

# ***Nuclear Emergency Preparedness and Response in Japan following Fukushima Accident***

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# Contents

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- 1. New Nuclear Regulatory Organization***
- 2. Enhancement of the Nuclear Emergency Framework***
- 3. Nuclear Emergency Response Guideline***
- 4. Summary***

# ***1. New Nuclear Regulatory Organization***

# ***New Nuclear Regulatory Organization***

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## **Independence:**

- To resolved the problem caused by having both “promotion of utilization” and “safety regulations” under the same organization, the safety regulation division was separated from the Ministry of Economy, Trade and Industry.
- The “**Nuclear Regulation Authority (NRA)**”, was established as an external organization of the Ministry of Environment.

## **Integration:**

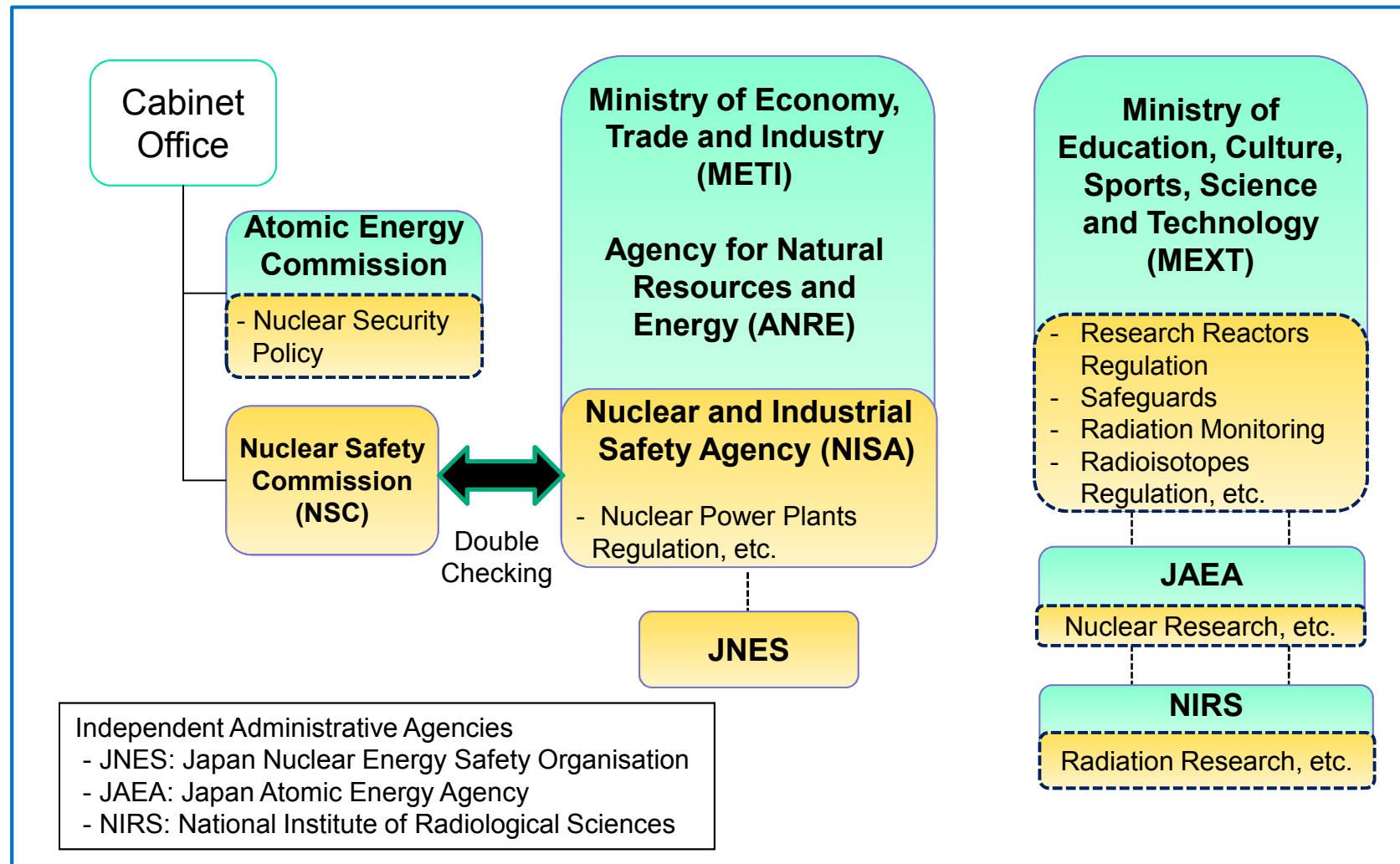
- Integrate nuclear regulation functions, namely, nuclear safety, security, safeguards, radiation monitoring and radioisotopes regulation, into the NRA.

## **Crisis Management:**

- Establish “Nuclear Emergency Preparedness Commission” in a cabinet
- Implement nuclear emergency prevention measures in close cooperation with relevant organisations.

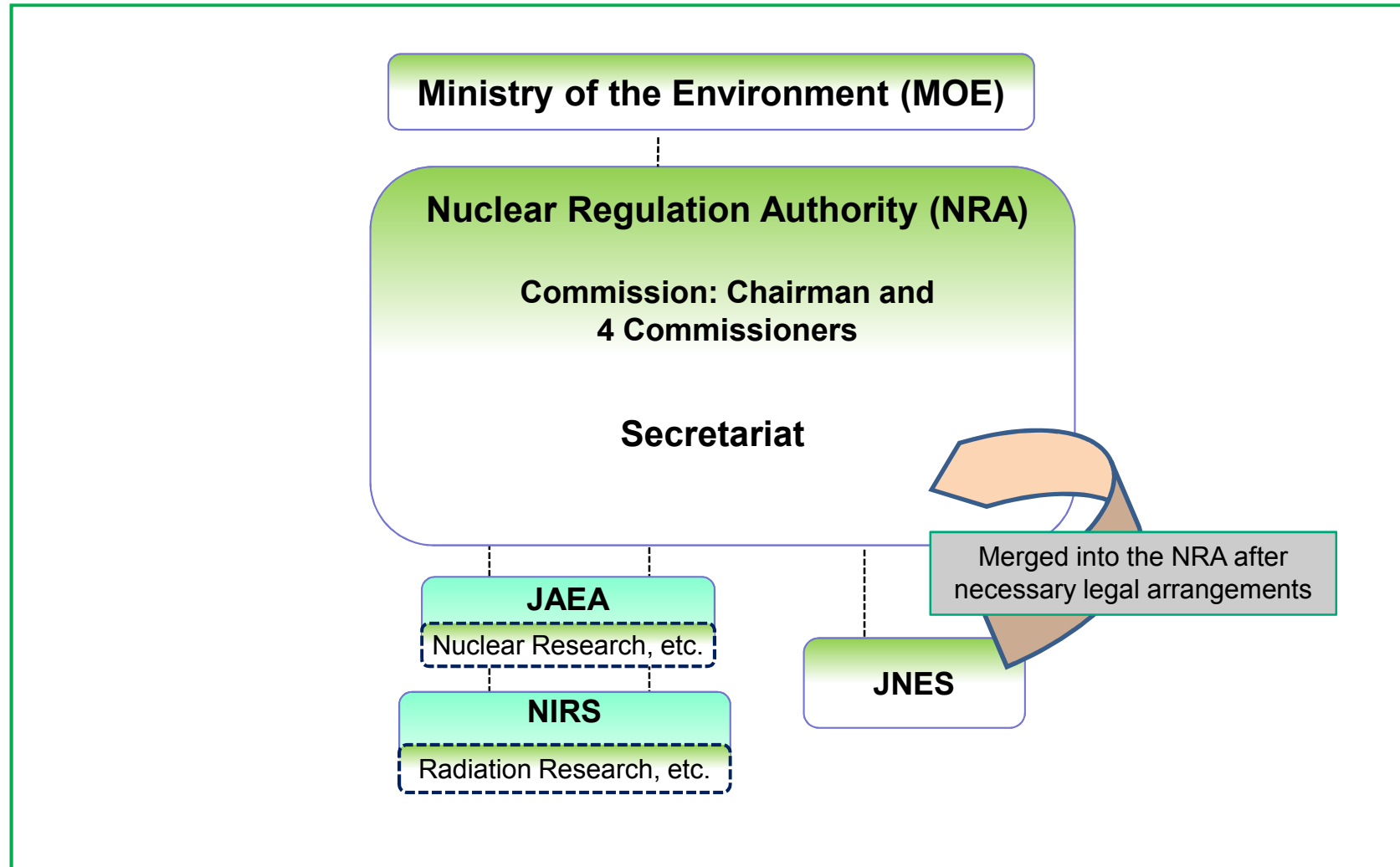
# New Nuclear Regulatory Organization

## Previous Organizations (till 9/19/2012)

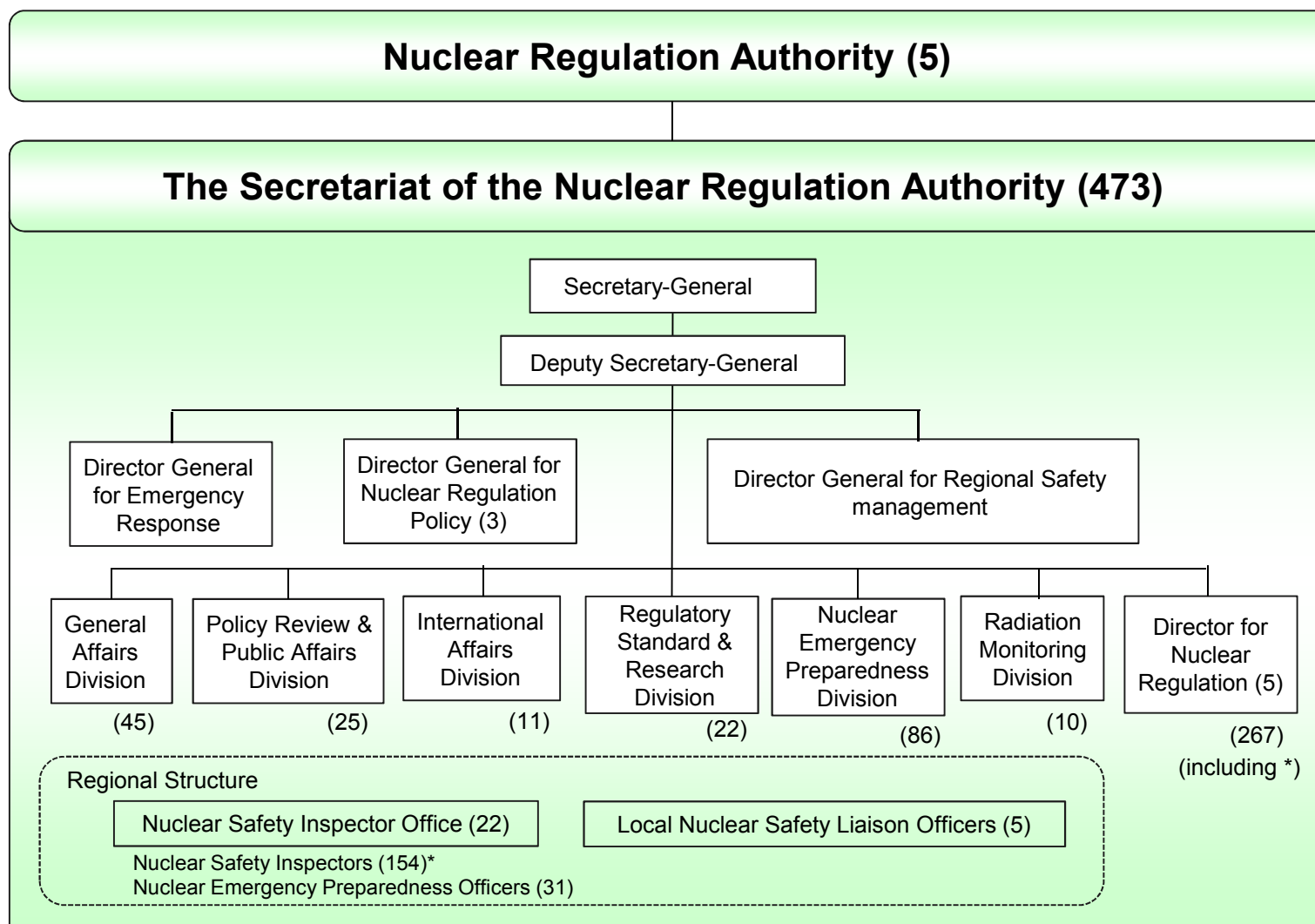


# New Nuclear Regulatory Organization

## New Organizations (from 9/19/2012)



# NRA Organization (as of March 2013)



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## ***2. Enhancement of the Nuclear Emergency Framework***



# ***National Government***

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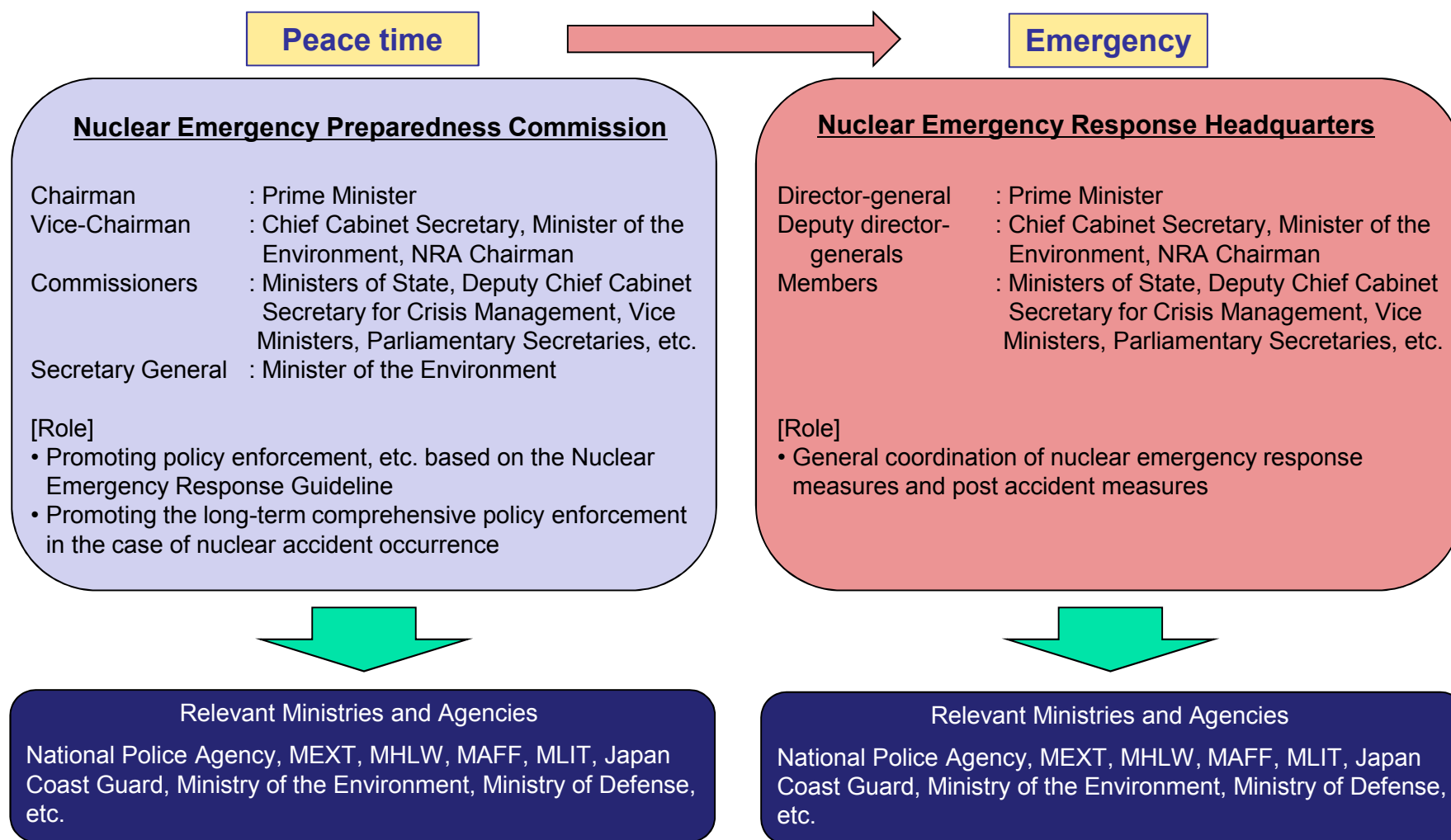
- **Peace Time**

As a precaution against emergencies, a new **Nuclear Emergency Preparedness Commission (NEPC)** is permanently established under the Cabinet to promote nuclear emergency preparedness measures throughout the government from peace time.

- **Emergency**

**Nuclear Emergency Response Headquarters** is temporarily installed under the Cabinet Office at the time of Declaration of the State of Nuclear Emergency.

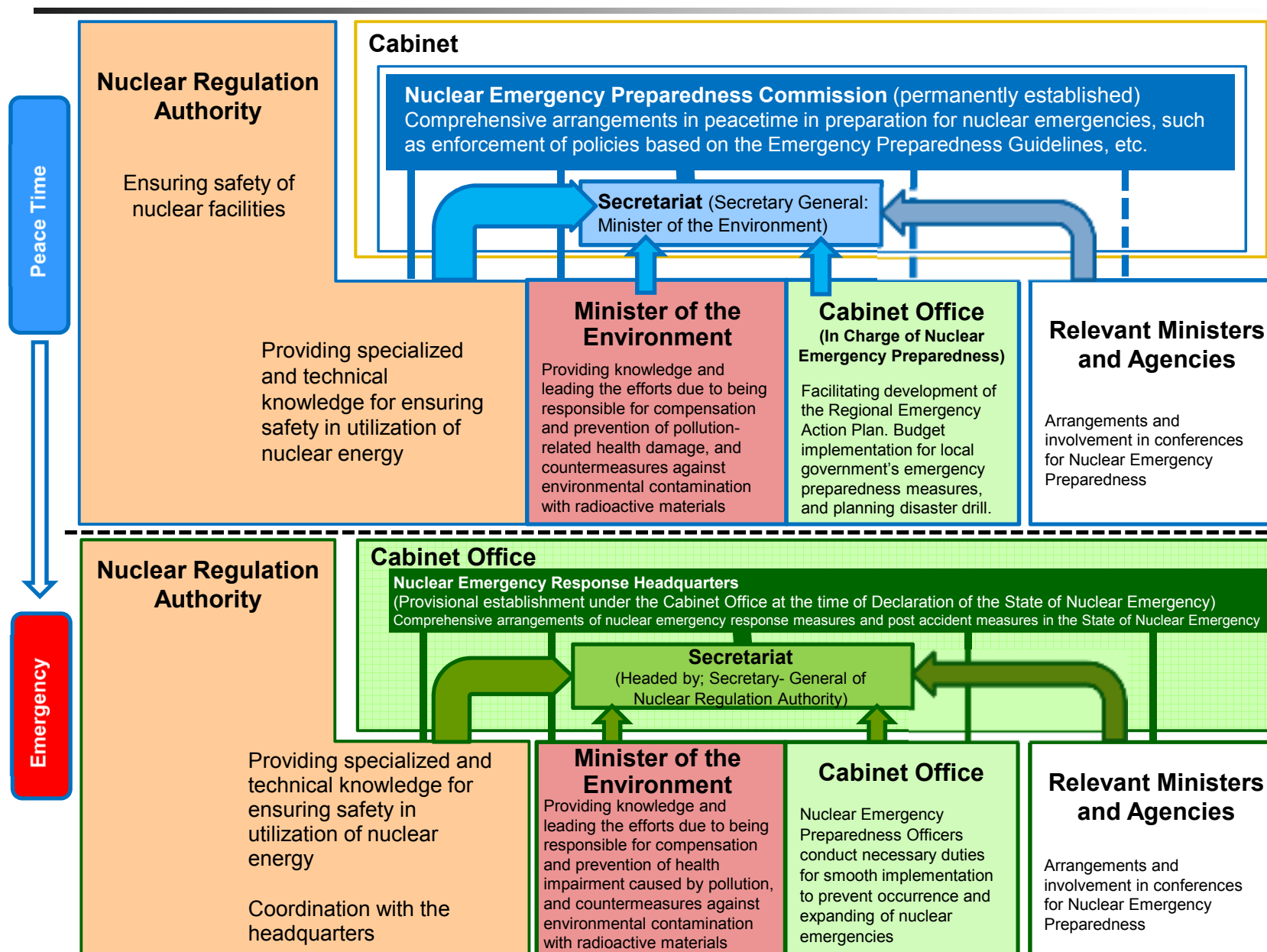
# Nuclear Emergency Preparedness Commission



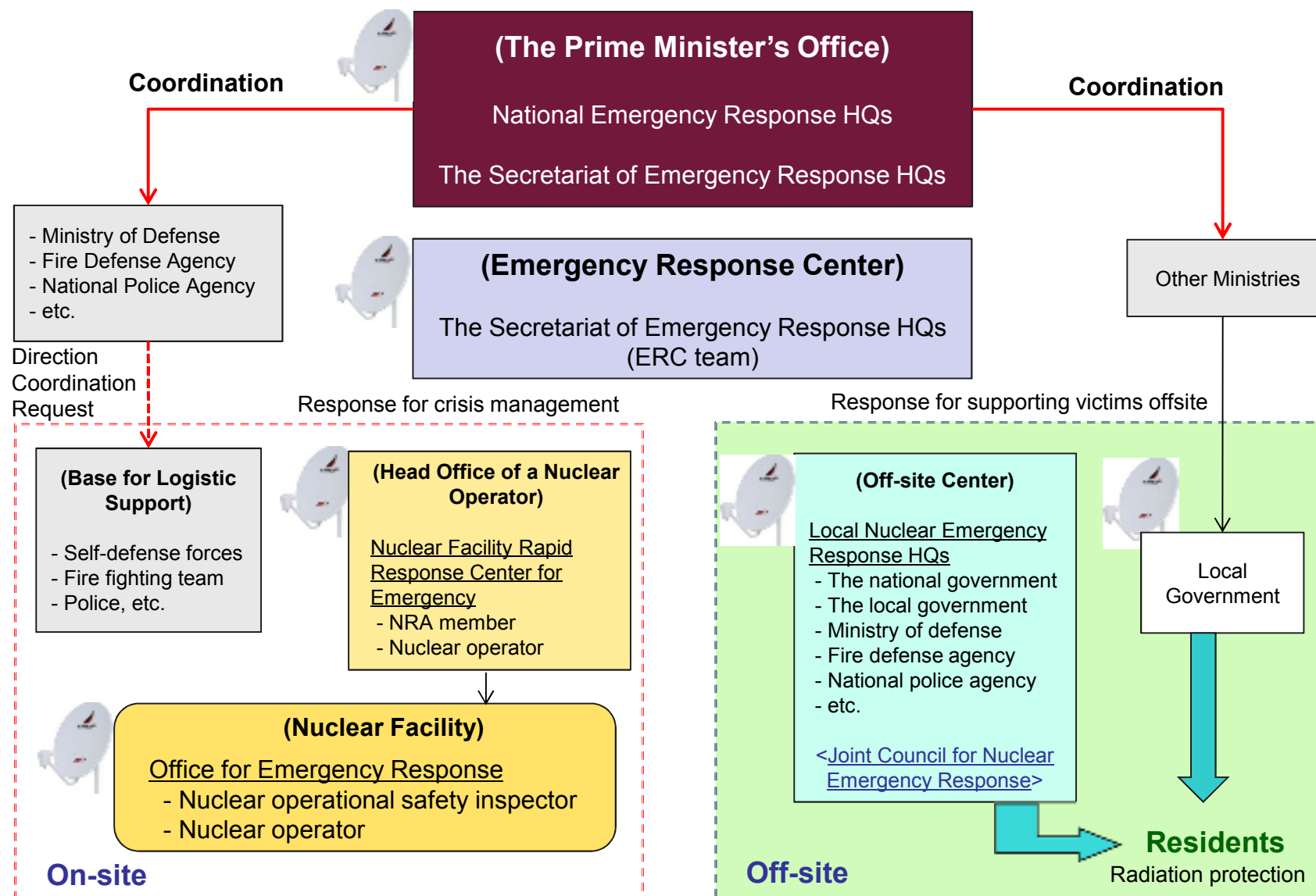
NRA: Nuclear Regulation Authority  
MEXT: Ministry of Education, Culture, Sports, Science and Technology  
MLIT: Ministry of Land, Infrastructure, Transport and Tourism

MAFF: Ministry of Agriculture, Forestry and Fisheries  
MHLW: Ministry of Health, Labour and Welfare

# Nuclear Emergency Framework of the National Government



# The National Crisis Management System in Case of Emergency



### ***3. Nuclear Emergency Response Guideline***

# *Nuclear Emergency Response Guideline*

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## *1979.3 Three Mile Island Nuclear Power Plant Accident*

- 1980.6 “Disaster Measure around Nuclear Power Plant (Nuclear Emergency Response Guideline)” by Nuclear Safety Committee (NSC)

## *1999.9 JCO Critical Accident*

- 2000.5 Revision of “Nuclear Emergency Response Guideline”
  - ☞ to rename “Disaster measure around Nuclear Facility”
  - ☞ to add and revise the content due to Special Law of Nuclear Emergency Preparedness” established on 1999.12

## *2011.3 Fukushima Dai-ichi Nuclear Power Plant Accident of TEPCO*

- 2012.10 “Nuclear Emergency Response Guideline” formulated by Nuclear Regulation Authority (NRA)
- 2013.2 “Nuclear Emergency Response Guideline” revised by NRA
- 2013.6 Enforcement of “Nuclear Emergency Response Guideline”  
([http://www.nsr.go.jp/activity/bousai/data/130605\\_saitaishishin.pdf](http://www.nsr.go.jp/activity/bousai/data/130605_saitaishishin.pdf))

# Ideas on the Implementation of Urgent Protective Actions in case of Emergency

Judge the situation based on the plant condition  
(Emergency Action Level (EAL))

- Protective measures (Avoiding deterministic effects)
- Evacuation
- Providing dose of stable iodine tablets...

Judge the situation based on the air radiation dose rate  
(Operational Intervention Level (EAL))

- Protective measures in an emergency  
(Reducing stochastic effects)
- Evacuation
- Temporary relocation
- Restriction of food and drink intake



**Emergency**



**EAL**

Release of  
radioactive  
materials



**OIL**

Progression of the situation

# The Status of Emergency Classification in Application of EAL

- Referred to IAEA requirement and U.S. EAL guideline (NUREG-0654, NEI 99-01)
- The guideline provides EAL for standard scenarios.
- Operators prepare each EAL and report to NRA.
- NRA reviews the EAL.

Emergency Class in Japan	NUREG0654/ NEI 99-01 (USA)	IAEA classification
General Emergency (Article 15)	General Emergency	General Emergency
Site Area Emergency (Article 10)	Site Area Emergency	Site Area Emergency
		Facility Emergency
Alert	Alert	Alert
Events written in Reactor Regulation Act	Unusual Event	—



# Emergency Classification Level and Evaluation Criteria

	Class 1	Class 2	Class 3
Emergency Class	<b>Alert :</b> Prepare for implementation inside and outside facilities	<b>Site Area Emergency:</b> Implement protective action on the site and prepare for protective actions off the site	<b>General Emergency:</b> Start evacuation in PAZ and implement protective actions in UPZ
(EAL) Emergency Action Level	(EAL1) Establishment of criteria to be used <ul style="list-style-type: none"> <li>- when plant safety level is decreased or</li> <li>- when an event which is possible to cause such a situation is occurred.</li> </ul>	(EAL2) Establishment of criteria to be used <ul style="list-style-type: none"> <li>- when plant function required to protect public safety is lost or</li> <li>- when an event which is possible to cause such a situation is occurred.</li> </ul>	(EAL3) Establishment of criteria to be used <ul style="list-style-type: none"> <li>- when a core damage or fuel melting is generated or</li> <li>- when an event which is possible to cause such a situation is occurred, and,</li> <li>- when an event which is possible to cause a loss of containment integrity is occurred.</li> </ul>

## ***Emergency Classification : Alert***

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### ● ***Special Alarm Phenomenon***

- 1) If, in prefectures where nuclear facilities are located, **more than intensity 6 earthquake** occurred.
- 2) If, in prefectures where nuclear facilities are located, **large tsunami warning** was issued.
- 3) When **the Tokai Earthquake Advisory** was issued
- 4) When **the critical failure**, which Director General for Nuclear Regulation Policy or General Manager of Accident Response at Nuclear Emergency Preparedness Division is deemed the necessary for alarm, **is occurred in nuclear facility**.
- 5) Others, such as when the chairman of the Nuclear Regulation Authority the establishment of a headquarters warning is deemed necessary.

## ***Emergency Classification : Site Area Emergency***

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- ***Article 10 on Special Law of Emergency Preparedness for Nuclear Disaster***

- 1) Leakage of reactor coolant
- 2) ECCS (High Pressure Coolant Injection System) doesn't work when water supply to nuclear power reactor is lost during operation
- 3) Loss of all water supply to steam generator during operation
- 4) A breakdown of residual heat removal capabilities in addition to the breakdown of heat removal capabilities from the reactor via the main condenser
- 5) Loss of all of the alternating-current power supply (for more than 5 minutes)
- 6) DC power capability to emergency busses reduce to a single power source (for more than 5 minutes)
- 7) Loss of water level that has resulted in the work of ECCS in the reactor vessel which is out of operation.
- 8) All nuclear reactor cooling functions break down while the reactor is an inactive state, etc.
- 9) Unable to use the control room

## ***Emergency Classification : General Emergency***

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### **● *Article 15 on Special Law of Emergency Preparedness for Nuclear Disaster***

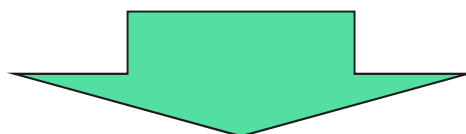
- 1) Plant shutdown capability by control rod or emergency injection boron is lost during plant shutdown for emergency.
- 2) All plant shutdown capability is lost during plant shutdown for emergency.
- 3) Unable to inject water into the nuclear reactor by any of the emergency core cooling system
- 4) The pressure level in the reactor containment vessel exceeds tolerance level
- 5) The depressurizing function of the nuclear reactor vessel breaks down when the residual heat removing function from the reactor has broken down.
- 6) All functions that cool the nuclear reactor break down.
- 7) All of emergency direct-current power supplies break down (for more than 5 minutes)
- 8) Detection of radiation doses or temperatures that indicate melting of the reactor
- 9) Loss of water level that has resulted in the uncovering of irradiated fuel in the reactor vessel
- 10) Lowering of water levels to the point at which the residual heat removal function breaks down (for more than 1 hour)
- 11) Unable to use the control room
- 12) Loss of water level that has resulted in the uncovering of irradiated fuel in spent fuel pool.
- 13) Radiation level of the boundary area of nuclear facilities greater than 5  $\mu\text{Sv/h}$  is continuously detected over 10 min.

## Operational Intervention Level (OIL)

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*After the release of radioactive materials,*

- ***Area where a high radiation level is detected***
  - *Evacuation within a few hours to one day*
  - *Screening and decontamination at evacuation center*
- ***Area where a low radiation level is detected***
  - *Temporary relocation within one week*
  - *Intake restriction on agricultural products*

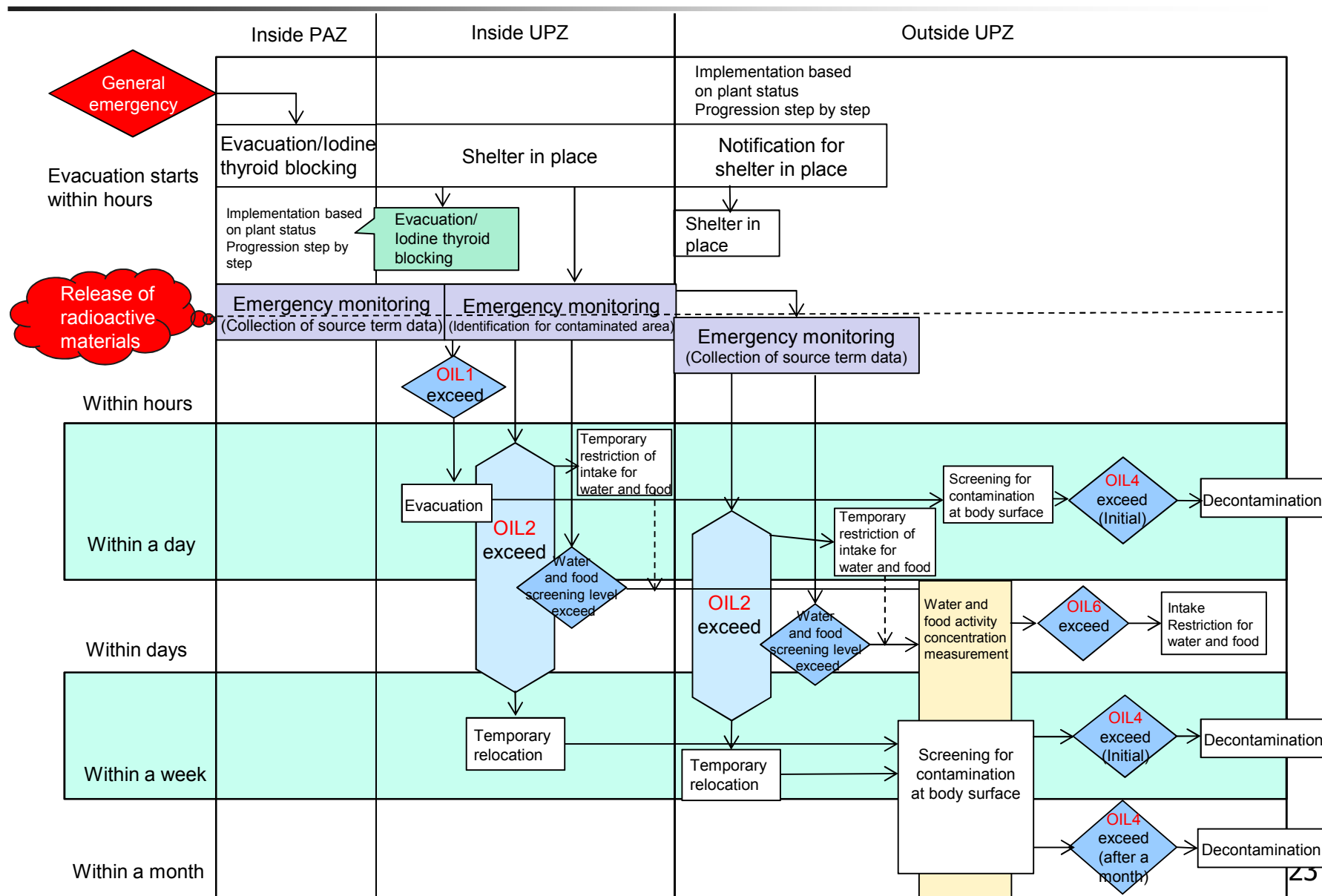


**Setting of Operational Intervention Level (OIL)**

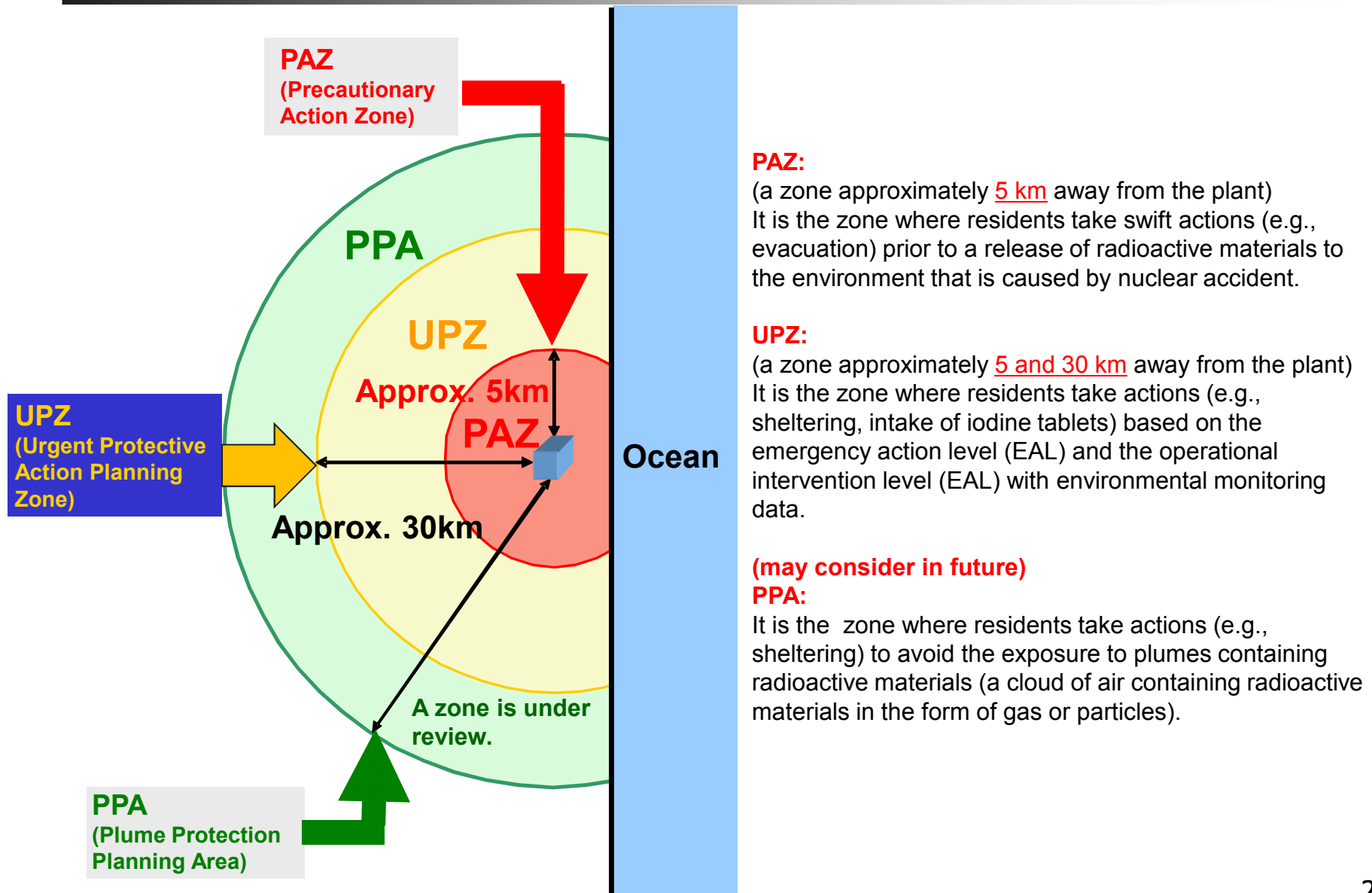
## OILs and Protective Actions

	Criteria	Description	Initial Setting Value		
Prompt Protective Action	OIL1	➤ Evacuation or indoor within hours	500 $\mu$ Sv/h (IAEA: 1,000 $\mu$ Sv/h)		
	OIL4	➤ Decontamination	$\beta$ ray: 40,000 cpm		
			$\beta$ ray: 13,000 cpm (1 month later)		
Early Protective Action	OIL2	➤ Intake restrictions on regional products ➤ Temporary relocation	20 $\mu$ Sv/h (IAEA: 100 $\mu$ Sv/h)		
Intake Restriction	Screening criteria for food and drink	➤ Specification of area where radioactive nuclide concentrations in food and drink are detected	0.5 $\mu$ Sv/h (IAEA: 1.0 $\mu$ Sv/h)		
	OIL6	➤ Intake restrictions on foodstuffs	Nuclide	Drinking Water, Milk, Dairy Products	Vegetables, Grains, Meat, Eggs, Fish, etc.
			Radioactive iodine	300 Bq/kg	2,000 Bq/kg
			Radioactive cesium	200 Bq/kg	500 Bq/kg
			Plutonium, $\alpha$ nuclide of uranide	1 Bq/kg	10 Bq/kg
			Uranium	20 Bq/kg	100 Bq/kg

# Concept of Operation for Protective Actions



# Key Zones for Nuclear Disaster Measures (Nuclear Power Plant)





# Key Zones for Nuclear Disaster Measures (Except for Nuclear Power Plant)



Facility		EPZ (radius)
Nuclear power plant under development, and the test nuclear facility above 50MWt		Approx. 8 -10 km
Reprocessing facility		Approx. 5 km
Test nuclear facility	thermal power < 41MW	Approx. 50 m
<div>Review based on PAZ and UPZ, and will revise</div>		
Processing facility, and the facility in which nuclear fuel materials above critical mass are used	<p>mass (except for the conditions for strict critical protection by mass control, form control and geometrical safety arrangement, and the static storage) are used, and furthermore the facility corresponds to the below conditions.</p> <ul style="list-style-type: none"> <li>- Treatment of unstable status (liquid, powder, gas) and unstable process (physical and chemical)</li> <li>- Treatment of uranium with concentration above 5%</li> <li>- Treatment of plutonium</li> </ul>	Approx. 500 m
	Facility except for above matter	Approx. 50 m
Waste disposal facility and Waste management facility		Approx. 50 m
Spent Fuel Interim Storage Facility		Approx. 50 m

## ***Emergency Environmental Monitoring***

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- The national government establishes “**Emergency Monitoring Centers**” at NPP site location, in which the measured dose rate results are consolidated.
- The national and the local governments share the monitoring data.
- The national government implements the monitoring in high dose rate area (exclusion zone), aerial regions and the sea.

## *Intake of Stable Iodine*

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### ● Nuclear Disaster Proactive Preparedness

- In PAZ, prior distribution to residents by the local government
- In UPZ, saving against emergency at the local government

### ● Nuclear Emergency Response

- In PAZ, Nuclear Emergency Response HQs or the local government indicates the intake.
- In UPZ, Nuclear Regulation Authority determines its necessity, then Nuclear Emergency Response HQs or the local government indicates the intake.

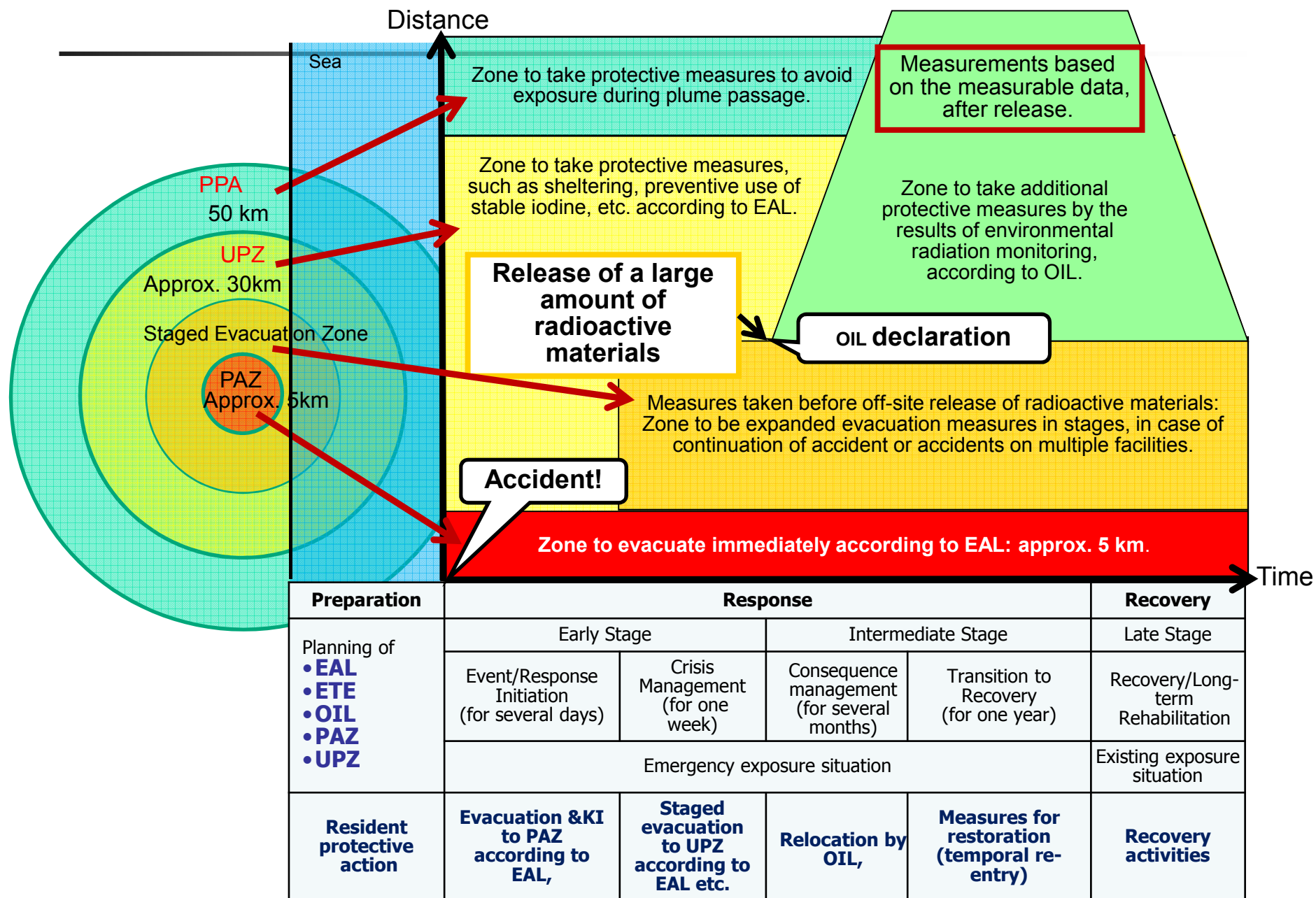
## ***4. Summary***

# Summary

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- The new regulatory system is established and separated from the promotion organization.
- The national nuclear emergency framework was enhanced due to the promotion of nuclear emergency preparedness measures throughout the government from peace time.
- The new “Nuclear Emergency Response Guideline” was enforced on June 2013.
- In this new guideline, the international criteria such as EAL and OIL were applied from Fukushima accident lessons.

# Concluding Remarks: Framework View



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