Radiation Control in the Decommissioning Work at Hamaoka Nuclear Power Station

October 25, 2018

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01 Outline of Hamaoka Nuclear Power Station

01 | Outline of Hamaoka Nuclear Power Station

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○ Hamaoka Nuclear Power Station is located in Omaezaki City, Shizuoka Prefecture.

○ The population of the four cities: approximately 245,000 (as of the end of March 2018)
Omaezaki City: 33,000, Makinohara City: 46,000, Kakegawa City: 118,000, Kikugawa City: 48,000

○ The population in the PAZ*1 + UPZ*2 among the 11 cities and towns including five cities and two towns: approximately 840,000 (as of April 2016)

*1 PAZ: Precautionary Action Zone
Zone where precautionary protective measures are to be prepared (within approximately 5 km in radius from the nuclear facilities)
*2 UPZ: Urgent Protective action planning Zone
Zone where urgent protective measures are to be prepared (within approximately 30 km in radius outside the PAZ)

01 Outline of Hamaoka Nuclear Power Station

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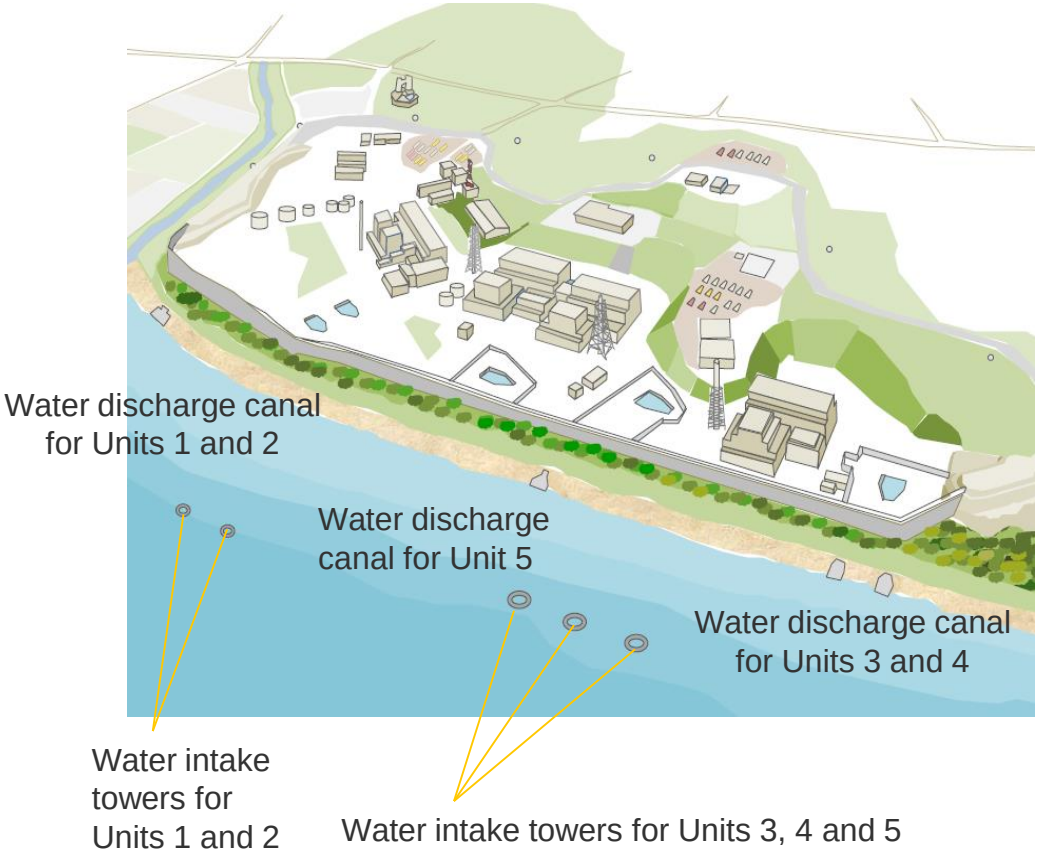
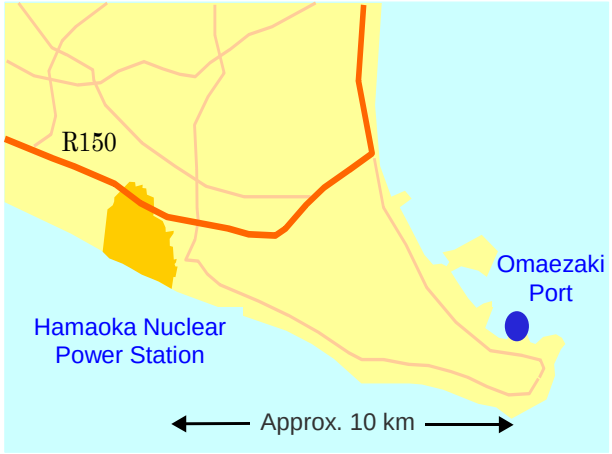
- The site area is approximately 1.6 million m^2 (approximately 1.6 km east-west, approximately 1 km north-south).
- It is the only nuclear power station in Japan without a dedicated port built in front of the site. Therefore, large components or the like are transported by land between the power station and Omaezaki Port.
- The seawater used to indirectly cool the steam after turning the turbine, which is generated in the reactor, is taken from a water intake tower established 600 m from the coast.





A photo of land transportation of a reactor pressure vessel

A dedicated quay/dedicated crane at Omaezaki Port

01 | Outline of Hamaoka Nuclear Power Station

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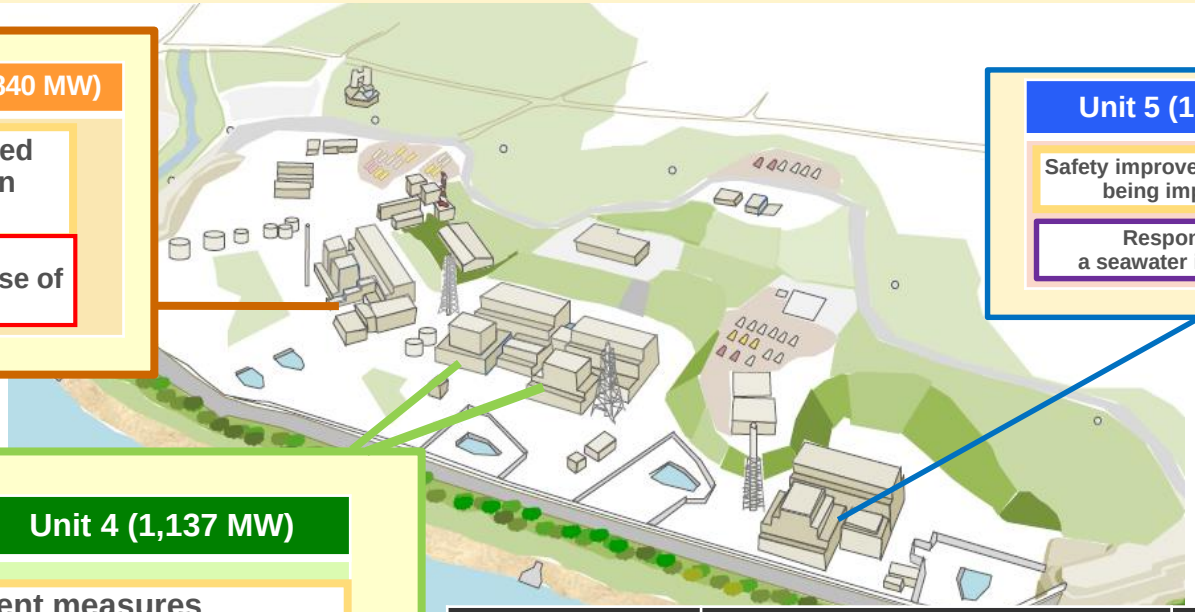
- Units 1 to 4 are boiling water reactors (BWRs), while Unit 5 is an advanced boiling water reactor (ABWR).
- Currently, Units 1 and 2 are being decommissioned. Units 3 and 4 are undergoing a conformity confirmation review. Unit 5 is responding to a seawater inflow event.



Unit 1 (540 MW) / Unit 2 (840 MW)

Being decommissioned (operation ceased on January 30, 2009)

February 3, 2016: Transition to the 2nd phase of decommissioning

Unit 5 (1,380 MW)

Safety improvement measures being implemented

Responding to a seawater inflow event

Unit 3 (1,100 MW) / Unit 4 (1,137 MW)

Safety improvement measures being implemented

Confirmation review of compliance with the new regulatory standards

Application filed on June 16, 2015

Application filed on February 14, 2014

Shutdown in response to a request by the Prime Minister
(Unit 4: May 13, 2011; Unit 5: May 14, 2011)

	Size of Hamaoka	Shizuoka Prefecture (west of the Fuji River: 60 Hz area)
Maximum power	3,617 MW (total electric output of Units 3 to 5)	4,060 MW [August 9, 2016]
Annual power demand	Amount of power generated (average in three fiscal years before the earthquake*) 22,057 GWh	20,508.583 GWh [actual result in Fiscal 2016]

*: Fiscal 2006 to 2008

02 Outline of the Decommissioning Plan

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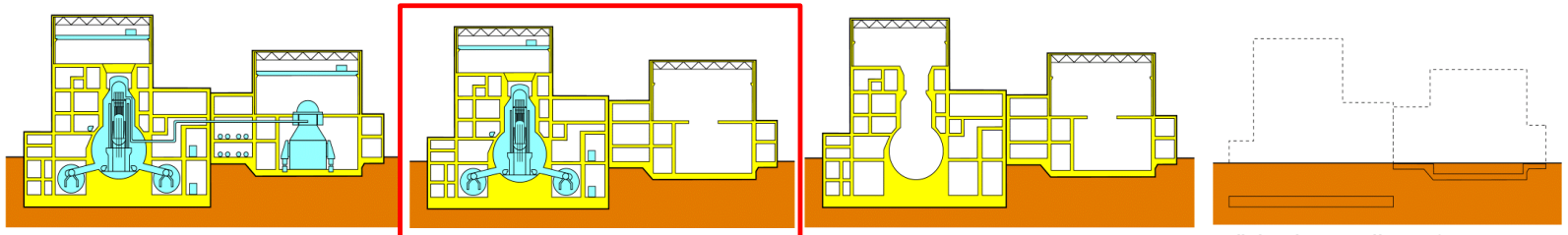
Overall plan for the decommissioning of Units 1 and 2

The decommissioning plan for Units No. 1 and No. 2 will be implemented in four phases over a period of approximately 30 years as described below.
The decommissioning entered the second phase on February 3, 2016. Currently, the “dismantling and removal in the area surrounding the reactor” are being implemented.



(i) Contamination state survey, decontamination, etc.

(ii) Dismantling in the surrounding area

(iii) Dismantling in the reactor area

(iv) Dismantling of buildings, etc.

Fiscal 2009 to 2015	Fiscal 2015 to 2022	Fiscal 2023 to 2029	Fiscal 2030 to 2036
1st phase Period of preparations for the dismantling work	2nd phase Period of dismantling and removal of peripheral equipment of the reactor area	3rd phase Period of dismantling and removal of the reactor area	4th phase Period of dismantling and removal of buildings, etc.
Discharge of spent fuel completed ▼(February 2014) Fuel discharge Discharge of new fuel completed ▼(February 2015)			
Investigation/study of the contamination state			
System decontamination			
Dismantling and removal of equipment and components in areas other than the radiation controlled area			
	Dismantling and removal of peripheral equipment of the reactor area		
		Dismantling and removal of the reactor area	Dismantling and removal of buildings, etc.
Treatment and disposal of radioactive waste (waste generated during operation, or dismantling waste)			

Photo of the removal work

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Major activities to be conducted in phase 1 (period of preparations for the dismantling work)

- **Fuel discharge**

  Carry all fuel out of the buildings of Units 1 and 2.

- **Investigation of the contamination state**

  Investigate the radioactivity level category (contamination state) for the equipment.

  ⇒ Determining the dismantling timing, developing the dismantling method, and assessing the amount of waste from dismantling (to be continued in phase 2 as well).

- **System decontamination**

  Remove radioactive material adhering to the piping and vessels by using a chemical.

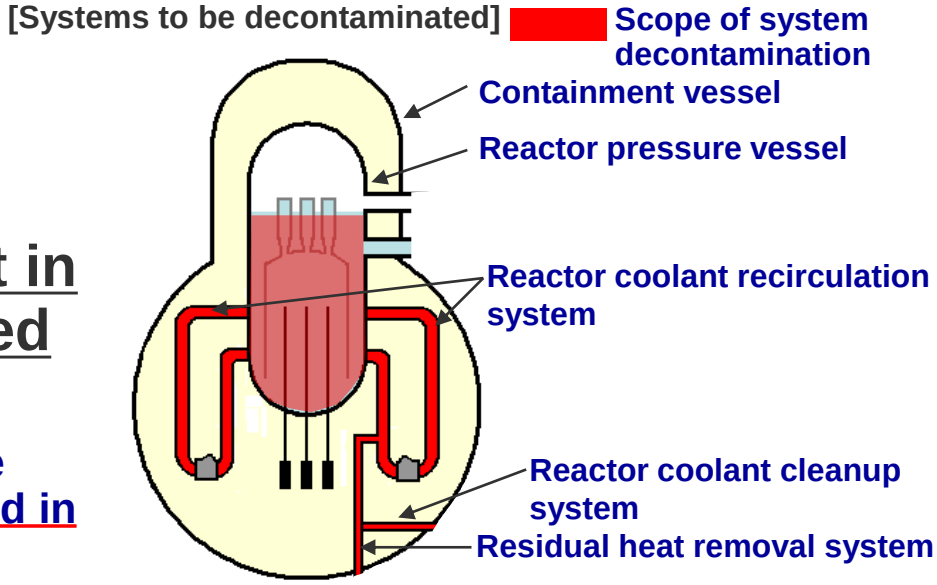
  <Systems to be decontaminated>

  - Reactor coolant recirculation system
  - Reactor coolant cleanup system
  - Reactor pressure vessel
  - Residual heat removal system

  (to be continued in phase 2 as well)

- **Dismantling and removal of equipment in areas other than the radiation controlled area**

  Dismantling and removing the equipment outside the radiation controlled area in sequence (to be continued in phase 2 and thereafter as well).



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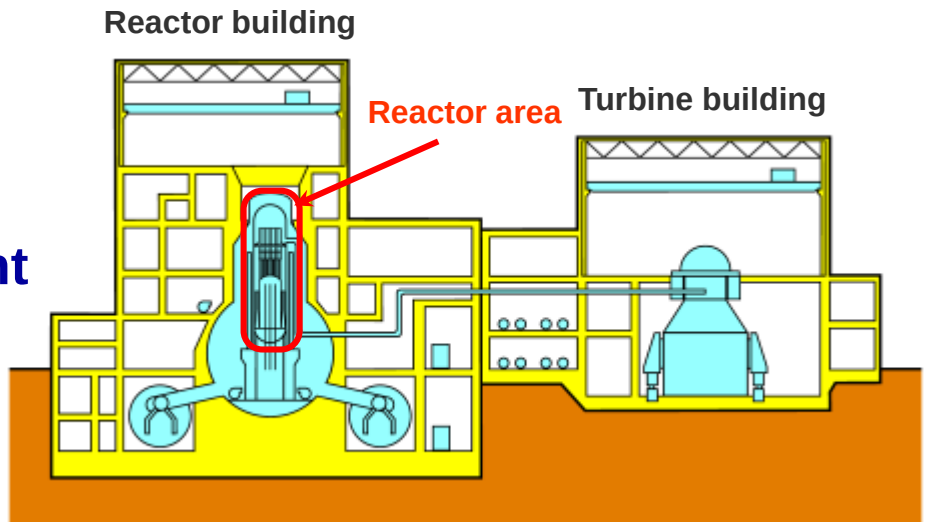
Major activities to be conducted in phase 2 (period of dismantling and removing the peripheral equipment of the reactor area)

- **Dismantling and removal of the peripheral equipment of the reactor area***

  Dismantling and removing low-radioactivity-level peripheral equipment of the reactor area in sequence.

  * This refers to the equipment outside the reactor area, and includes equipment in the turbine building and reactor cooling system facilities in the reactor building.

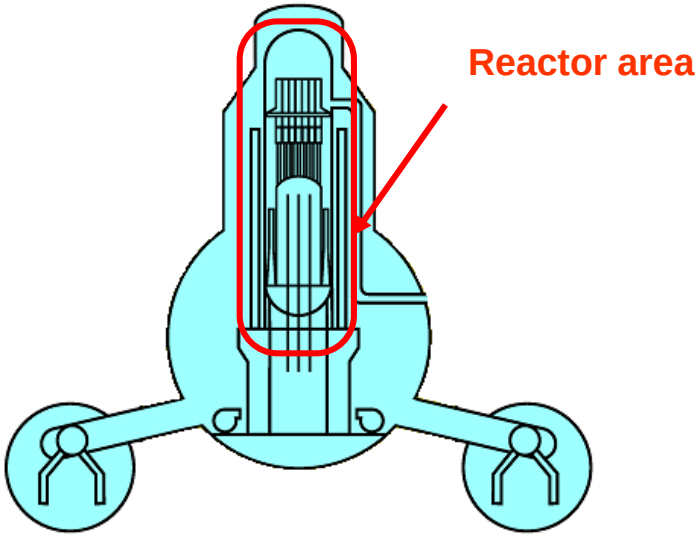


- **Dismantling and removal work of buildings**
  - Unit 1 noble gas hold-up system building
  - Vent stack

Major activities to be conducted in phase 3 (period of dismantling and removing the reactor area)

- Dismantling and removal of the reactor area*, etc.

  * An area that contains the reactor vessel and the radiation shield surrounding the reactor vessel.



Major activities to be conducted in phase 4 (period of dismantling and removing the building)

- Dismantling and removal of all equipment, buildings, etc. that will cease to operate as a result of dismantling and removal

The vacant lot after the dismantling and removal of facilities to be decommissioned will continue to be managed as an area for surveillance in the vicinity of Hamaoka Nuclear Power Station.

03 Radiation Control in the Decommissioning Work

Radiation Control in the Decommissioning Work

(1) Decommissioning work plan <measures to reduce exposure>

Preparing a decommissioning work plan <Department in charge of planning>	Project procurement/work management <Department in charge of the project/work>	Studying the content of the work/preliminary investigation of hazards <Work contractor>

The three parties will discuss measures to reduce exposure and prepare a decommissioning work plan before the work is conducted, and then the work will be conducted.

⇒ Measures to reduce exposure are one item of the measures to secure safety in the decommissioning work plan.

Radiation Control in the Decommissioning Work

(1) Decommissioning work plan <measures to reduce exposure>

<A sample of a decommissioning work plan>

Outline of the contamination removal work (system decontamination) (Fiscal 2010)

Purpose: Decontaminate high-dose piping in the containment vessel in order to reduce to the extent possible exposure during the work in the containment vessel, which is part of the contamination status survey conducted in the period of preparations for the dismantling work.

Systems to be decontaminated: PLR, CUW, RHR

Method: piping – chemical decontamination and jet cleaning
Interface valves – mechanical decontamination
(e.g., ultrasonic cleaning, dry ice blasting)

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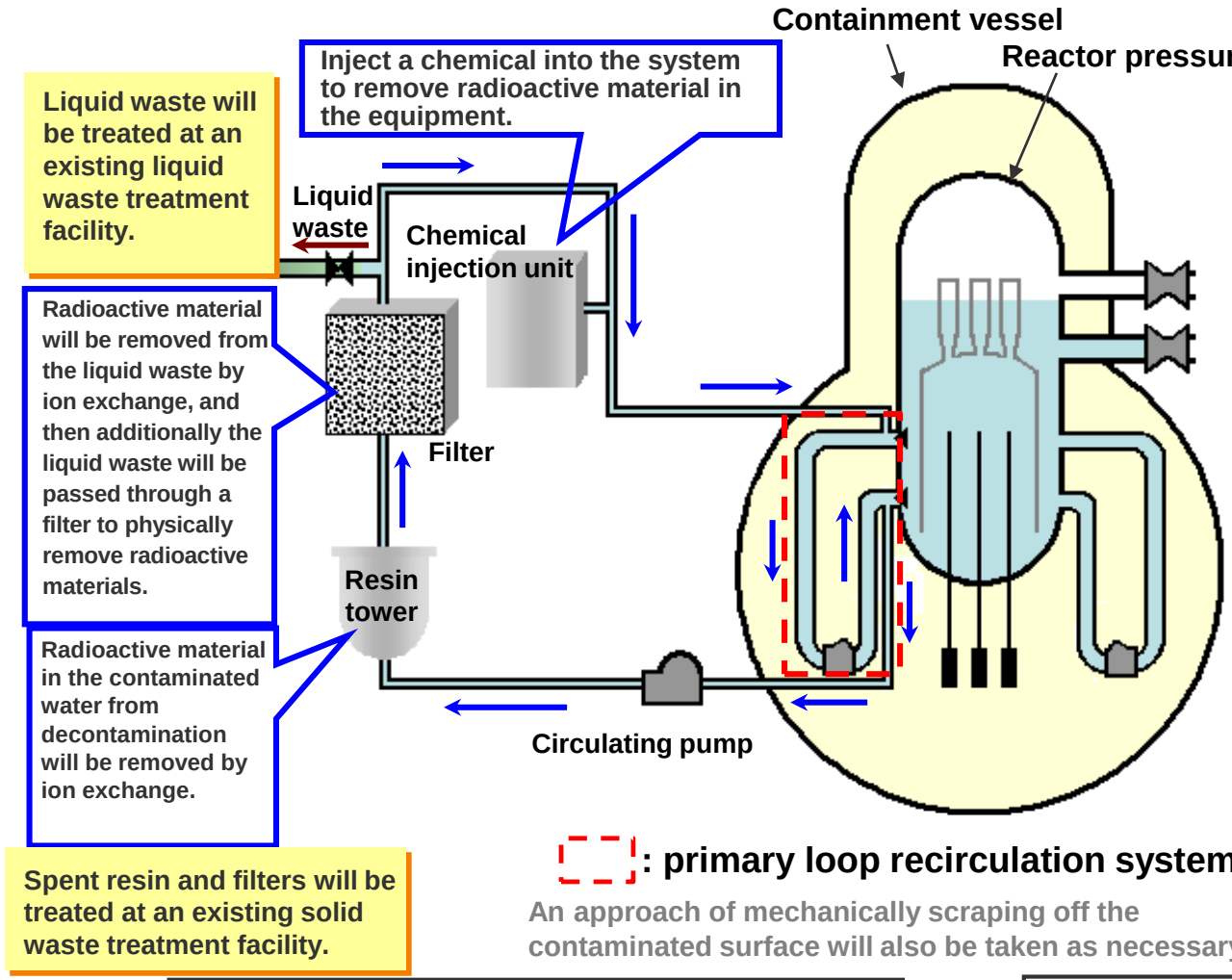
◆ Example of system decontamination (primary loop recirculation system)

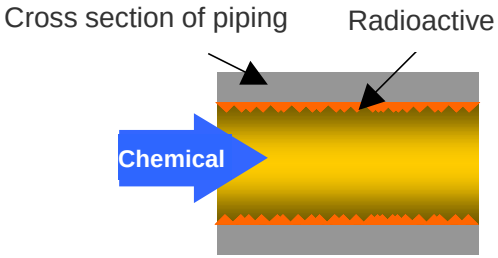


: primary loop recirculation system

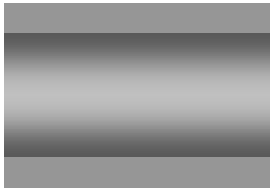
An approach of mechanically scraping off the contaminated surface will also be taken as necessary.

◆ Image of decontamination inside piping

<Before decontamination>



<After decontamination>



Pour a chemical into the piping to remove radioactive material adhering to the inside.

The decontamination will be conducted with the goal of achieving 0.05 mSv/h of piping dose after system decontamination.

⇨ The purpose is not to limit the duration of stay in the containment vessel.

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(2) System decontamination

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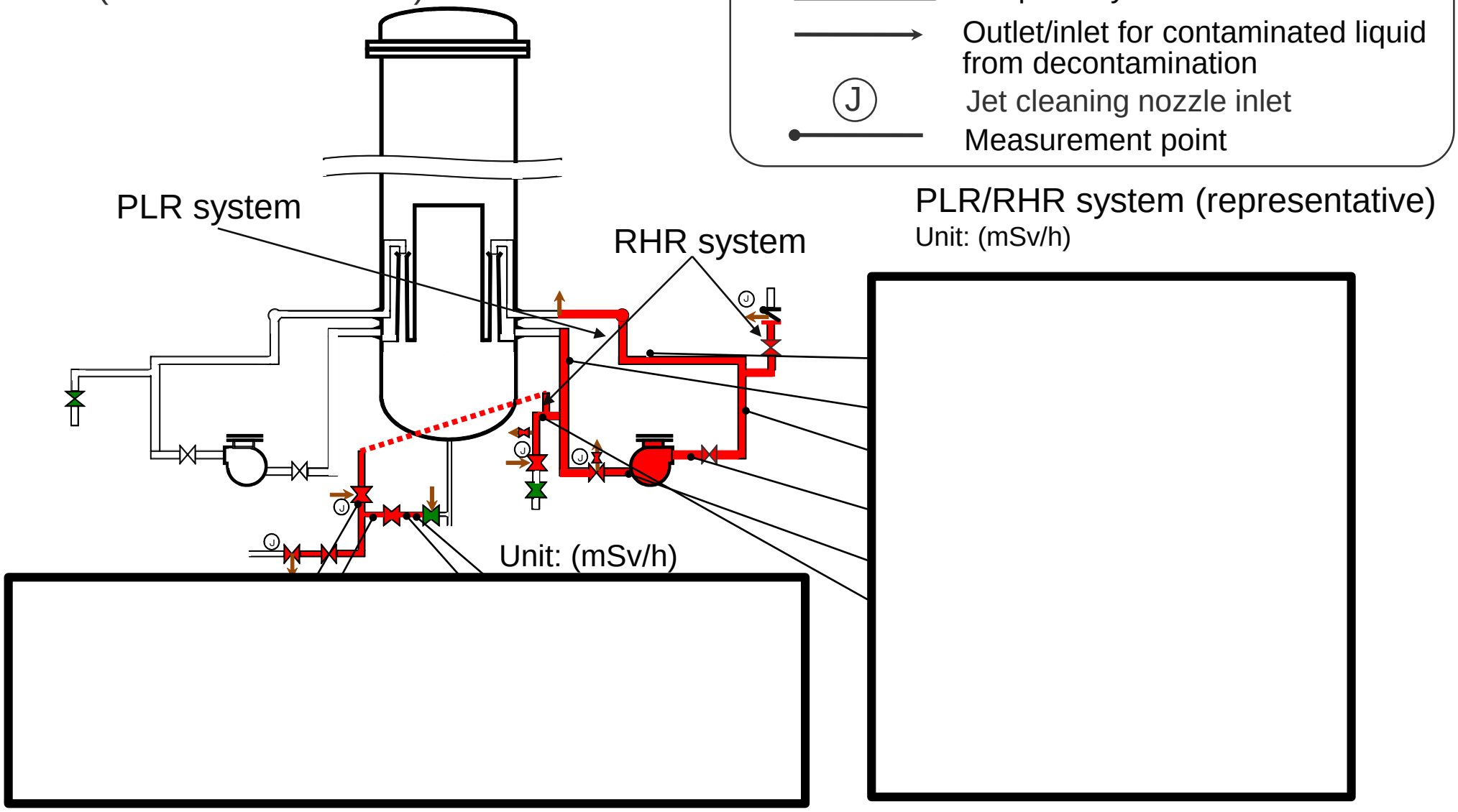
Result of system decontamination
(in the case of Unit 1)



As a result of system decontamination, the average dose equivalent rate decreased.

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Result of system decontamination (in the case of Unit 1)

Atmosphere dose equivalent rate by floors in the reactor containment vessel of Unit 1 [geometric mean value]

As a result of system decontamination, the atmosphere dose equivalent rate on each floor decreased by [redacted]% at maximum*.

* Comparison between after drainage/after chemical decontamination

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(3) Change in the dose equivalent rate from the end of operation to the present

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Change in the atmosphere dose equivalent rate at different points in the reactor containment vessel from the end of operation to the present (in the case of Unit 1)

The atmosphere dose equivalent rate in the reactor containment vessel started to decrease with system decontamination.

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(3) Change in the dose equivalent rate from the end of operation to the present

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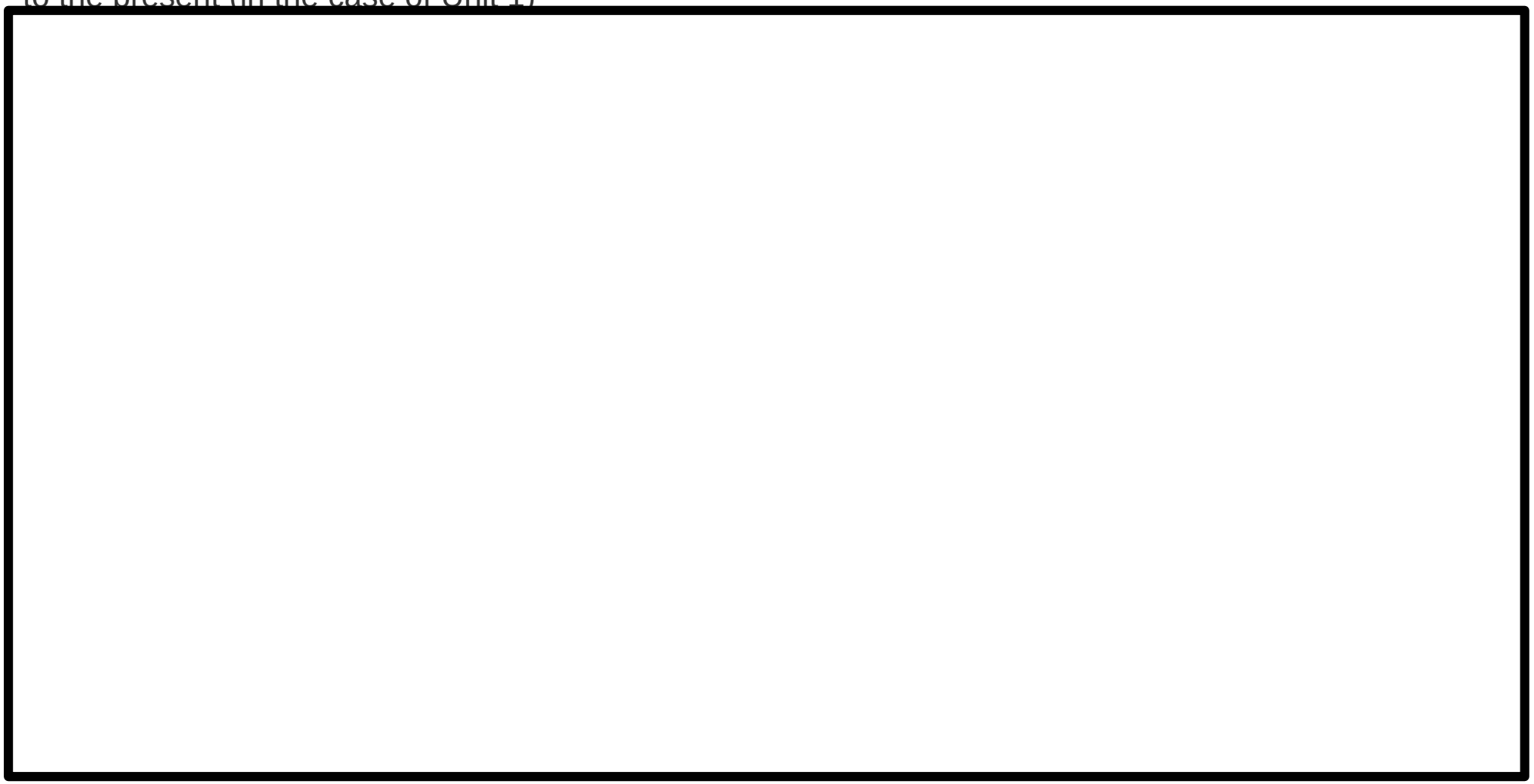
Change in the surface dose equivalent rate at different points in the reactor building from the end of operation to the present (in the case of Unit 1)



The surface dose equivalent rate of the reactor building attenuated to approximately □% of the initial rate in nine years after the end of operation.

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(4) Schedule of phase 2

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<Dismantling and removing the peripheral equipment of the reactor area (phase 2)>

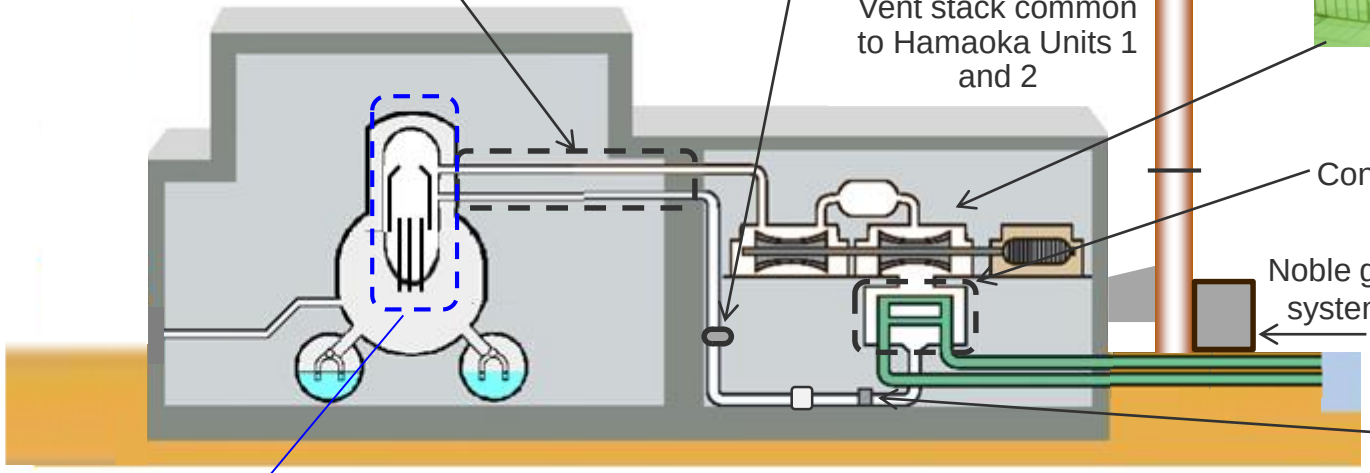
◆ **Initiate the dismantling and removal of the vent stack and the turbine equipment, etc., which is the peripheral equipment of the reactor area in the building.**

Main steam piping
(in the case of Unit 2)

Feedwater heater
(in the case of Unit 2)

Vent stack common to Hamaoka Units 1 and 2

Turbine body (in the case of Unit 1)



Condensate pump
(in the case of Unit 2)

Decontamination of the reactor pressure vessel (including core internals)

04 Summary

04 | Summary

- ✓ Hamaoka Nuclear Power Station will be decommissioned in four phases.
- ✓ As a result of system decontamination in phase 1, the atmosphere dose equivalent rate in the reactor containment vessel decreased.
- ✓ In phase 2 in the future, the peripheral equipment of the reactor area will be dismantled and removed, and the reactor pressure vessel (including core internals) will be decontaminated, etc.

Thank you for your kind attention.

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