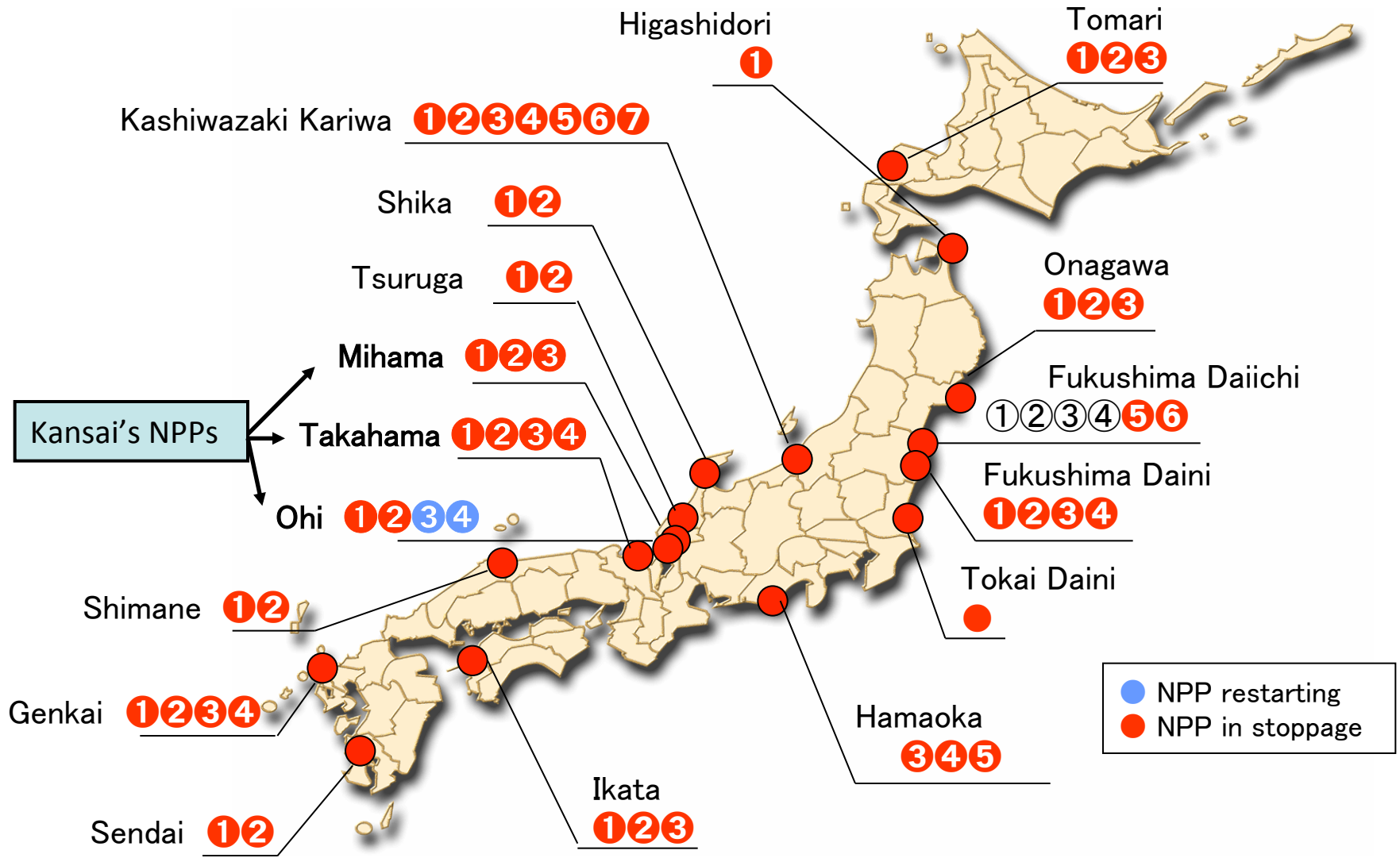


# 1. Safety Response Measures taking the Fukushima Accident into Consideration (Restart of Ohi Units 3 and 4)

# Nuclear Power Plants in Japan



# Overview of the New Safety Regulations

## Old Safety Regulations

Measures are taken for accident management by utilities voluntarily.

+

Design basis assuming the conditions not leading to core damage (assuming only a single failure of components, etc.)

Considerations for natural phenomena
Considerations for fire
Considerations for reliability
Reliability of power sources
Performance of cooling systems
Performance of other systems
Resistance against earthquake and tsunami

## New Safety Regulations

Restriction on diffusion of radioactive materials	Newly established (severe accident management measures)
Addressing intentional aircraft crash	
Measures to prevent containment failure	
Measures to prevent core damage (assuming failure of multiple components)	
Considerations for natural phenomena	Enhanced
Considerations for fire	
Considerations for reliability	
Reliability of power sources	
Performance of cooling systems	
Performance of other systems	Enhanced
Resistance against earthquake and tsunami	

# Outline of the New Safety Regulations (Examples)

	New Safety Standard Draft Outline (Examples)
Severe Accident	<ul style="list-style-type: none"><li>• Installation of both portable and permanent equipment</li><li>• Isolated special safety facility housing (with cooling function and emergency power source)</li><li>• Installation of vents with filters (PWR, BWR (2 trains))</li></ul> etc.
Back-Fitting	<ul style="list-style-type: none"><li>• Single failure assumption for important passive components</li><li>• Prohibition of sharing of equipment between multiple units in principle</li><li>• Reinforcement of emergency battery capacity</li><li>• Strengthening of fire protection measurements</li></ul> etc.
Seismic	<ul style="list-style-type: none"><li>• Reevaluation of standard seismic ground motion and tsunami height</li><li>• Absence of active fault just beneath important facilities</li></ul> etc.

# Status of Conformity to the New Safety Regulations (1/3)

Newly required functions (Abstracts from the handouts of the Nuclear Regulation Authority as of April 10)		Examples of measures taken at Ohi Units 3 and 4
Functions to resist earthquake and tsunami	Safety must not be impaired by the reference tsunami.	•It has been confirmed that the Ohi plant site (T.P. 9.7 m) is higher than the design tsunami height (T.P. 2.85 m) based on the reference tsunami and thus safety would not be impaired.
	Tsunami protection facilities, etc. must have strong anti-seismic performance.	•It has been confirmed that there is no facility that requires S-class design, such as tsunami protection functions, etc.
	The assessment of active faults shall be traced back as far as 400,000 years ago, if necessary.	•It has been confirmed that the results of previous assessments of active faults are not affected.
	Subsurface structures shall be understood in three dimensions in order to establish the basic design ground motion.	•Concerning subsurface structure, a ground model as deep as 4 km has been set as the stratification because hard bedrock was confirmed by studies including boring surveys.
	Key buildings for safety shall be built on ground where there is no outcropping of active faults.	•A fracture zone survey is now underway at the site; no fault that could become active in the future has been identified.
Functions that should be guaranteed by design to prevent serious accidents	Safety must not be impaired by volcanic activity, tornadoes, external fires, etc.	•It has been confirmed that safety is not impaired by the newly assessed natural phenomena. Measures to prevent thermal influence (deforestation, etc.) have been implemented for external fire.
	Safety must not be impaired by internal flooding.	•The internal flooding assessment confirmed that safety is not impaired.
	Safety must not be impaired by internal fire.	•It has been confirmed that safety is not impaired by internal fire by taking various measures to prevent fire, including fire prevention, fire detection and extinguishing, and mitigation of influence of fire, and also by the fire impact assessment.
	Reliability of the functions of the key buildings for safety shall be ensured.	•It has been confirmed that a high level of reliability is secured although some parts of the systems including the annulus air cleanup system are not redundantly structured.
	Reliability of the electric systems shall be ensured.	•It has been confirmed that the external power supply system is connected to the power grid by at least two transmission lines and has a reliable configuration.
	The systems transferring heat to the ultimate heat sink must be physically protected.	•It has been confirmed that the ultimate heat sink would not be lost by the design tsunami height (T.P. 2.85 m) based on the reference tsunami.

# Status of Conformity to the New Safety Regulations (2/3)

	Newly required functions (Abstracts from the handouts of the Nuclear Regulation Authority as of April 10)	Examples of measures taken at Ohi Units 3 and 4
Functions required to respond to serious accidents	Function to shut down the reactor	It has been confirmed that safety would not be impaired even when ATWS occurs during the current cycle.
	Function to cool down the reactor coolant under high pressure	Deployment of portable battery system to start up the turbine driven auxiliary feed water pump Establishment of the procedure to start up the motor driven auxiliary feed water pump by standby air-cooled emergency generators, etc
	Function to reduce the pressure of the reactor coolant pressure boundary	Deployment of nitrogen gas cylinders and portable compressors, etc. to reduce the pressure of the pressurizer relief valve Establishment of the means to operate the pressurizer relief valve by power supply cars
	Function to cool down the reactor coolant under low pressure	Deployment of portable and permanently installed alternative low-pressure water injection pumps Establishment of the procedure to restore the residual heat removal system by the large-capacity pumps, etc.
	Function to secure the ultimate heat sink in the serious accident preventive measures during an accident	Establishment of the means to continuously cool down the reactor using steam generators Deployment of large-capacity pumps, etc.
	Function to cool down, reduce pressure and reduce radioactive materials in the containment atmosphere	Establishment of the means to inject water into the containment by permanently installed alternative low-pressure water injection pumps
	Function to prevent failure of the containment due to overpressure	Establishment of the procedure to cool down the containment through natural convection taking advantage of the containment re-circulation unit Establishment of the procedure to directly introduce seawater into the containment re-circulation unit by large-capacity pumps
	Function to cool down the melted core after falling into the lower containment	Establishment of the means to inject water into the lower containment by permanently installed alternative low-pressure injection pumps, etc.

# Status of Conformity to the New Safety Regulations (3/3)

	<b>Newly required functions (Abstracts of the handouts of the Nuclear Regulation Authority as of April 10)</b>	<b>Examples of measures taken at Ohi Units 3 and 4</b>
<b>Functions required to respond to serious accidents</b>	<b>Functions to cool, shield, and secure subcriticality of the spent fuel pool</b>	<ul style="list-style-type: none"> <li>• Establishment of a means to inject water into the spent fuel pit by portable fire pumps</li> <li>• Deployment of a portable alternative spray system, etc.</li> </ul>
	<b>Function to supply water</b>	<ul style="list-style-type: none"> <li>• Establishment of a procedure to use multiple alternative fresh water sources</li> <li>• Establishment of a procedure to supply seawater into the condensate pit, etc. by portable fire pumps</li> </ul>
	<b>Function to supply a power source</b>	<ul style="list-style-type: none"> <li>• Deployment of power supply cars, addition of connecting ports</li> <li>• Always-on connection of air-cooled emergency generators</li> <li>• Establishment of a means to secure a DC power source by connecting regularly used batteries</li> <li>• Deployment of standby cables for exchanging electricity among units</li> </ul>
	<b>Function of the control room</b>	<ul style="list-style-type: none"> <li>• Implementation of measures to reduce the release of radioactive materials during an accident (installation of an alternative operation line for the annulus air cleanup system) based on the results of the control room habitability assessment</li> </ul>
	<b>Function of the emergency response center</b>	<ul style="list-style-type: none"> <li>• Establishment of an alternative command center (implementation of measures to reduce exposure)</li> </ul>
	<b>Instrumentation function</b>	<ul style="list-style-type: none"> <li>• Establishment of a procedure to measure/estimate the parameters of the reactors and containments</li> </ul>
	<b>Monitoring function</b>	<ul style="list-style-type: none"> <li>• Deployment of monitoring cars/portable monitoring posts</li> </ul>
	<b>Communication function</b>	<ul style="list-style-type: none"> <li>• Deployment of satellite phones and external antennas</li> </ul>
	<b>Function to limit the release of radioactive materials outside of the plant</b>	<ul style="list-style-type: none"> <li>• Deployment of water cannons</li> <li>• Deployment of silt fences</li> </ul>
	<b>Functions to inject water, etc. under the condition where the plant is significantly damaged by a large-scale natural disaster or terrorism including intentional aircraft crash</b>	<ul style="list-style-type: none"> <li>• Planning to respond to the situation by individually required items such as the use of portable units and the development of procedures</li> </ul>

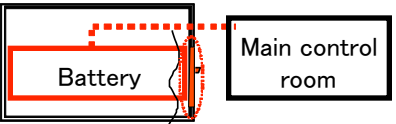
# Safety Measures (Examples of Ohi Units 3 and 4)

## Safety Measures

### Equipment to be powered

Equipment to safely shut down the plant

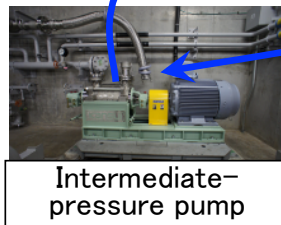
- Monitoring instruments
- M/D-AFWP
- RHRP
- CCWP, etc.



### Assurance of power supply

Electric supply by emergency air-cooled generators

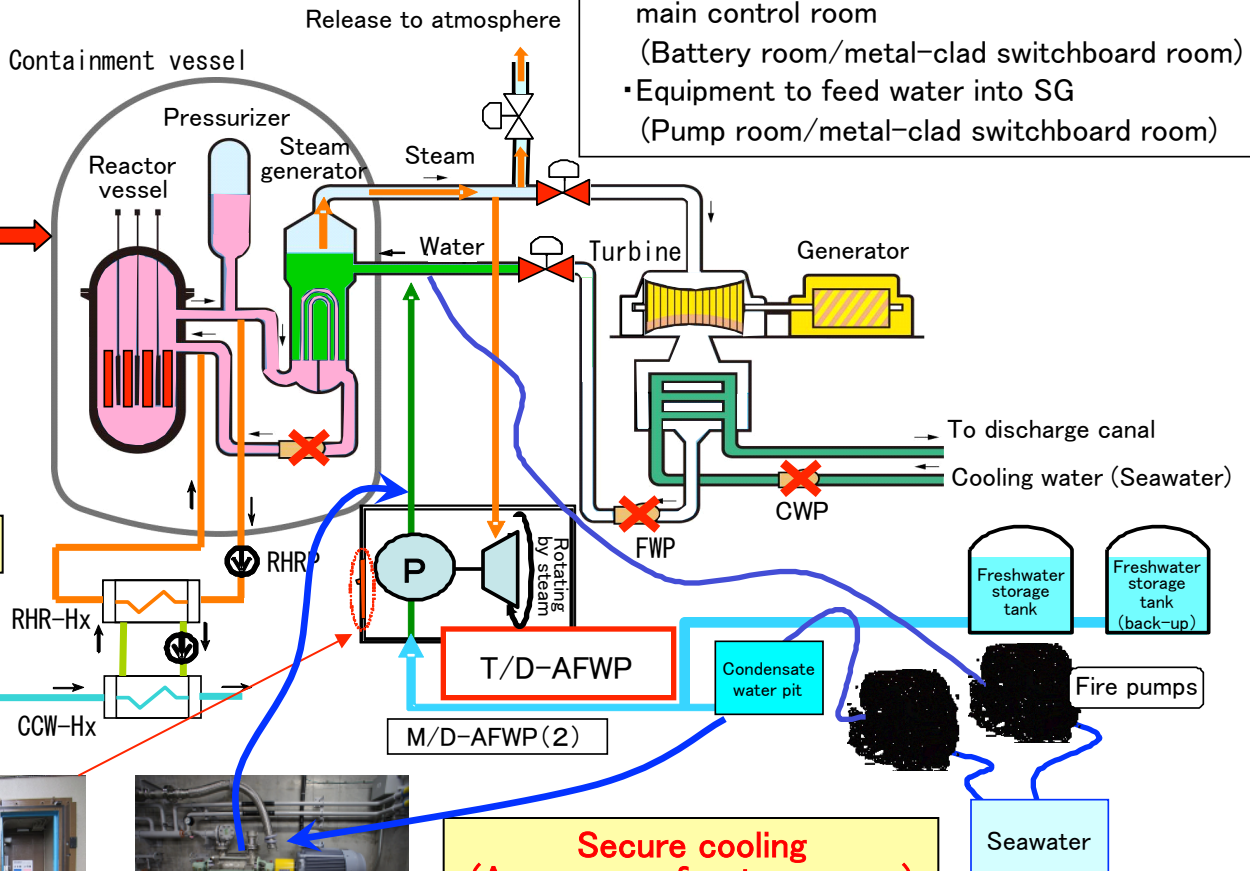
Seawater



Intermediate-pressure pump

### Measures against flooding

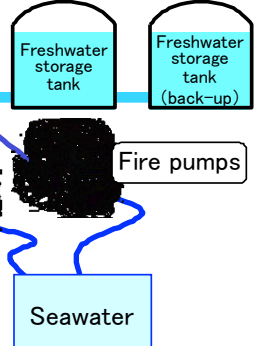
- Sealing of doors and piping penetrations, etc.
- Rooms with equipment to supply power to the main control room (Battery room/metal-clad switchboard room)
- Equipment to feed water into SG (Pump room/metal-clad switchboard room)



### Secure cooling (Assurance of water source)

Feedwater supply by super-pump, fire pumps, etc.

Seawater

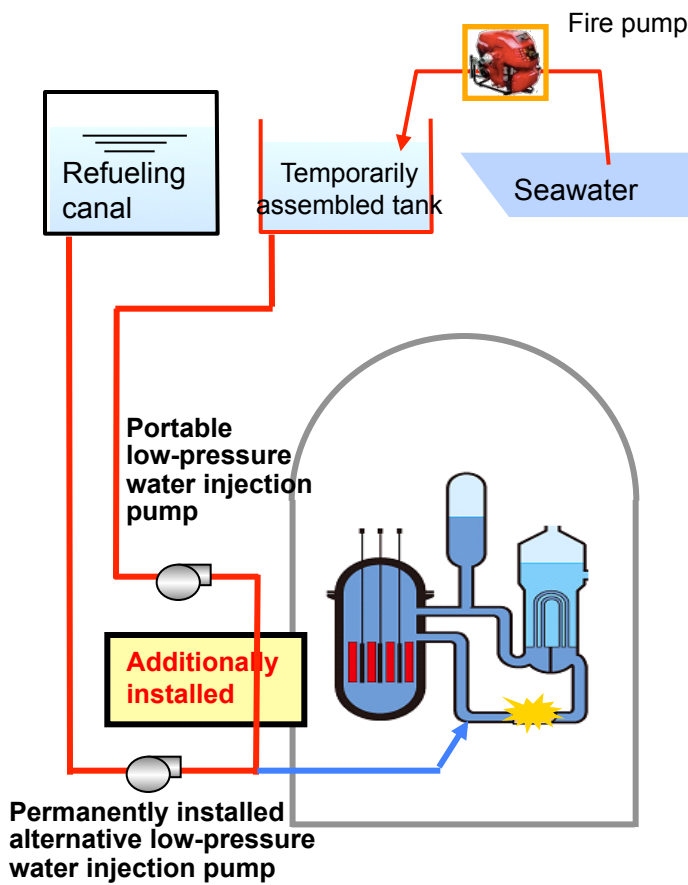




# Primary Measures to Respond to the New Safety Regulations (Serious Accident Measures)

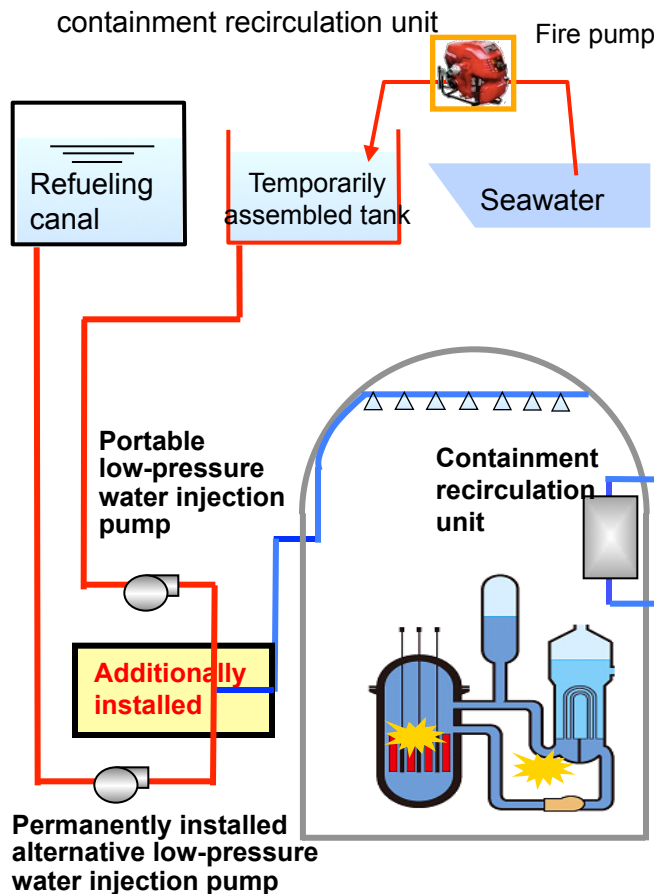
## Measures to prevent core damage

- Core cooling by the portable and permanently installed alternative low-pressure water injection pumps



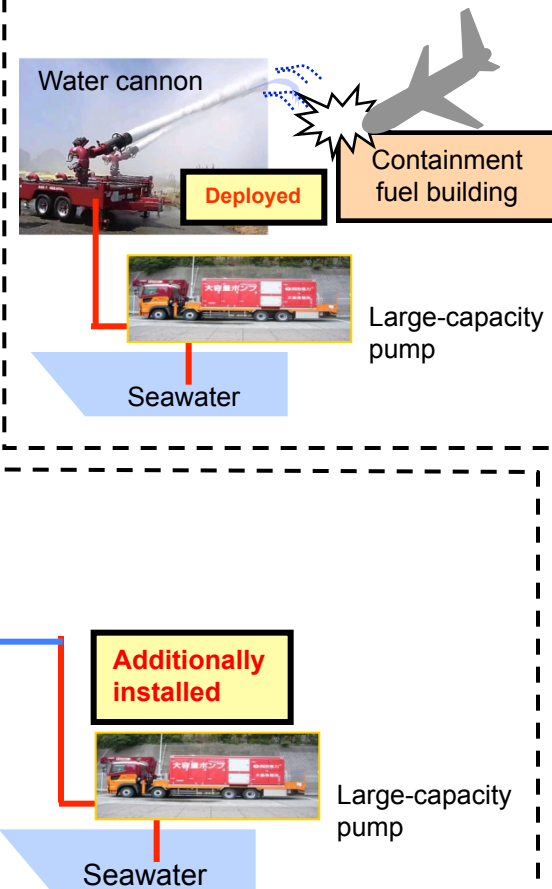
## Measures to prevent containment damage

- Cooling, and reducing the pressure of the containment atmosphere and contained radioactive materials by the portable and permanently installed low-pressure water injection pumps
- Addition of a seawater injection line to the containment recirculation unit

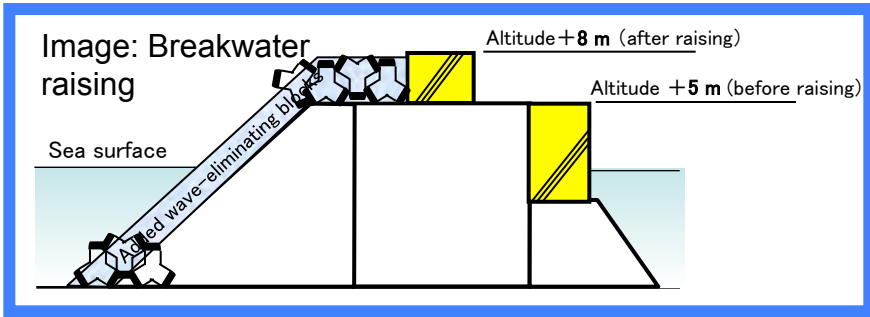
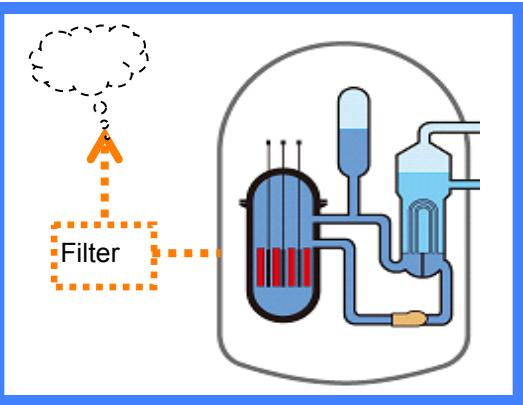


## Measures to address external events

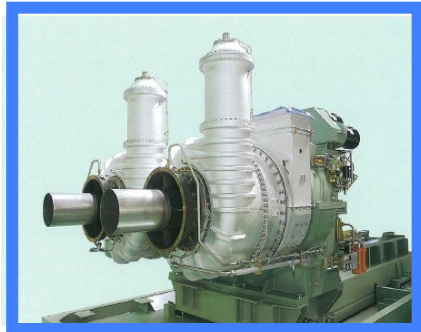
- Deployment of water cannons to limit the release of radioactive materials in the event of significant damage to the plant caused by aircraft crash, etc.



**[Installation of vent equipment with filter]**  
Minimization of long-term evacuation areas  
(FY2015)



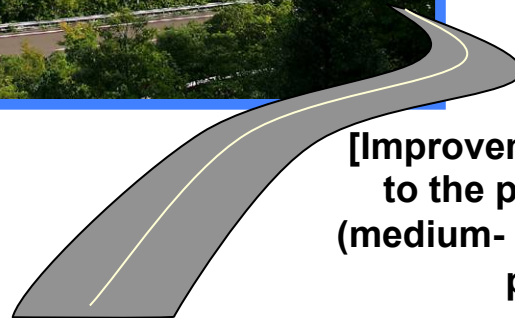
**[Breakwater raising]**  
(FY2013)



**[Permanent installation of emergency generators]**  
(FY2015)



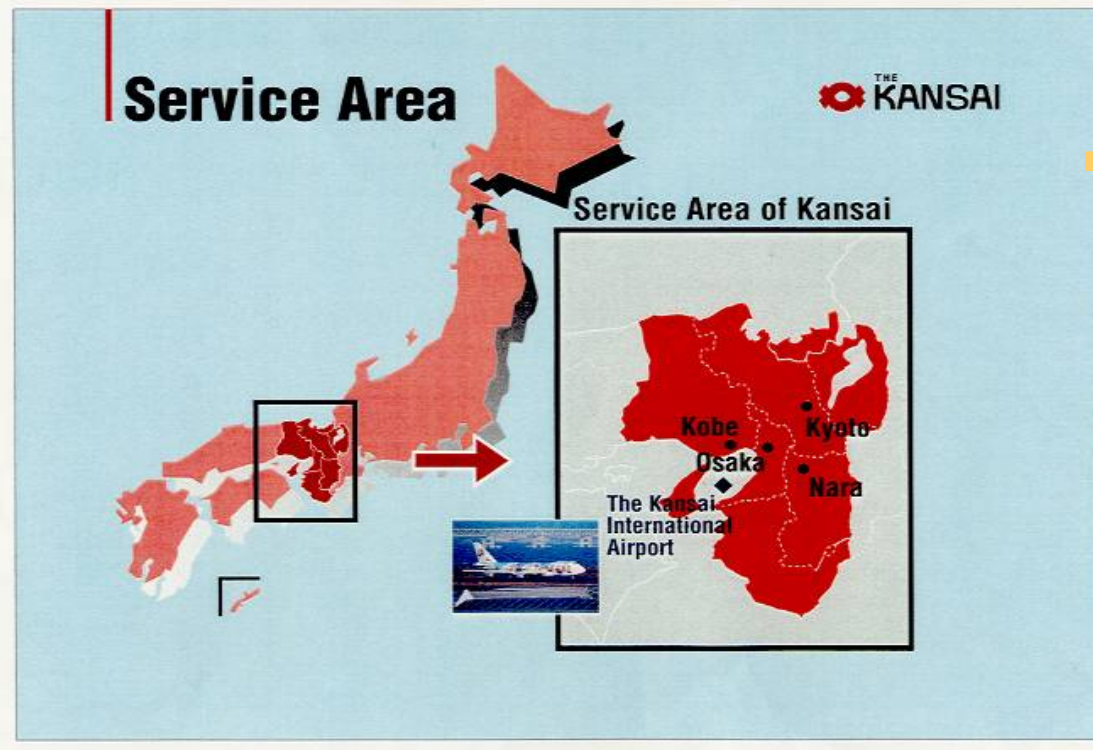
**[Construction of base-isolated office building]**  
(1<sup>st</sup> half of FY2015)



**[Improvement of roads to the power plant]**  
(medium- and long-term plan)

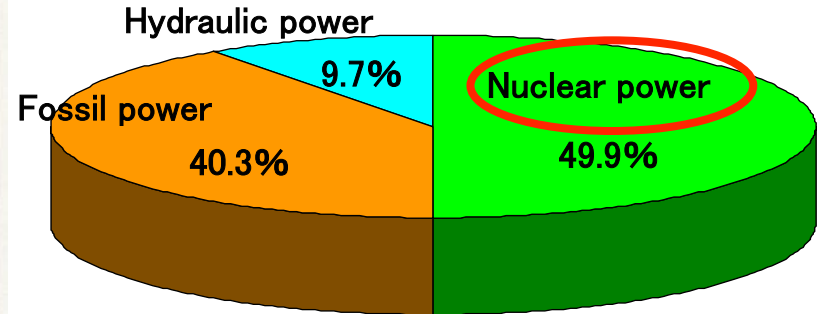
## 2. Safety Culture Assessment

# Outline of Kansai Electric Power Company



## Power source composition

<Total 124.2 TWh \*>



\*Power source by KEPCO's own power sources

- ❖ Generation capacity: 33.86 GW
- ❖ Electricity sales: 145,900 million kWh
- ❖ Number of employees: About 22,000 (FY2008 as of March 31, 2009)



# Outline of Nuclear Power Plants of Kansai Electric Power Company

## ■ Nuclear Power Division



## ■ Takahama NPP



Unit	Gross Capacity (MW)	Start of Commercial Operation
1	826	1974.11
2	826	1975.11
3	870	1985. 1
4	870	1985. 6

## ■ Ohi NPP

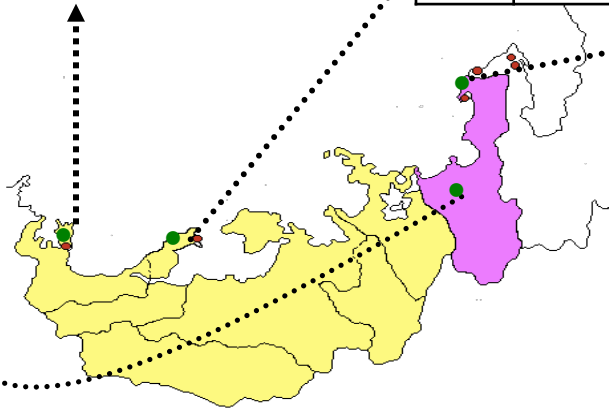


Unit	Gross Capacity (MW)	Start of Commercial Operation
1	1175	1979. 3
2	1175	1979.12
3	1180	1991.12
4	1180	1993. 2

## ■ Mihama NPP

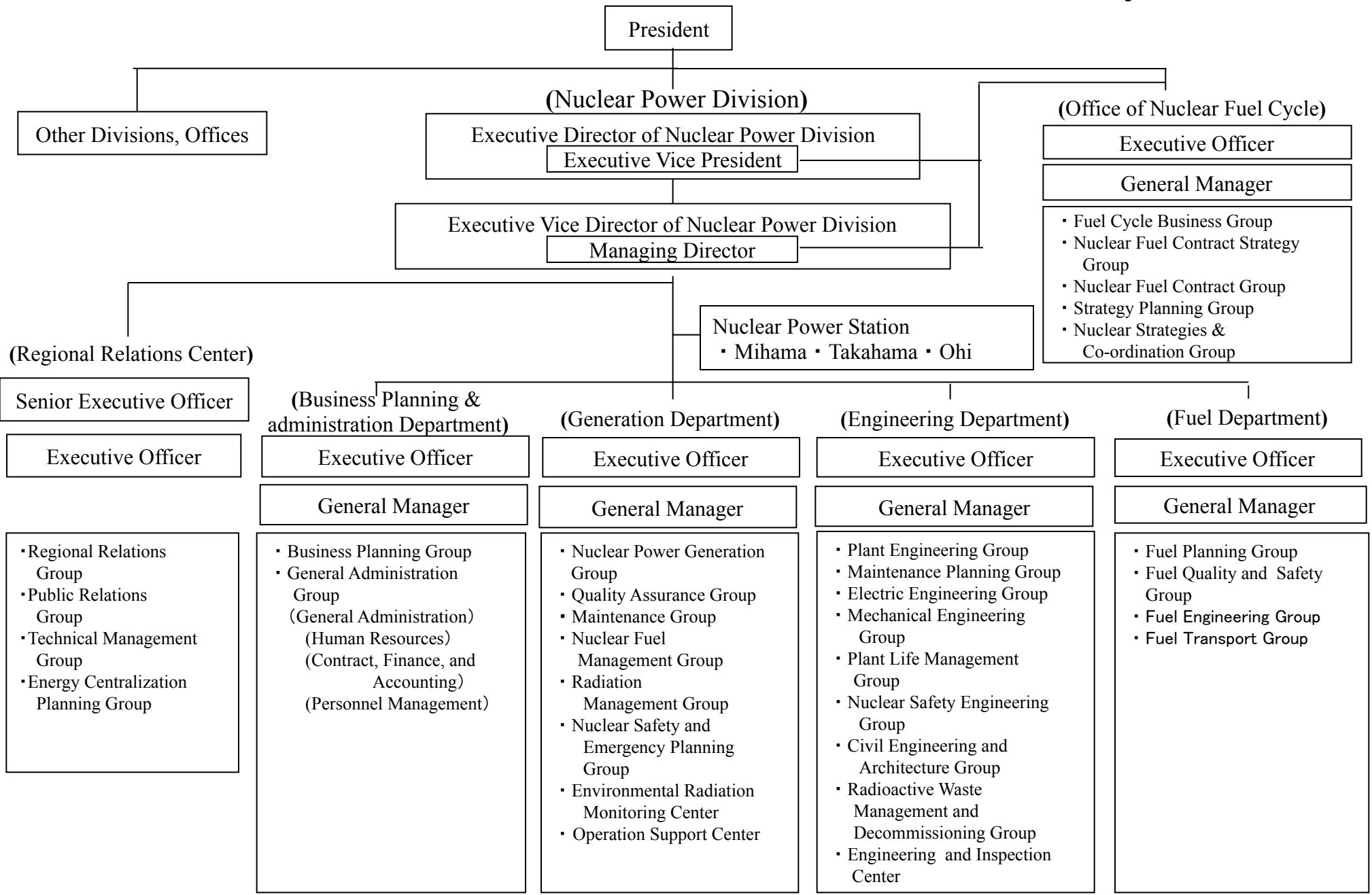


Unit	Gross Capacity (MW)	Start of Commercial Operation
1	340	1970.11
2	500	1972. 7
3	826	1976.12



▪ Mihama-1 started operation in November 1970 as the first pressurized water reactor (PWR) in Japan.

# Nuclear Power Division • Office of Nuclear Fuel Cycle



# Overview of the Secondary Cooling System Pipe Rupture Accident at Mihama Unit No. 3

- Overview of the accident

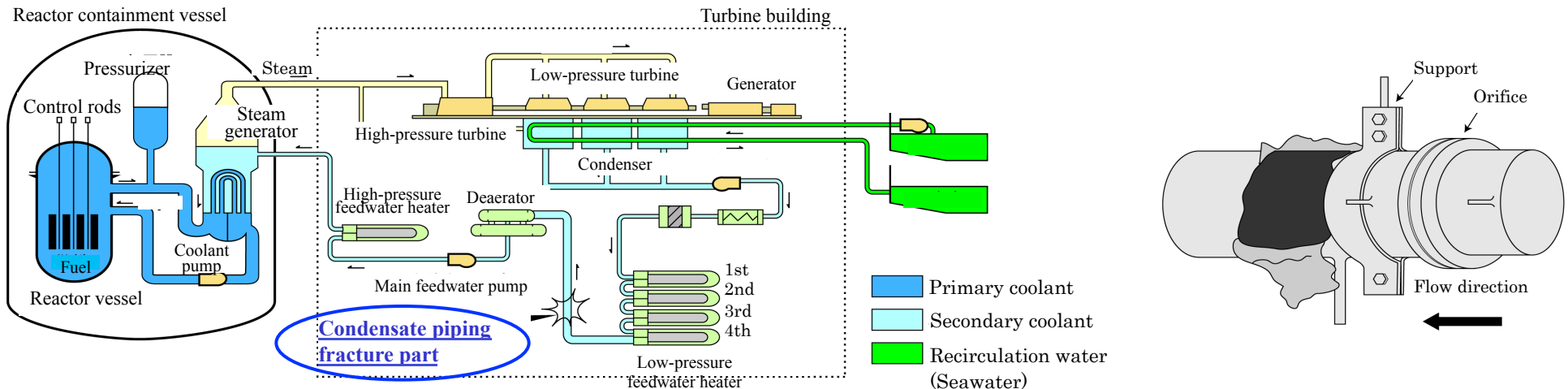
An accident occurred when a pipe in the secondary cooling system ruptured on August 9, 2004.

And spewing high-temperature water heated to approximately 140 degrees Celsius at a pressure of about nine atmospheres, which then turned into steam, 11 employees of contractors were injured.

- Cause of the accident

The pipe wall thickness had been gradually decreased due to erosion and corrosion over the years and a large rupture occurred.

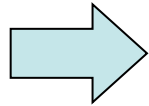
Pipe wall thickness is measured systematically, but the portion where the rupture occurred had been omitted from the inspection list.



## **Direct causes**

- The ruptured portion was omitted from the original inspection list.
- The omission remained undiscovered until the accident took place.

## **Various areas should be improved**



## **for Countermeasures against the Recurrence of Accidents**

(ex. ) Work plan and organization, Procurement, Information sharing



Our company established an action plan and we have taken the Countermeasures against the Recurrence of Accidents (29 items) based on five basic policies since March 2005.

### **【President's declaration】**

“Ensuring safety is my mission, the mission of the Company.”

### **【Five basic action policies】**

1. Making safety our top priority.
2. Proactively introducing resources to ensure safety.
3. Continuously improving maintenance management to ensure safety and establishing closer cooperation with manufacturers and contractors.
4. Striving to regain the trust of local communities.
5. Objectively assessing our efforts toward safety and widely disclosing our safety initiatives.



## ○ Purpose

❑ To maintain and improve the safety-first organizational climate (safety culture)

❑ To prevent serious problems

By early recognition of signs of safety culture deterioration or concerns and informing the top management of them

## ○ Subjects of Assessment

Not only

- All activities intended for maintaining/improving plant safety,

But also

- Industrial safety,
- Compliance with laws, etc.

(Including Mihama Unit 3 accident recurrence prevention measures, other safety activities, and CSR activities)

## I. Organizational/Group Awareness and Behavior

**14 viewpoints (questions)** were developed to assess awareness and behavior from:

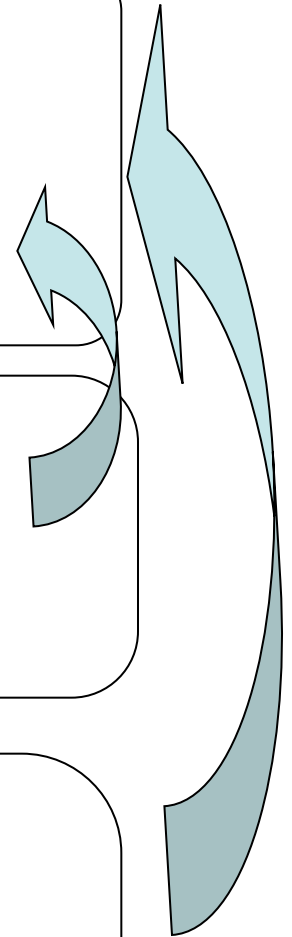
- Lessons learned from the MIHAMA-3 pipe rupture accident
- National & international knowledge (NSC, IAEA, INPO, etc.)

## II. Safety Performance

- **Plant safety** (Ex. Trend of an event)
- **Occupational safety** (Ex. Trend of workers' injuries)
- **Compliance** (Ex. Trend of a non-compliance event)

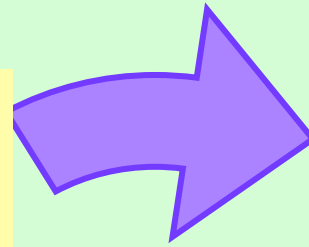
## III. External View

- **Local communities**
- **Nuclear Safety Reform Verification Committee**  
(Mainly composed of external experts from various fields)



## YEARLY PLAN

- Focused measures
- Assessment plan



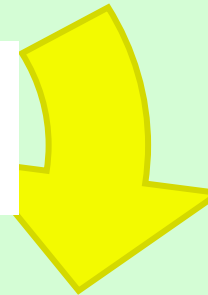
## DO

- Focused measures
- Other activities based on safety culture policy



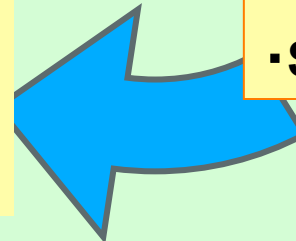
## Safety Culture Enhancement Committee

-Chairperson; Executive Vice-President



## ACTION

- Feedback from the assessment result



## CHECK

- Safety culture assessment

# Flow of Safety Culture Assessment



**Nuclear Power Division  
(small NPD)  
assessment result**



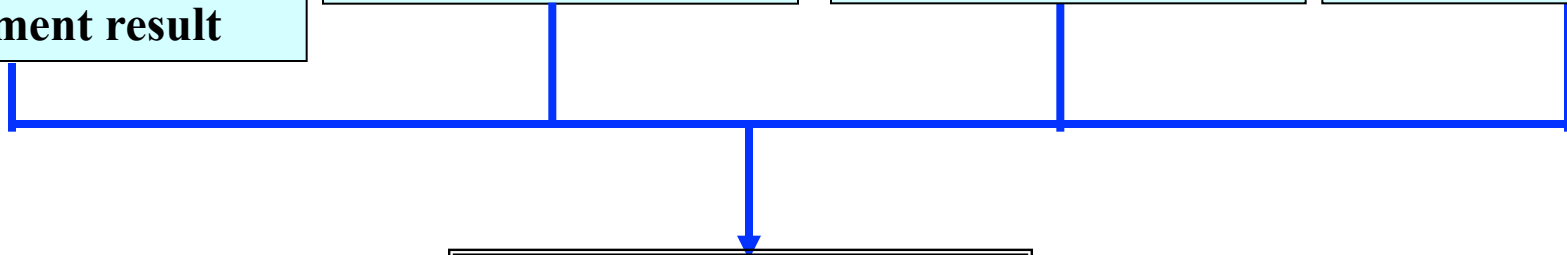
**Takahama NPP  
assessment result**



**Ohi NPP  
assessment result**



**Mihama NPP  
assessment result**



**Nuclear Power Division  
(large NPD)  
assessment result**



**President**

# Outline of the Guidelines for Safety Culture Assessment:

## Viewpoints for Assessing Signs of Decline in Safety Culture (1/5)

Elements of safety culture	Viewpoints for assessing signs of decline
1. Commitment of the top management	(1) The top management makes all the members of the organization know the definite message, "Safety comes first." (2) The top management presents and carries out policies for activities to secure safety without feeling any conflict with pursuing profit.
2. Definite policy and practice of the senior management	(1) The senior managers present and carry out policies for activities to secure safety. (2) The senior managers formulate resource plans (a budget plan, a personnel plan, an equipment input plan, and a maintenance plan) that give first priority to safety, and carry out the plans (taking into consideration the priority order of safety, importance, urgency, etc. and including revision of the plans responding to changes). (3) The senior managers decide the system for safety activities for the whole organization (the head office and power stations) and also decide the roles, responsibilities, and authority of departments, and make the system function.
3. Measures to avoid improper decision making	(1) Measures to avoid improper decision making concerning safety and measures to eliminate closed nature (indiscretion of a group) from the organization are established and function. (2) Decision making concerning safety activities is in accordance with the decision-making system fixed by the quality management system.

# Outline of the Guidelines for Safety Culture Assessment:

## Viewpoints for Assessing Signs of Decline in Safety Culture (2/5)

Elements of safety culture	Viewpoints for assessing signs of decline
4. Questioning attitude	The members of the organization establish a questioning attitude about their own behaviors, the state of machinery, and the state of the organization from the viewpoint of safety.
5. Reporting culture	There is a workplace atmosphere in which the members can report personal errors, potentially dangerous incidents, and information undesirable for the organization without hesitation. In addition, the senior managers provide examples for creating such an atmosphere on their own initiative.
6. Active communication	<p>(1) In-house communication (between senior and junior members, cross-sectional) is effectively functioning.</p> <p>(2) The organization appropriately exchanges communication with cooperative companies, including the transmission of requirements, and what is communicated is fully disseminated within the cooperative companies. In addition, the organization strives to create opportunities to exchange communication with the cooperative companies to promote mutual understanding.</p>
7. Full accountability and high transparency	If a situation requiring accountability arises, the organization offers highly transparent information in a timely manner to local residents, the nation, and the regulatory authorities. The organization strives to create opportunities to exchange communication with the local residents, the nation, and the regulatory authorities to promote mutual understanding.

# Outline of the Guidelines for Safety Culture Assessment:

## Viewpoints for Assessing Signs of Decline in Safety Culture (3/5)

Elements of safety culture	Viewpoints for assessing signs of decline
8. Compliance	<p>(1) Rules are maintained (including timely review, revision, change or abolishment, and the addition of new rules) to ensure the appropriateness and effectiveness of the rules.</p> <p>(2) Compliance is established in daily work.</p> <p>(Note) Compliance: To comply with not only laws and the requirements of regulations but also in-house rules (standards for the safety of nuclear power and procedures) to secure the safety of nuclear power, responding to the social demand underlying the laws and the requirements, in order to achieve the purpose of the organization</p> <p>(3) If a problem arises regarding compliance, a system or an atmosphere in which to offer opinions about the problem is prepared.</p>

# Outline of the Guidelines for Safety Culture Assessment:

## Viewpoints for Assessing Signs of Decline in Safety Culture (4/5)

Elements of safety culture	Viewpoints for assessing signs of decline
9. Learning organization	<p>(1) The organization strives to educate and motivate the members in each stratum, including the management, by education, training, evaluation of ability, selection, and qualifications in order to maintain and improve the technological capacity of the organization.</p> <p>(2) Knowledge, information, and data concerning safety activities are accumulated and transmitted to related departments.</p> <p>(3) Knowledge obtained from significant accidents and faults in the company, in Japan, and in foreign countries is accumulated, and the members of the organization learn from the knowledge and reflect it in improvement activities.</p> <p>(4) Knowledge obtained from the analysis of human errors and potentially dangerous incidents is accumulated, and the members of the organization learn from the knowledge and reflect it in improvement activities.</p>
10. Organization striving to prevent accidents and faults	To prevent accidents and faults, knowledge obtained from the root cause analysis of accidents and faults, and information on improper actions, corrective actions, or preventive measures are transmitted to the organization.
11. Self-assessment or third-party assessment	<p>(1) Self-assessment or third-party assessment is conducted to prevent actions to enhance safety culture from being stereotyped.</p> <p>(2) The indicator is fixed to grasp the degree of enhancing safety culture, to detect any signs of decline in safety culture, and to conduct self-evaluation by using this indicator.</p>



# Outline of the Guidelines for Safety Culture Assessment: Viewpoints for Assessing Signs of Decline in Safety Culture (5/5)

Elements of safety culture	Viewpoints to assess the signs of decline
12. Management of work environment	The organization creates a reasonable work schedule and carries out reasonable operations, and improves the work environment.
13. Configuration management	<p>(1) When the organization, including cooperative companies, is changed, the organization appropriately assesses the impact of the change and conducts configuration management.</p> <p>(2) When a organization changes rules and procedures, the organization appropriately assesses the impact of the change on safety, and conducts configuration management.</p>
14. Attitudes and motivation	<p>(1) The organization takes measures for the employees to improve their attitudes to and eagerness in undertaking their duties, to enhance their working motivation, and to assign proper duties.</p> <p>(2) The organization takes measures for the managers to improve their leadership, eagerness in management, and attitudes toward management.</p> <p>(3) The organization strives to create a favorable workplace climate.</p>

## Number of newly employed staff

FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
16	29	37	55	55	72	73

— Continuously High

## Funding for industrial safety

Item (Example)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
Funding for industrial safety	1	Over 10	Over 10	Over 10	Over 10	Over 10	Over 10

(Unit: The factor against the funding in FY 2004 is taken as unity.)

— Continuously High

## Number of **work-related** injuries

2004	2005	2006	2007	2008	2009
10(2)	9(1)	7(2)	15(7)	20(5)	15(10)

&lt;FY&gt;

Numbers in ( ) are the number of accidents that involved workers with fewer than two years' experience at a power plant.

## Trend analysis

1. “Basic actions to prevent injury not taken”
  2. “Unimplemented/insufficient KY”
  3. “Insufficient safety management of site”
- The same trends as seen in FY2008

## Evaluation

[Issue] Safety awareness of inexperienced contractors' workers needs to be further improved. (Feed back to Viewpoint 9,10.)