparedness for Nuclear Licensees”(Radiation. 03) “Regulation on the Inspection for Radiological Emergency Preparedness of Nuclear Licensees”(Radiation. 21)	
Guide for review and inspection	- EPR Review Procedure (EP-11) - EPR Inspection Procedure(EP-12) - EPR Review Guide(KINS/GE-R-010) - EPR Inspection Guide(KINS/GE-R-011)	KINS

NSSC : Nuclear Security and Safety Commissions(Regulatory body)

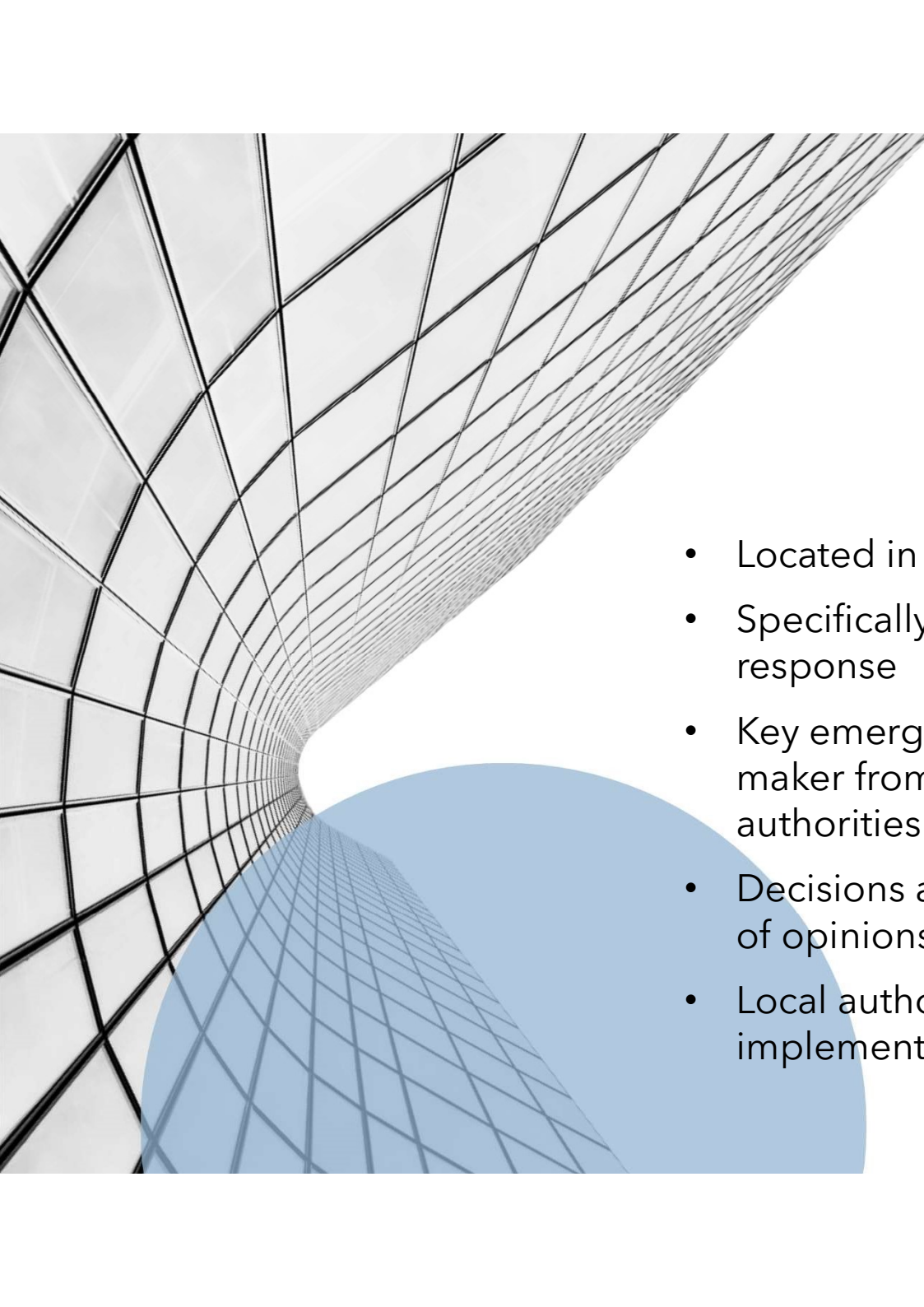
KINS : Korea Institute of Nuclear Safety(Technical Advisory agent supporting NSSC)

CONCEPT OF OPERATIONS



Off-site emergency management centre

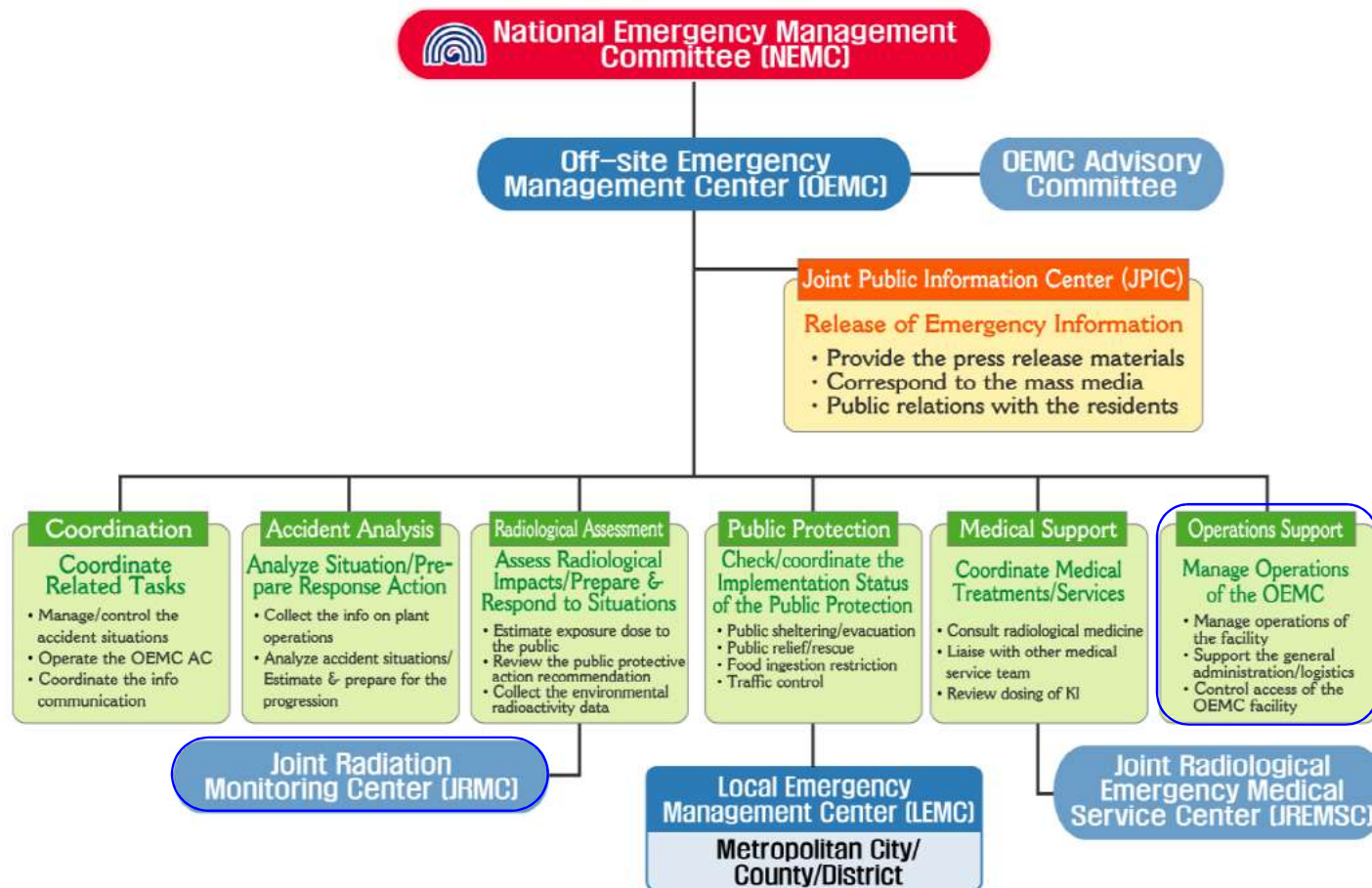




OFF-SITE EMERGENCY MANAGEMENT CENTRE

- Located in the vicinity of NPPs (within 30 km)
- Specifically built for a nuclear or radiological emergency response
- Key emergency response personnel including decision-maker from the NSSC, the MOIS, the KINS, local authorities physically gather at the centre
- Decisions are made by the central government in account of opinions from local authorities, technical experts, etc
- Local authorities are dedicated for effective implementation of protective actions

Emergency Management Center (NEMC/OEMC)



ROLES & RESPONSIBILITIES



Nuclear Safety and
Security Commission

Independent administrative authority in charge of nuclear safety and radiation protection for nuclear power in South Korea. It manages all affairs related to a nuclear or radiological emergency preparedness and response, security of nuclear materials and facilities from attacks and attempts to illicit use of radioactive materials.



Ministry of
the Interior and Safety

Prepares, coordinates and monitors the implementation of protective measures and is responsible for ensuring public order and protecting people and property.



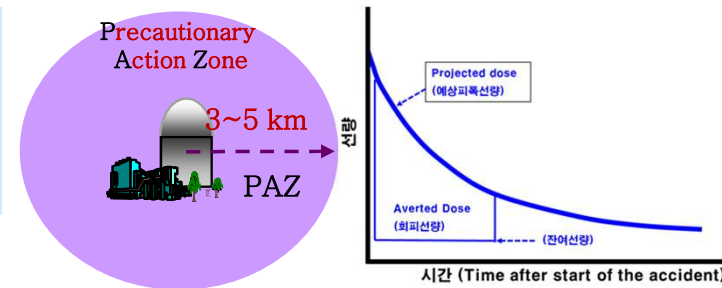
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Source of technical expertise on a nuclear or radiological emergency response. As such, it participates in managing emergencies. It assists the NSSC to protect people and the environment and return facilities to safe conditions.

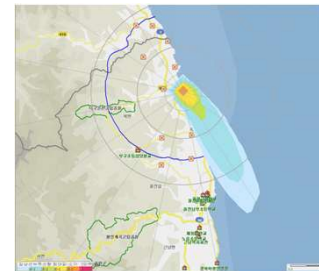
Strategy of Emergency Management in Korea

- Goal of Emergency Management: To prevent occurrence of **deterministic effects**, to reduce occurrence of **stochastic effects** in population to the extent practicable

1. Establish **precautionary action zone (PAZ)** in advance and do precautionary urgent protective actions (**EAL, General Emergency**)
 - to prevent the deterministic effects



2. From (projected) dose assessment result, to perform protective actions in accordance with **GIL (Generic Intervention Level)**
 - to reduce stochastic effect
 - before radiological release
3. Based on environmental monitoring (sampling and analysis) results, to perform protective actions applying **OIL (Operational Intervention Level)**
 - to reduce stochastic effect
 - after radiological release



EMERGENCY PLANNING ZONES FOR NUCLEAR POWER PLANT(BASIC AREA)

	PAZ	UPZ
NPP	3-5 km	20-30 km
Description	• An area requiring precautionary urgent protective action (e.g. evacuation, shelter-in-place, ITB) based on prevailing conditions at a facility. • Detailed evacuation plan within the entire PAZ is defined.	• An area where an off-site emergency plan is required to assure that protective actions can be taken promptly and effectively to protect the public and the environment. • A general strategy is defined to extend evacuation based on prevailing conditions at a facility and/or off-site monitoring results.

EMERGENCY PLANNING ZONES FOR RESEARCH REACTOR (BASIC AREA)

		PAZ	UPZ
Power Level	2~10 (MW)	-	0.5 km
	10~50 (MW)	-	1.5 km
	50~100 (MW)	-	5 km

EMERGENCY PLANNING ZONES (ACTUAL)

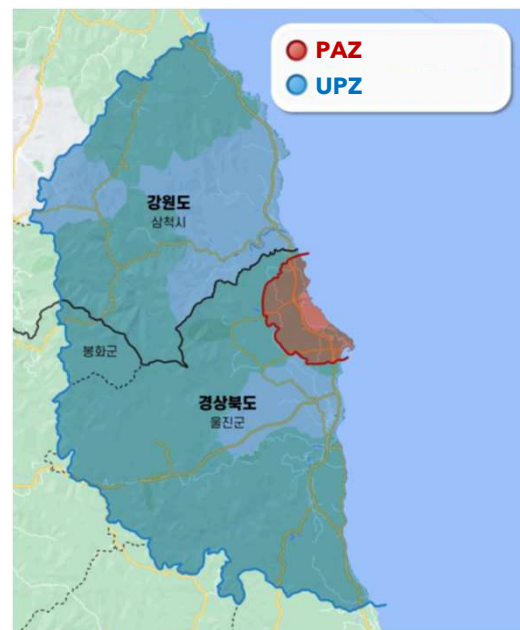
- CURRENT STATUS



KORI/SAEUL



WOLSONG

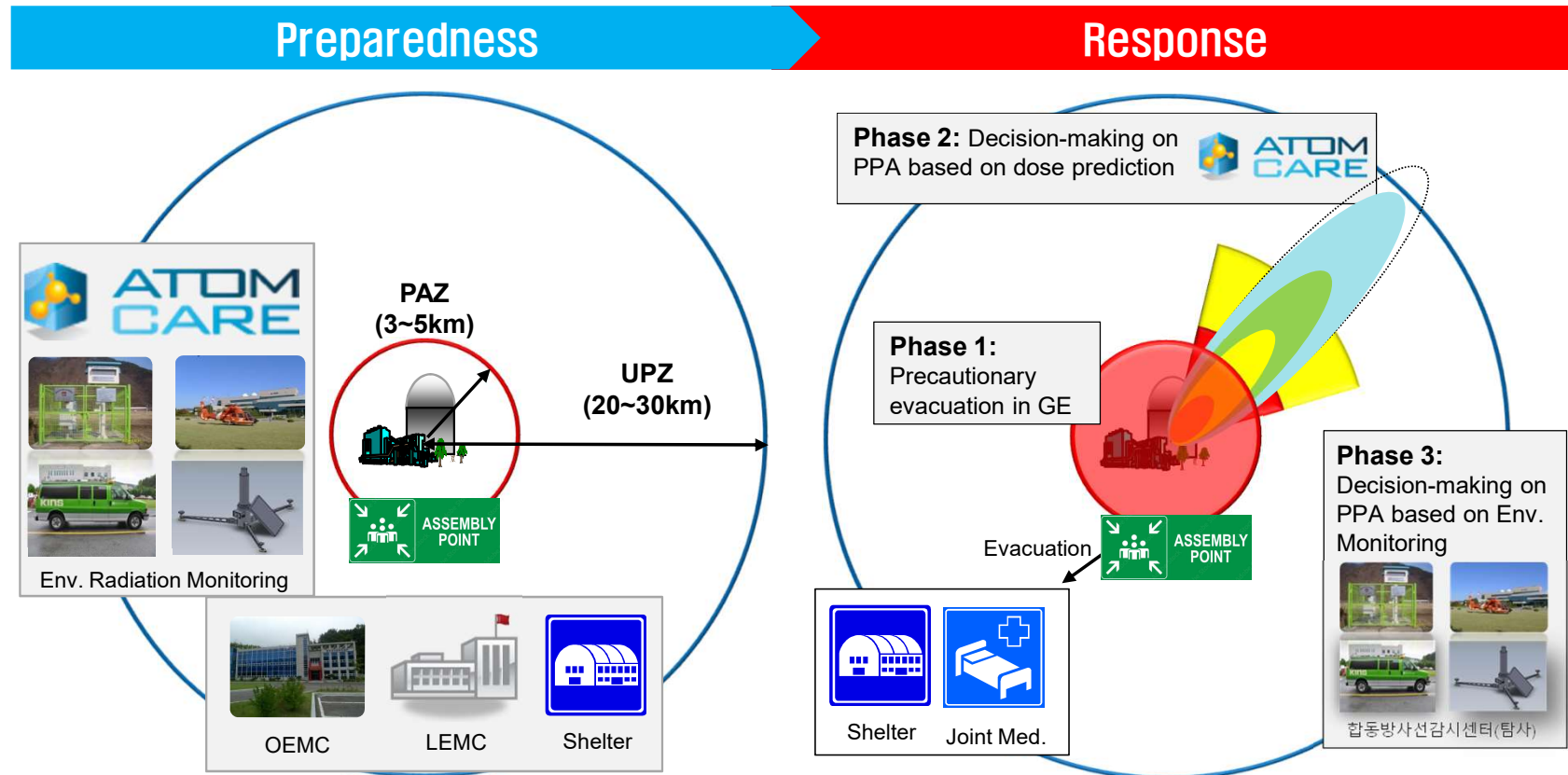


HANUL



HANBIT

Emergency Preparedness and Response



Phase 1 [GE declaration] All residents in the PAZ are immediately evacuated. The LEMC establishes and operates evacuation plans.

Phase 2 [Before or immediately after radioactive material release] Based on the projected dose, the KINS recommends the public protective action to the OEMC. Then LEMC implements public protective action after OEMC makes a decision.

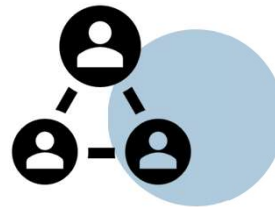
Phase 3 [After end of the release] OEMC focuses on environmental monitoring and survey (vehicle and aerial) and determines additional protective action. Then LEMC implements additional public protective action.

HOW WE RESPOND



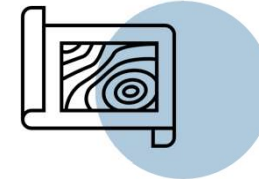
EMERGENCY ACTION LEVELS

- **A primary measure** for urgent response phase decision-making
- **Predefined criteria** for declaration of an emergency and initiating the **predetermined protective actions and other response actions**



MODEL PREDICTIONS

- **A secondary measure** for adjusting and optimising initial protective actions implemented per EALs
- Giving a way for field monitoring



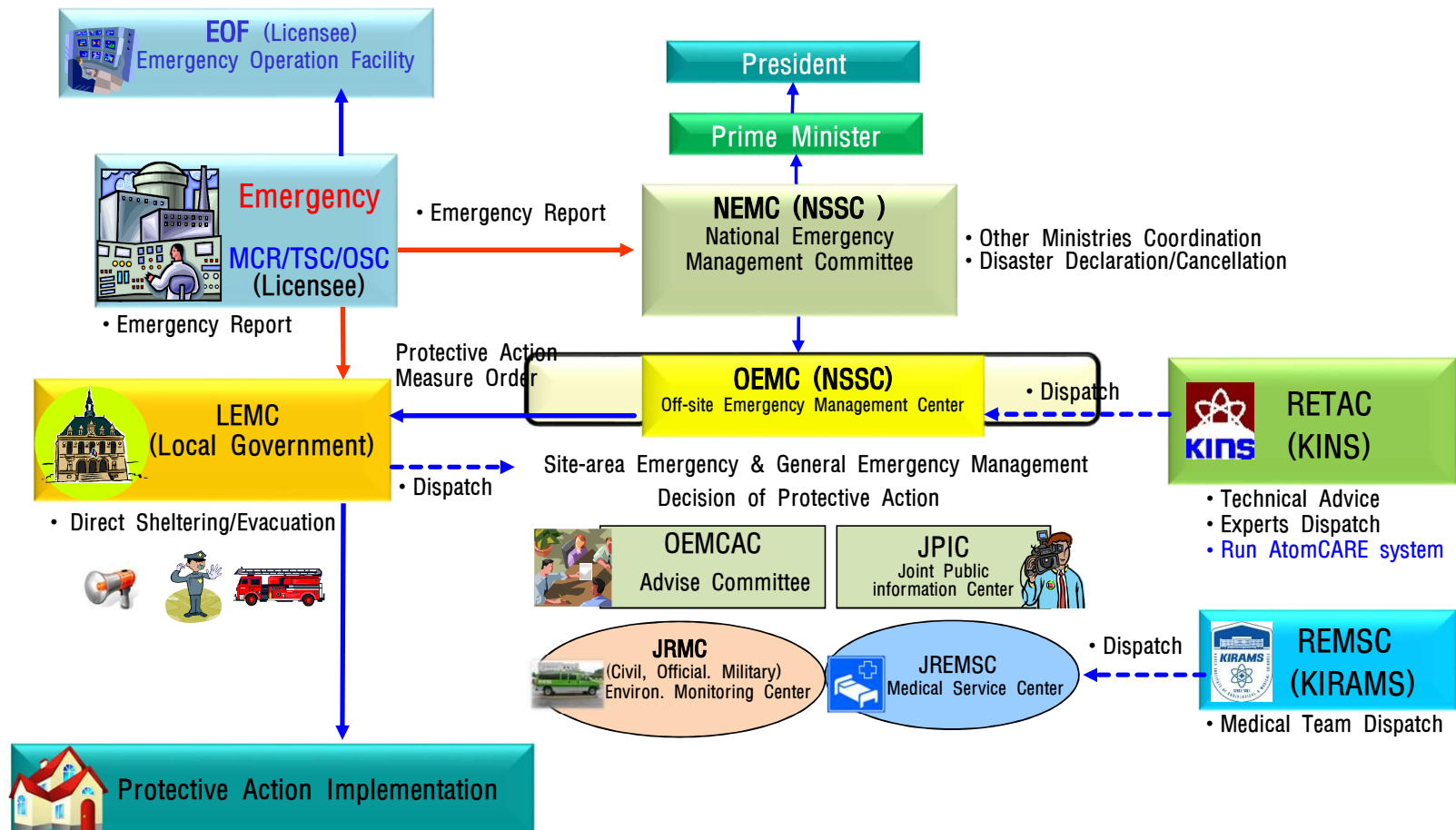
ENVIRONMENTAL MONITORING

- Basis for **adjusting initial protective actions** and **transitioning** from urgent responses to early responses
- Basis for longer-term responses and recovery

EMERGENCY CLASSIFICATION

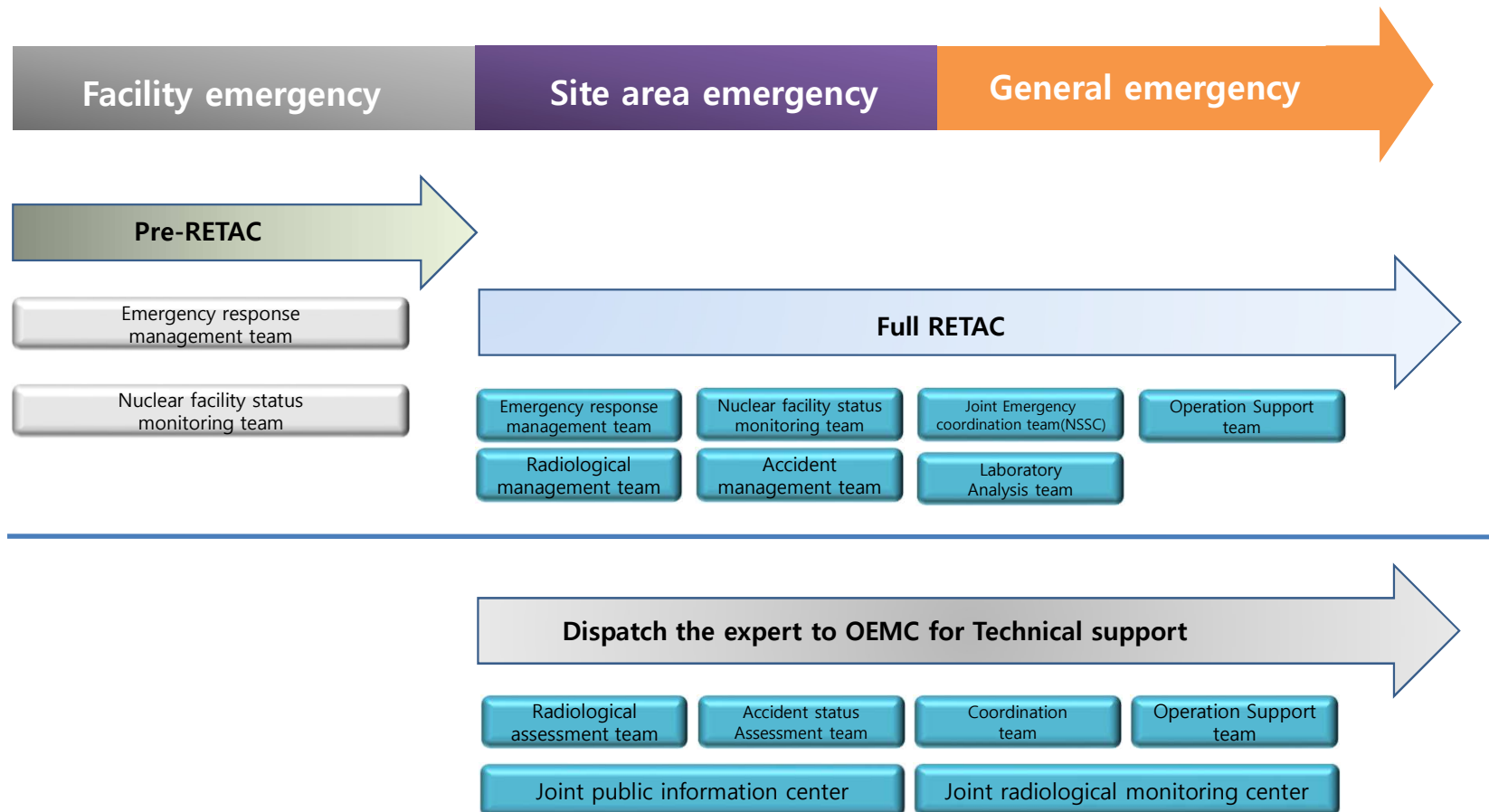
	Key actions to be taken for off-site emergency responses	
	Operator	Off-site Response Organisations
White Emergency (Facility Emergency)	• Notification to OROs • Providing information to OROs • Operation of emergency response facilities	• Preparatory activation for emergency response organisations • Notification to other relevant organisations • Public communication
Blue Emergency (Site Area Emergency)		• Full activation of emergency response organisations
Red Emergency (General Emergency)	• Protective action recommendations • Supporting off-site response activities	• Deciding and implementing protective actions and other response actions

Nuclear Emergency Response Steps in Korea



Rad. Emergency Technical Advisory Center (RETAC in KINS)

❖ Operation of RETAC



KINS – Rad. Emer. Technical Advisory Center

❖ Missions and Roles

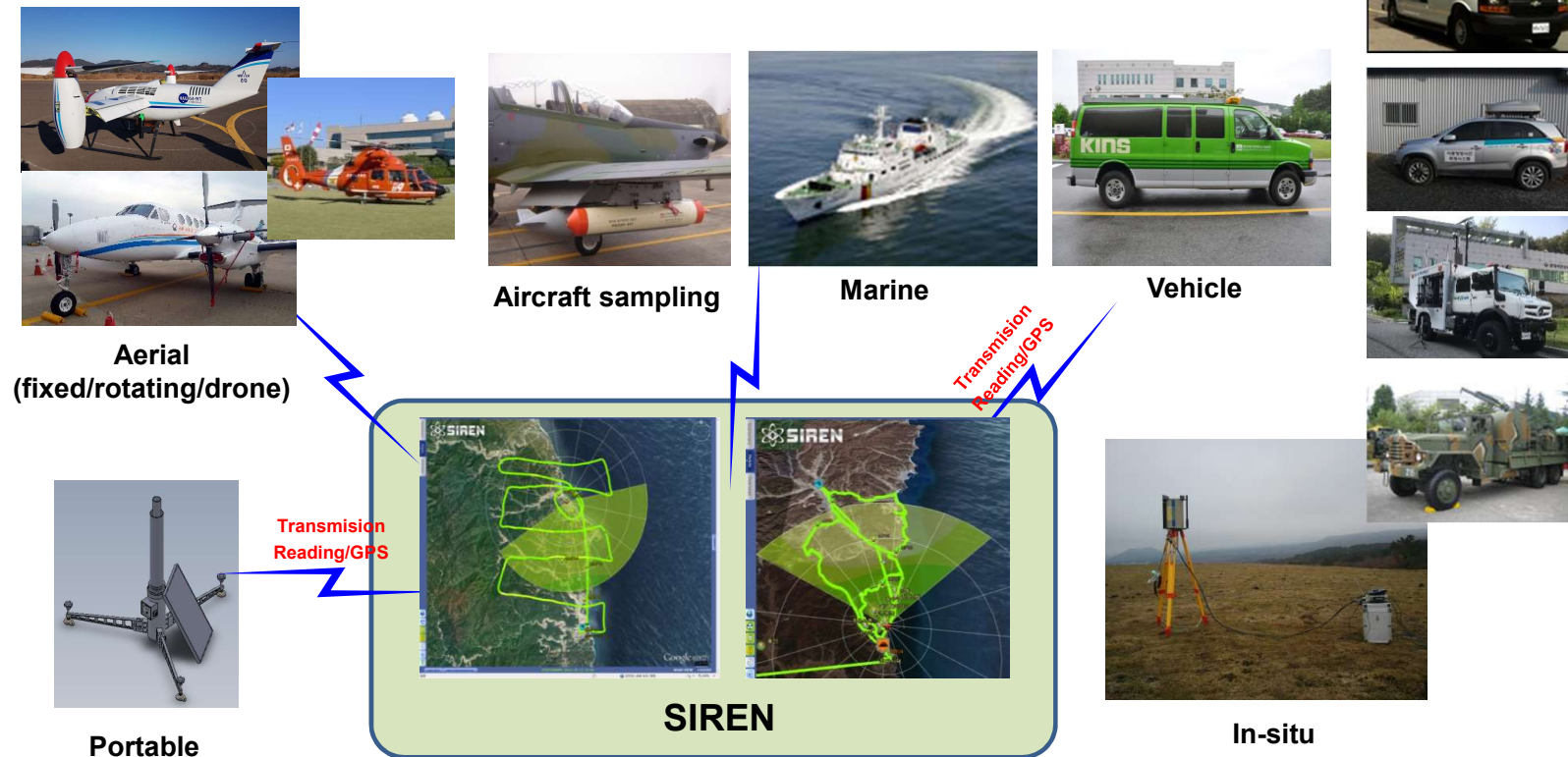
- Technical advice on emergency management
- Off-site radiological monitoring and evaluation support
- Makes recommendation for emergency response measures
- Operates the nuclear emergency response system (AtomCARE)



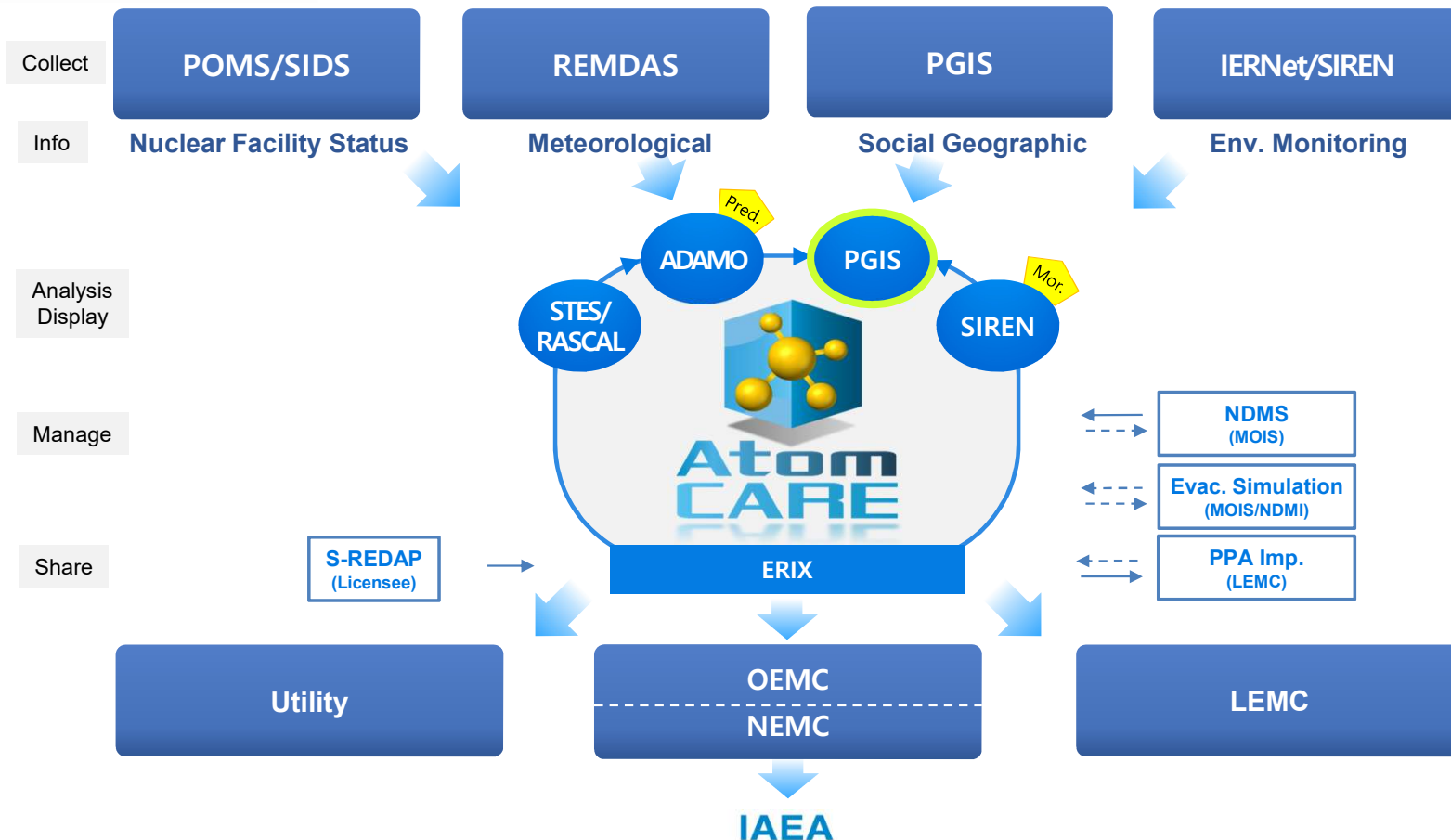
OEMC – Joint Rad. Env. Monitoring Center

❖ Environment Radiation Monitoring

- Emergency call for joint monitoring personnel (KINS, army, licensee, etc.)
- Collect environmental radiation monitoring and radioactivity analysis results on SIREN system through aerial, marine, vehicle and portable monitoring in addition to fixed monitoring.

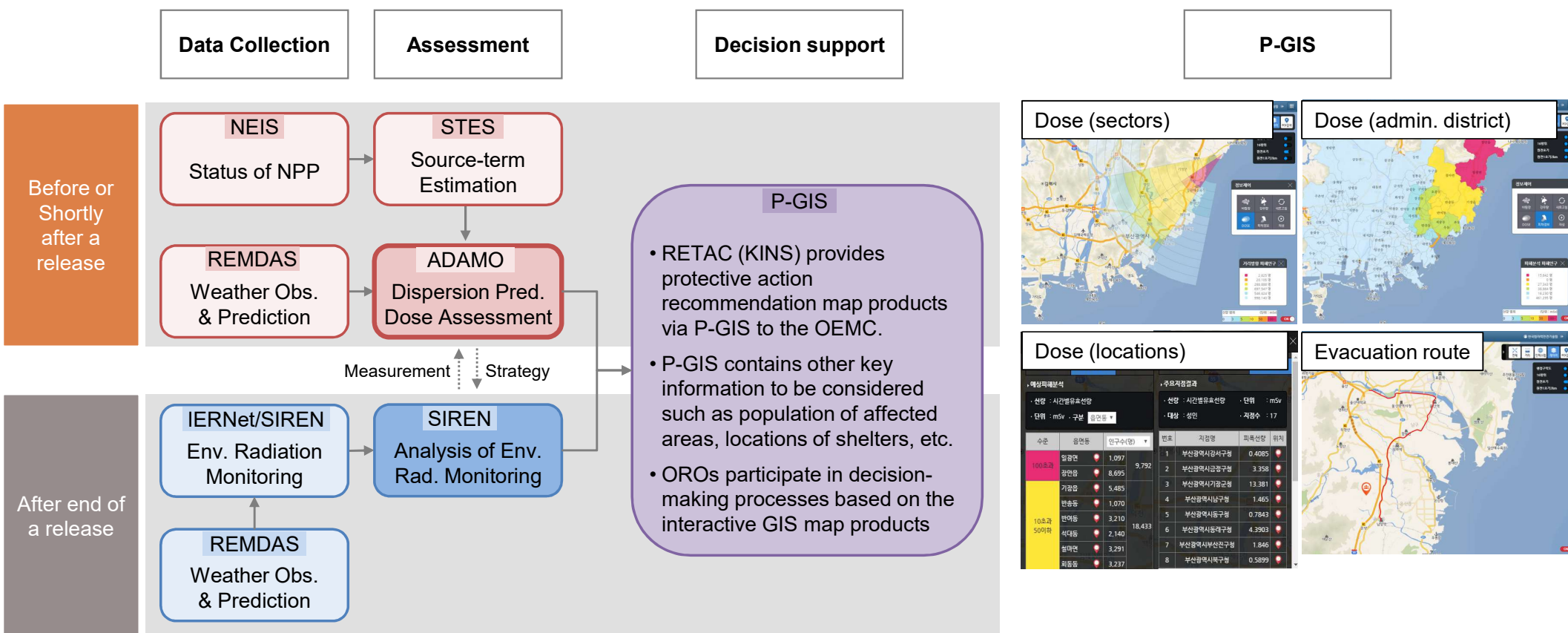


Composition and Flow of Information of AtomCARE system



- ✓ Normally, AtomCARE monitors nuclear safety and environmental radiation information.
- ✓ In case of emergency, AtomCARE's functions move on to the characterization and management of the accident and the assessment of radiological consequences. Finally, it provides recommendations for the public protective actions to the government.

PREDICTIVE MODEL STRUCTURE



A secondary measure for adjusting and optimising initial protective actions implemented per EALs

EXERCISES & DRILLS

Unified Exercise	Integrated Exercise	On-site Exercise	Drills
Once a year (in the country)	Once every two year (per a site)	Once a year (per a plant)	Once a quarter (per a plant)
Conducted by the government	Conducted by local authorities	Conducted by operators	Conducted by operators
Full-scope exercise in a national level	Semi-full-scope exercise in a local level	On-site emergency response exercise	Demonstration of key response skills



THANK YOU