

NATIONAL RESPONSE FRAMEWORK AND PROGRESS IN A&P STRATEGY IN REPUBLIC OF KOREA

ASSESSMENT AND PROGNOSIS SYMPOSIUM INTERNATIONAL RAMP USER'S GROUP MEETING HOTEL PRESIDENT, IVY HALL

16 APRIL 2024

KYUWON CHOI KOREA INSTITUTE OF NUCLEAR SAFETY

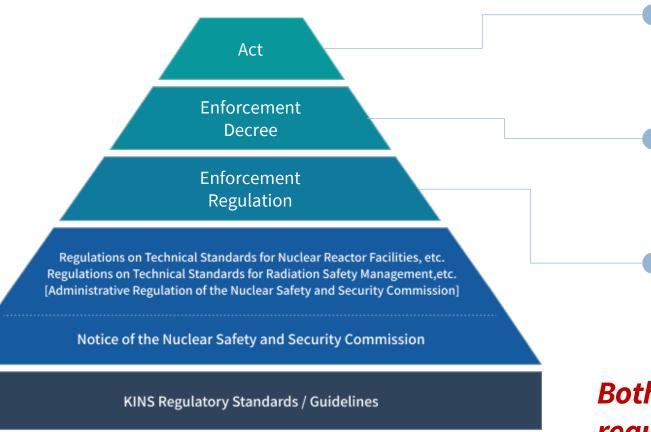


A&P SYMPOSIUM - APRIL 2024

NATIONAL RESPONSE FRAMEWORK

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LEGAL FRAMEWORK FOR EP&R



KINS Guidelines for Safety Review and Inspection Technical Guidelines

Both licensees and KINS are legally required to perform A&P during an emergency

Act on Physical Protection and Radiological Emergency

Enforcement Decree of the Act on Physical Protection and Radiological Emergency

Enforcement Rule of the Act on Physical Protection and Radiological Emergency



ROLES & RESPONSIBILITIES



Nuclear Safety and Security Commission



Ministry of the Interior and Safety





Independent administrative authority in charge of nuclear safety and radiation protection for nuclear power. 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.

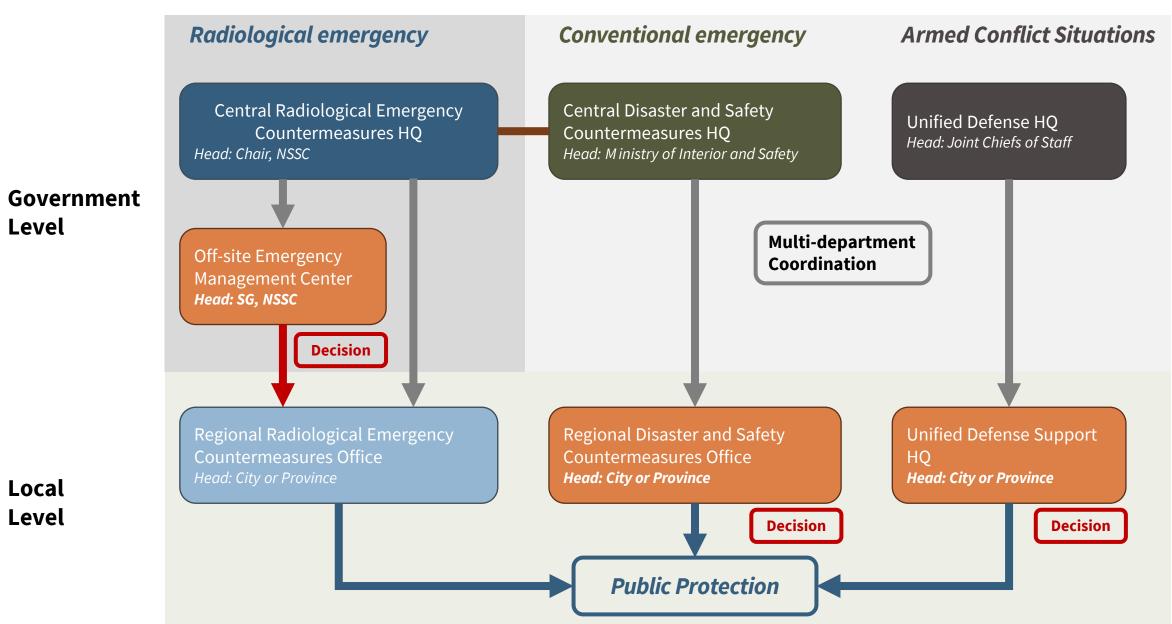
Takes charge of establishing, supervising and adjusting policies related to safety and disaster management such as emergency countermeasure, civil defence and disaster prevention.

A state-owned Korean electric utility company that operates all nuclear reactors in Korea. Its primary responsibilities are mitigating the consequences of an incident and minimising the radiological hazards to the public.

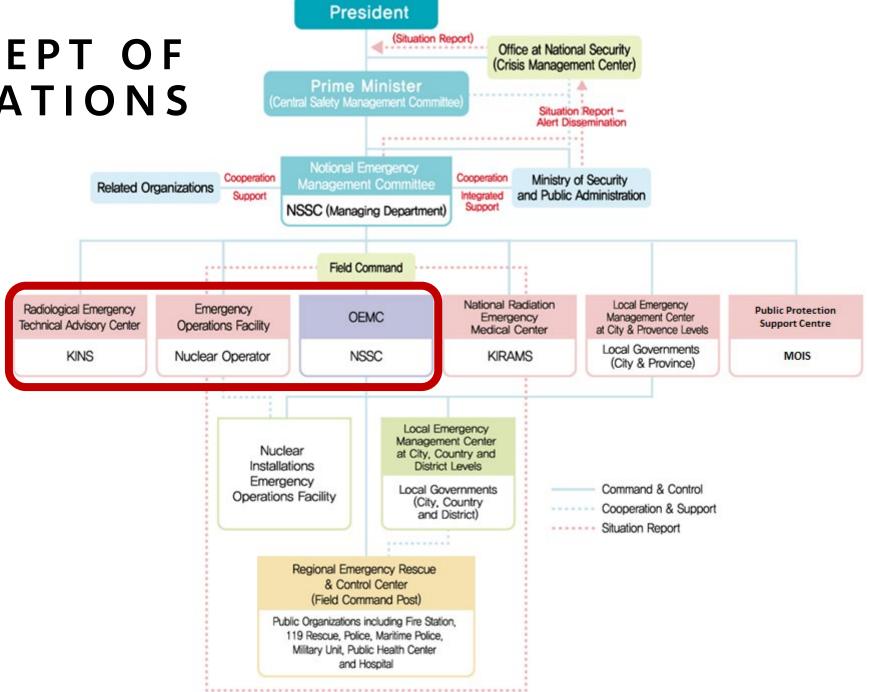
Source of technical expertise on a nuclear or radiological emergency response. As such, it participates in managing emergencies. It assists the NSSC to protect people and the environment and return facilities to safe conditions.

<mark>한국원</mark> KOREA IMOT

COMMAND AND CONTROL SYSTEM



CONCEPT OF OPERATIONS



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OFF-SITE EMERGENCY MANAGEMENT CENTRE

- Located in the vicinity of NPPs (within 30 km)
- Specifically built for radiological emergency response
- Key emergency response personnel from the NSSC, the MOIS, the KINS, local authorities physically gather at the centre
- The Head of OEMC is appointed by the Secretary General of the NSSC, who will act as the decision-maker consulted by relevant authorities
- Local authorities are dedicated for implementation of protective actions

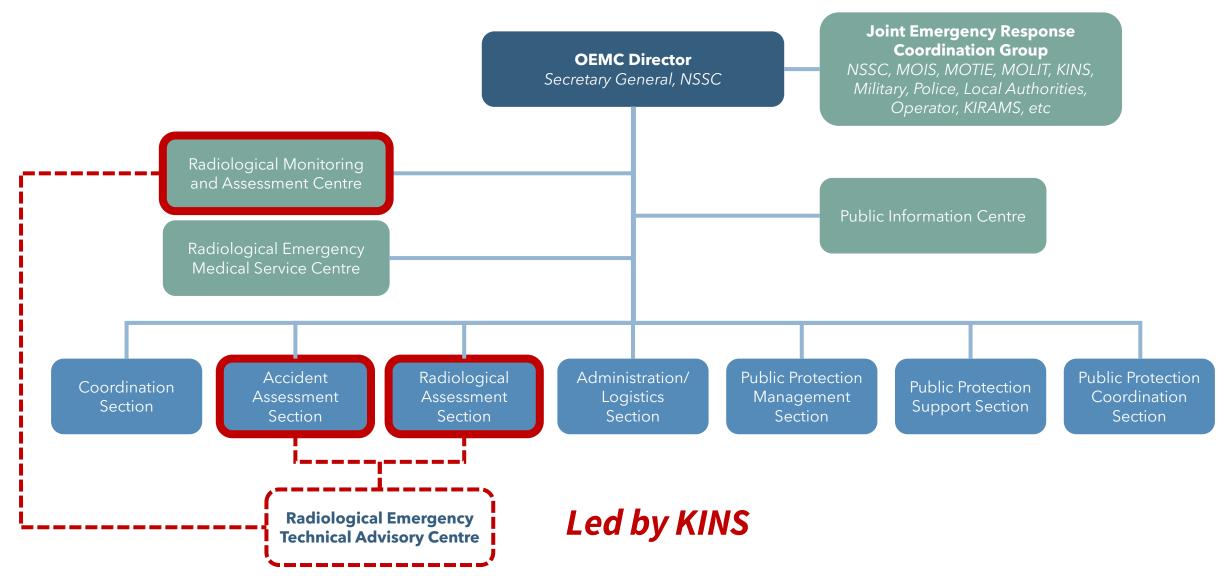
PAR/PAD PROCESS IN A NUTSHELL...





한국원자력안전기 korea institute of Nuclear

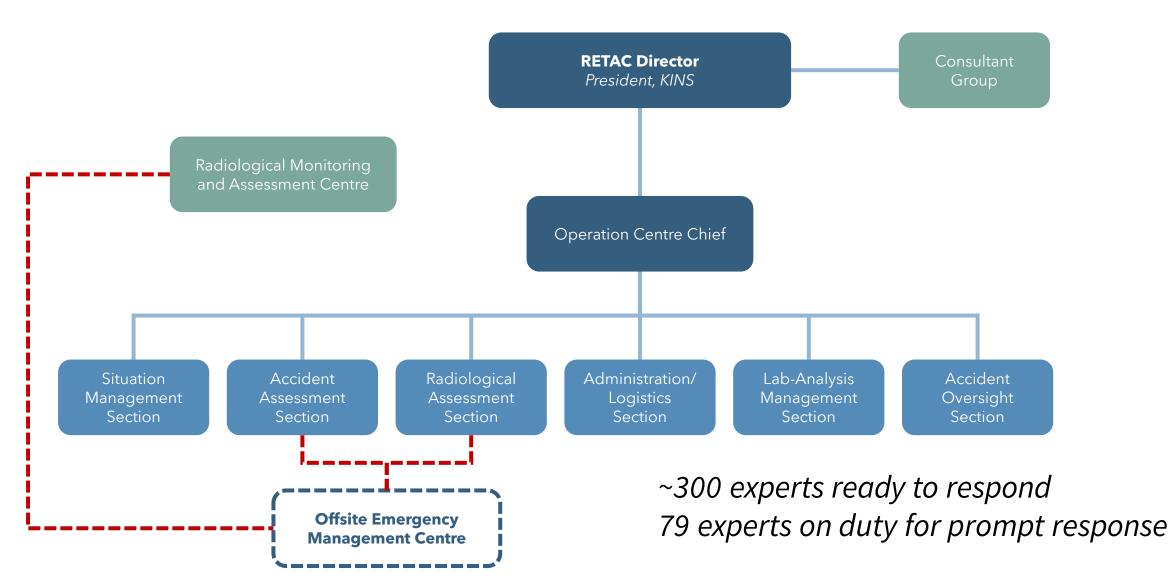
OFF-SITE EMERGENCY MANAGEMENT CENTRE (OEMC)



A & P

S Y M P O S I U M

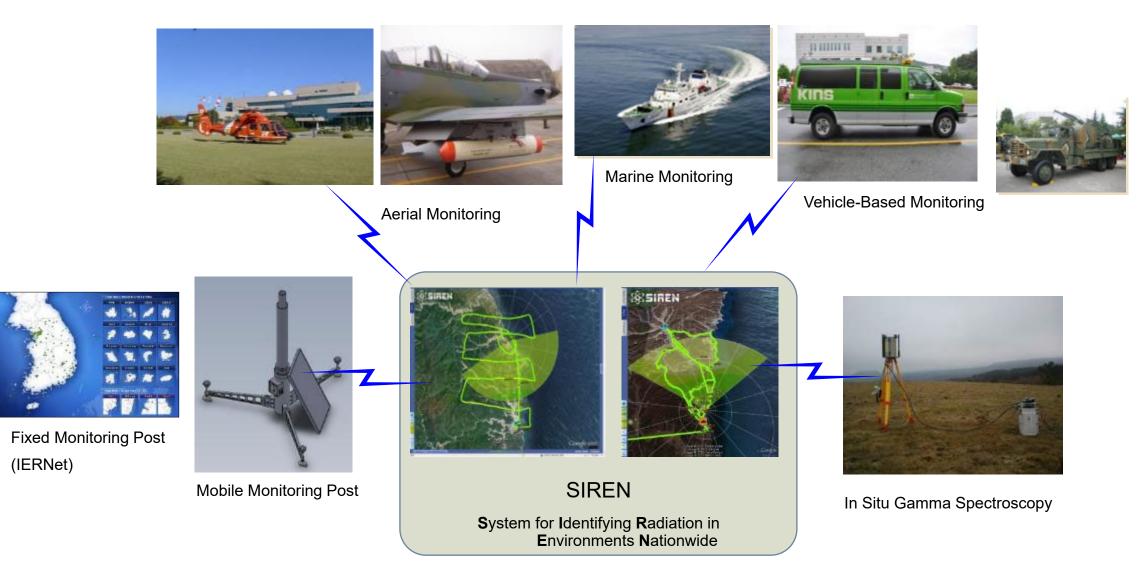
RADIOLOGICAL EMERGENCY TECHNICAL ADVISORY CENTRE (RETAC)



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2024 APRIL S Y M P O S I U M A & P

ENVIRONMENTAL MONITORING RESOURCES





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MISSION/ROLE OF KINS DURING AN EMERGENCY

- Performing independent A&P of the incident and potential offsite consequences and issuing PARs
- Oversighting licensee's A&P, to include monitoring, evaluation of protective action recommendations, advice, and assistance
- Leading technical sections at OEMC
- Operating RMAC and conducts national monitoring programme
- Being a technical focal point for domestic/international communication



PROGRESS IN A&P STRATEGY

IN REFLECTION OF LESSONS-LEARNED FROM PAST EMERGENCIES AND NATIONAL/INTERNATIONAL EXERCISES

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A&P IS PERFORMED AGAINST:



KEY BARRIERS

- Fuel clad •
- Reactor coolant system ٠
- Containment •



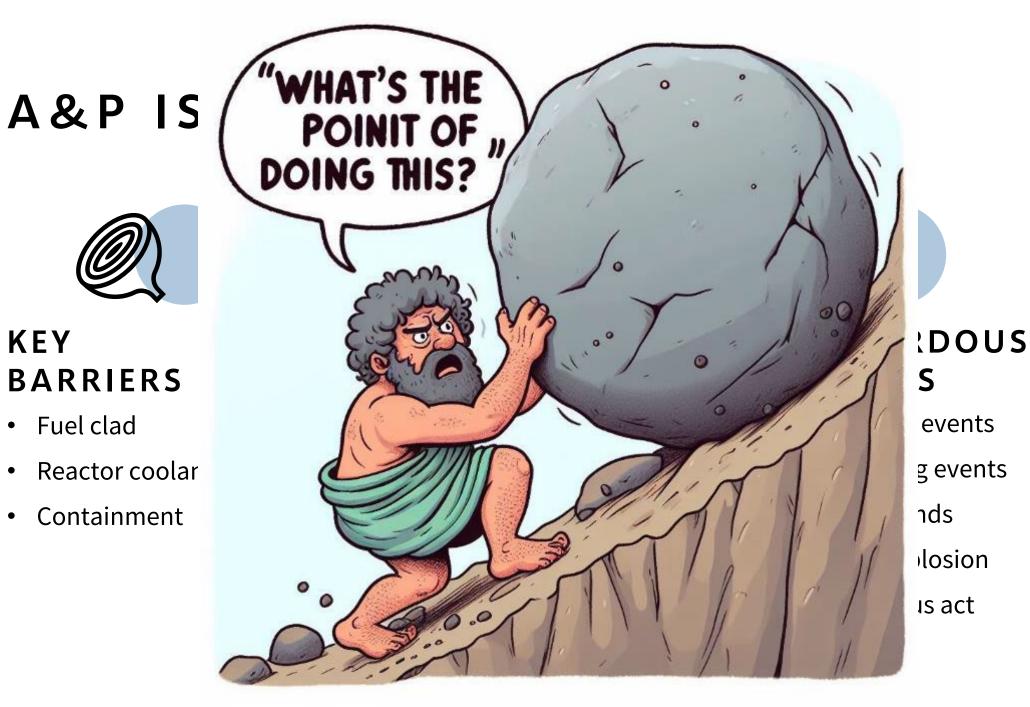
SAFETY **SYSTEMS**

- Core cooling systems •
- Containment systems
- Fission product ٠ removal/control systems



- Seismic events
- **Flooding events** ٠
- High winds ٠
- Fire/explosion •
- Malicious act •





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OBJECTIVES OF A&P IN KOREA

- To provide a clear transition point from Operating Procedures to Emergency Operating Procedures (EOPs) or Severe Accident Management Guidelines (SAMGs)
- To classify an emergency
- To assist the decision-maker in determining where to implement public protective actions
 Licensee & KINS
- **To provide timely insights** about ongoing situation to relevant authorities and the public including international communities
- To figure out further assistances needed in federal or international level
- To prioritise limited resources

Licensee & KINS

Licensee ONLY

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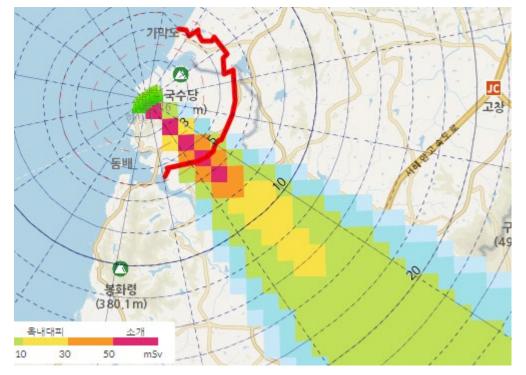
Siger Tainty To assist the decision-maker in determining where to implement public protective actions TIME CONSTRAINT • To provide timely insights about ongoing situation to relevant authorities and the public including international communities

A&P CHALLENGES REGARDING:

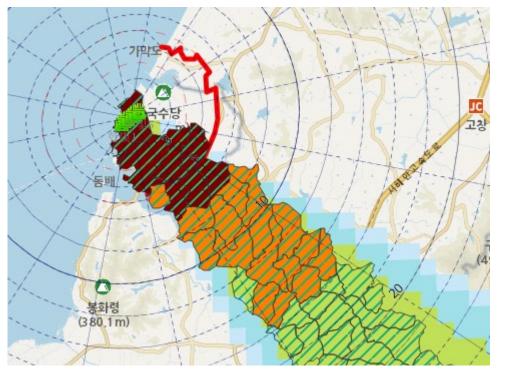


WHAT INFORMATION CAN ASSIST DECISION MAKER?

Potential offsite impact



Relevant administrative area



To provide these map products, followings need to be assessed: **1** Accident Source Term, **2** Dispersion/Deposition, **3** Public Dose

WHAT IS ACCIDENT SOURCE TERM?

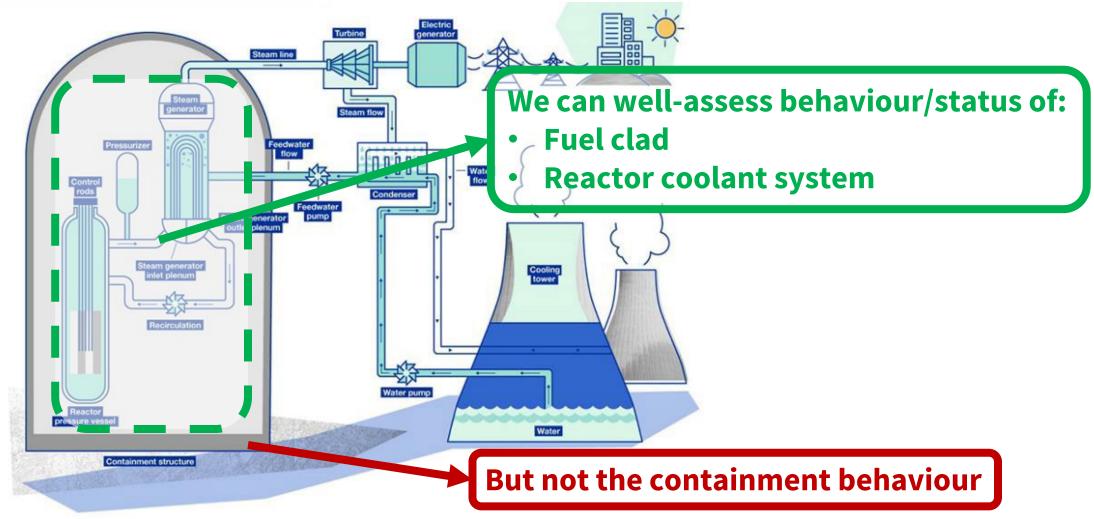
"Magnitude of the radionuclides released from the fuel to the environment"

Accident Source term = radionuclides released from the fuel × leakage fraction to the environment × release duration



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WHY IS IT SO UNCERTAIN DURING BDBAs?



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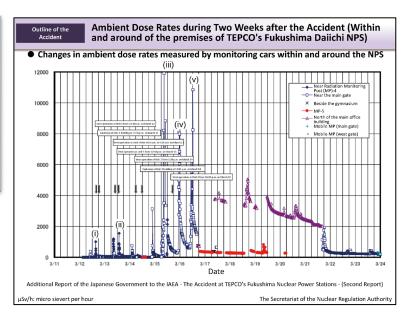
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CONUNDRUMS OF CONTAINMENT BEHAVIOUR DURING BDBAs

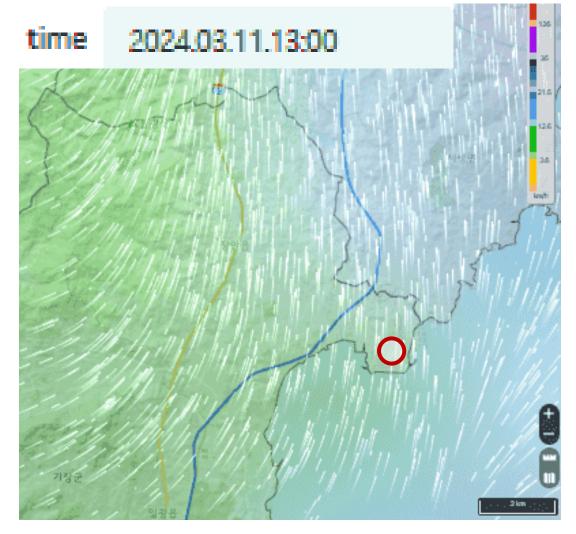
- When will the containment **fail** or **be bypassed**?
- How severe will the potential release be?
- How long will the potential release last?



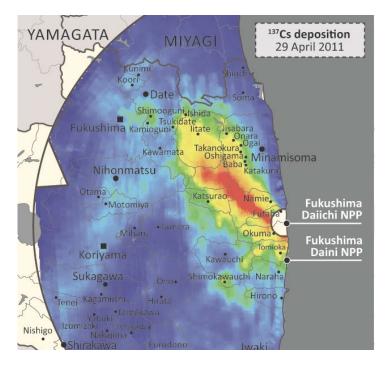




ALSO, WIND DOES SHIFT



... and major downwind/distance changes



The actual dispersion/deposition pattern will be a lot more complex

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QUESTIONS WE NEVER EXERCISE

Is this all we need to do? Is there any other possibility? Is it the worst possible scenario? ... Are you sure?

A & P

During an emergency, you are neither water nor oil, BUT A BAR OF SOAP.



A&P shall be performed TO CONVINCE, NOT TO CONFUSE.

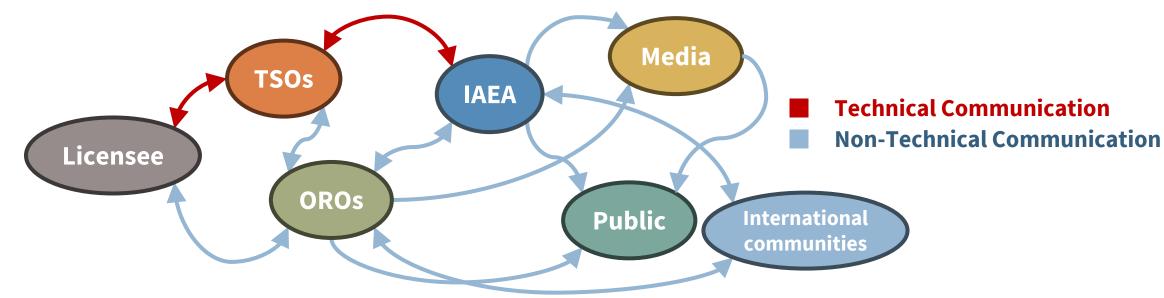


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DIFFICULTIES IN "TIMELY" COMMUNICATION

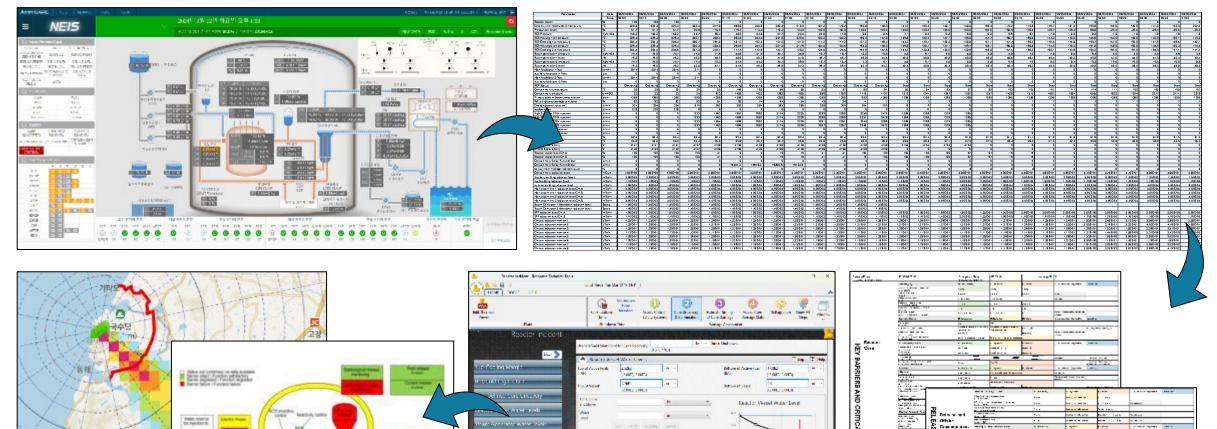
- Data processing and delivery
- Accident assessment and prognosis by licensee and TSOs
- Validation, comparison, and discussion
- Reporting, explanation, and Q&As



자력안전

인국원

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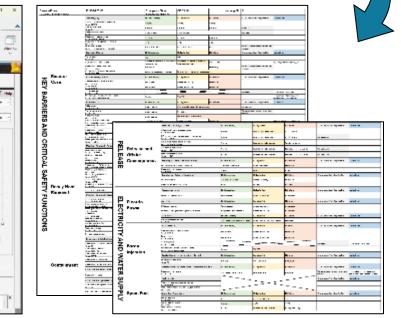
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Past release No release

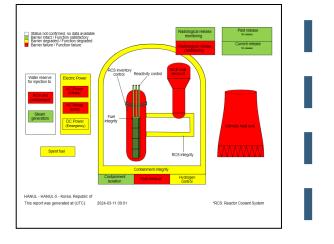
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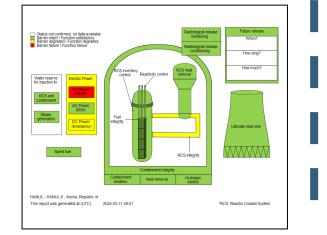
"RCS: Reactor Coolant System

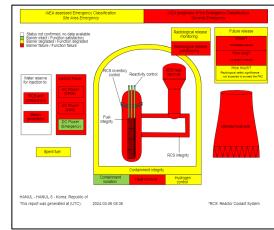
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TECHNICAL COMMUNICATIONS

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Barrier intact / Function satisfactory Barrier degraded / Function degraded Barrier follow

Spent fuel

HANUL - HANUL-5 - Korea, Republic of

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Validation/Verification

Comparison/Discussion

TECHNICAL COMPANY

Non-technical communication may disperse key technical resources during an emergency





Verification

Comparison

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S Y M P O S I U M

DOS: Departure Creational Structure

SIMPLE & CLEAR COMMUNICATION FRAMEWORK needs to be established for the entire period of an emergency



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HOW WE RESPOND

EMERGENCY CLASSIFICATION

- Key communication tool between all relevant organizations
- A primary measure for recommending & initiating the predetermined protective actions

within the EPZs



ASSESSMENT BY USING MODELS

- Primary communication tool between technical organizations
- A secondary measure for adjusting and optimising initial protective actions decided per EALs

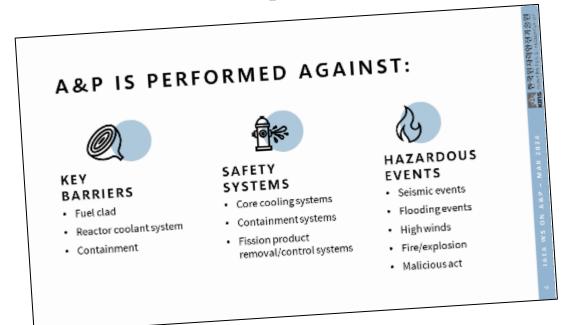
Giving a way for field monitoring



ENVIRONMENTAL MONITORING

Basis for adjusting initial protective actions and transitioning from urgent responses to early responses

Emergency is classified by EALs which are developed considering:



And its severity increases:

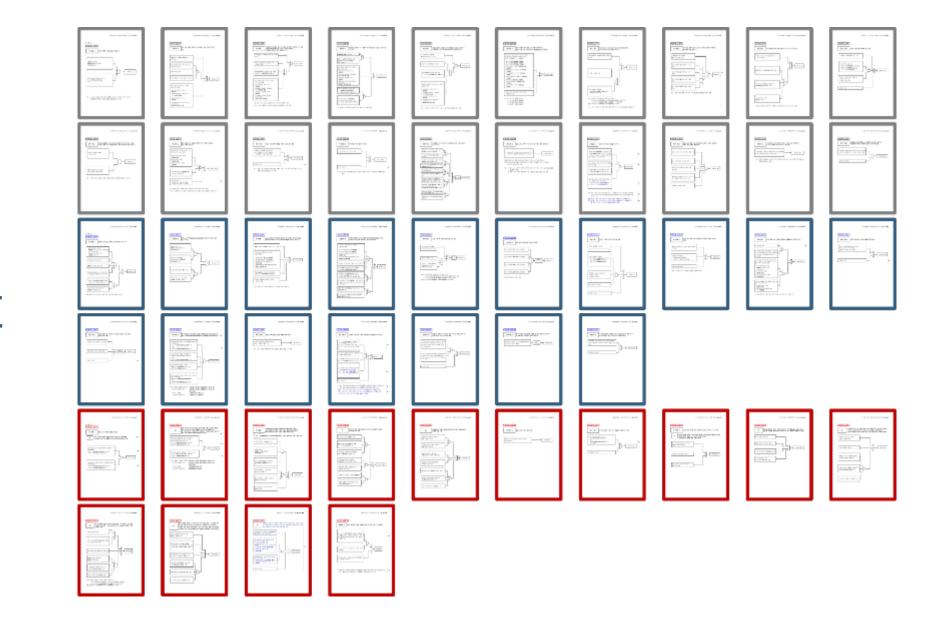
FESAEGELost of key barrier(s)/ Failure of safety system(s)
/ Radiological significance of potential release

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Example Set of EALs



FE

SAE

GE

EMERGENCY CLASSIFICATION AND ITS APPLICATION (1/2)



Why (precautionary) urgent protective actions are based on emergency classification

- High risk of major release for core damage accidents
- Ease of detection of core conditions
- Difficulty in projecting containment failure/bypass
- To avoid/minimize severe deterministic effects near a facility
- Urgent protective actions shall be implemented before containment failure (a major release begins)

KOREA KOREA

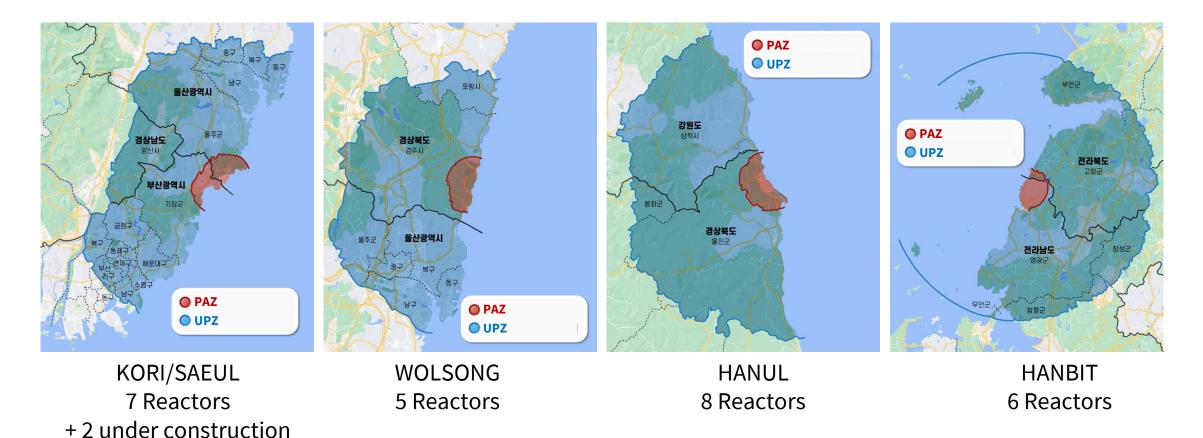
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EMERGENCY CLASSIFICATION AND ITS APPLICATION (2/2)

Emergency Class	Key actions to be taken for off-site emergency responses							
	Licensee	Off-site Response Organisations						
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 						
Site Area Emergency		• Full activation of emergency response organisations						
General Emergency	 Protective action recommendations to OROs Supporting off-site response activities 	 Implementing predetermined protective actions and other response actions 						

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EMERGENCY PLANNING ZONES



Population in the PAZ Population in the UPZ

Few thousands to few tens of thousands

Few tens of thousands to few millions

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2024

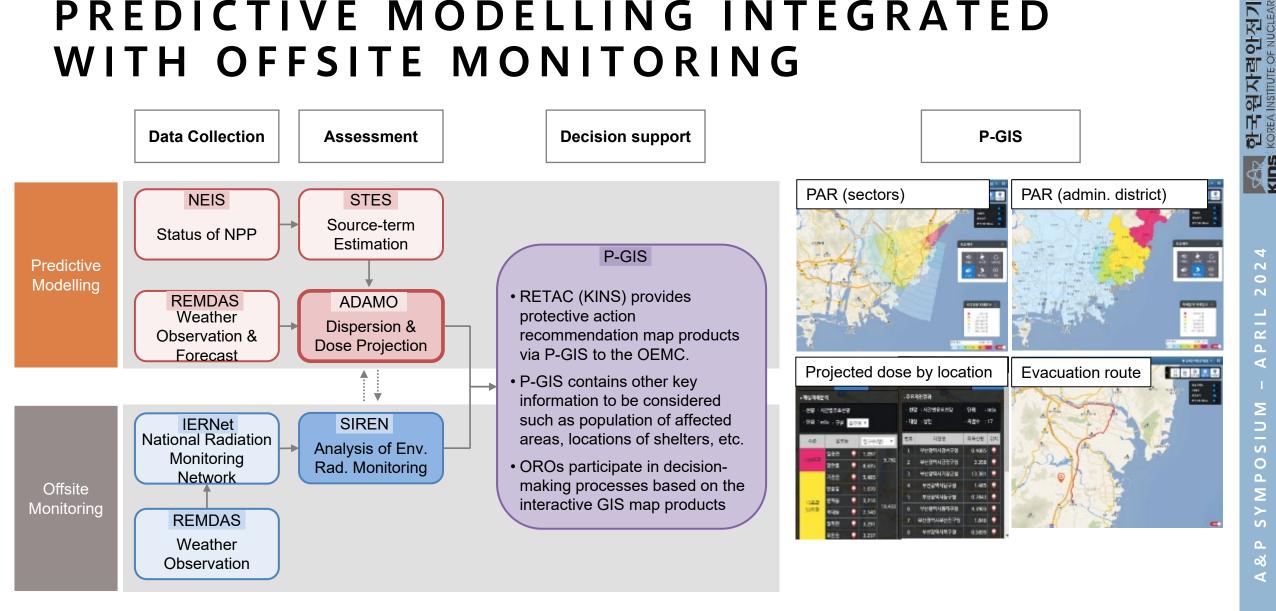
LIST OF TOOLS (1/2)

Tools	Use					
Nuclear Emergency Information System (NEIS)	Provides a direct real-time data transfer from licensee plant computers to RETAC					
Source Term Estimation System (STES) - RASCAL 4.3.4 South Korea version	Estimates accident source term to assess potential offsite consequences					
Accident Dose Assessment and Monitoring (ADAMO)	Assesses offsite consequence based off of source term and monitoring data					
Integrated Environmental Radiation Monitoring Network (IERNet)	Aggregates and visualise radiation monitoring data collected from fixed monitoring system					
Emergency Response Information eXchange (ERIX)	Enables emergency response organisations to communicate and exchange key information during an emergency					
Public protection Geological Information System (PGIS)	Displays protective action recommendations onto the interactive map incorporated with key information such as population, shelter locations, etc					

LIST OF TOOLS (2/2)

Tools	Use				
Unified System for Information Exchange in Incidents and Emergencies (USIE)	Notification and sharing of information to the IAEA and other relevant countries				
International Radiation Monitoring Information System (IRMIS) by the IAEA	Sharing of environmental monitoring data to the IAEA and other relevant countries during an emergency				
Reactor Assessment Tool (RAT)	Assessment & prognosis of NPPs per the IAEA methodology				
Response Technical Tool (RTT)	Detailed assess and prognosis				

PREDICTIVE MODELLING INTEGRATED WITH OFFSITE MONITORING



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RESPONSE FRAMEWORK

	Hours			Days	Weeks - Months				
Event	Declaration of emergency class	Beginning of major releases No major release		major release <i>Ground depo</i>	d deposition of ctive material				
Basis	Emergency Action Levels (EALs)	Observables Operational Intervention I			Levels (OILs) aided by predictive modelling OILs & radiological assessment				
Priority	Avoid or minimize severe determin	nistic effects	Reduce the	e risk of stochastic effects	Reduce the risk of stochastic effects (with further optimization)				
Responses	Precautionary urgent protective actions	Urgent protect	ive actions and ot	her response actions	Early protective actions and other response actions				
PAZ	 Evacuation to the beyond the UPZ and taking an ITB agent Or sheltering and taking an ITB agent if safe evacuation is not possible Access restriction to the PAZ 	 Registration Medical follo 	and monitoring of w-up	evacuees	 Lifting the initial urgent protective actions implemented Relocation Restriction on consumption and trade of non- essential food, milk and drinking water as well as of commodities Registration 	 Further adjustments on emergency response actions 			
UPZ	• Shelter-in-place (remain indoors)	• Sheltering an agent	d taking an ITB	 Evacuation of hot-spots Registration and monitoring of evacuees Medical follow-up 	 Medical follow-up 				
EPD	Reducing inadvertent ingestion			·					
ICPD	 Protecting food chain and water sup Restriction on consumption and trac commodities 			inking water as well as of					

THANK YOU

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Alls