

Fukushima Daiichi Nuclear Power Station Unit 2 PCV Internal Investigation/ Preparation Status of Fuel Debris Trial Retrieval

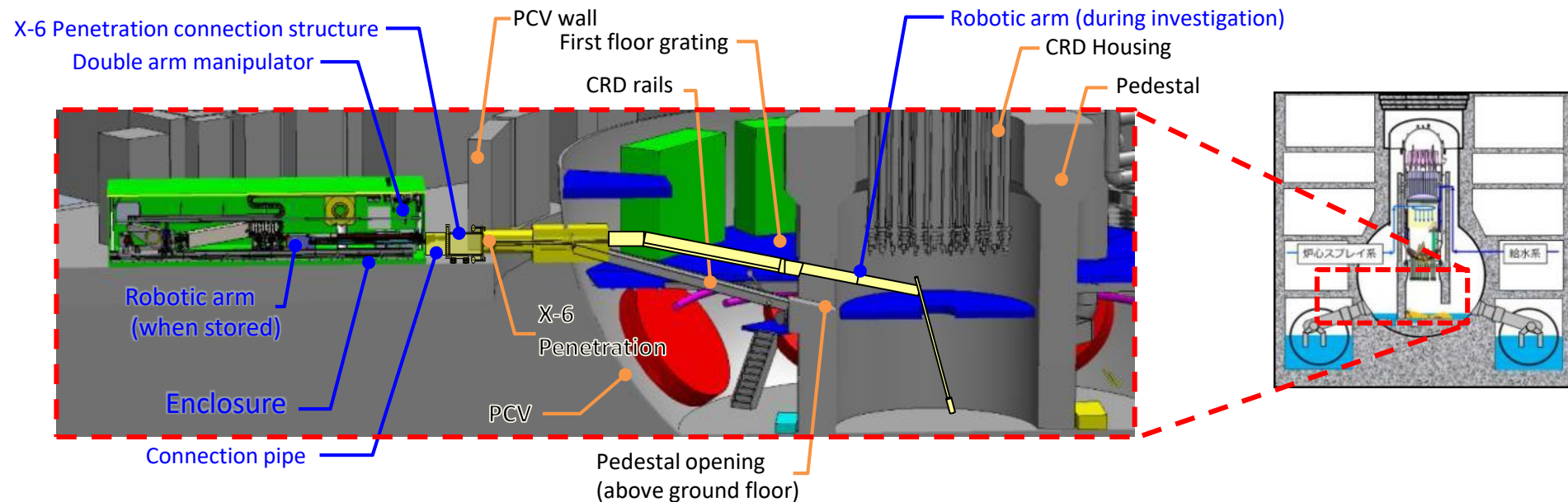
May 30, 2024



International Research Institute for Nuclear Decommissioning
Tokyo Electric Power Company Holdings, Inc.

1. PCV internal investigation and trial retrieval plan overview

- In order to guarantee work safety and prevent the spread of contamination, the following equipment will be installed at the penetration to the Unit 2 primary containment vessel (hereinafter referred to as, "X-6 penetration") that will be used for the PCV internal investigation and also as a preparatory stage of trial retrieval.
 - The X-6 Penetration connection structure isolates the inside of the PCV from the outside
 - The connection pipe shields radiation
 - A metal box that contains the telescopic device and the robotic arm (enclosure)
- After installation of the aforementioned equipment, the robotic arm shall be fed into the PCV through the X-6 penetration to remove obstacles inside the PCV while also conducting internal investigations and moving forward with the trial retrieval of fuel debris.



Unit 2 internal investigation/trial retrieval plan overview

2-1. Field Work Progress

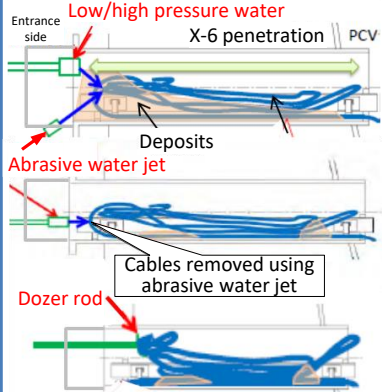
Primary Steps of the Fuel Debris Trial Retrieval (Internal Investigations/Debris Sampling)

1. Isolation chamber installation

2. Opening of the X-6 penetration hatch

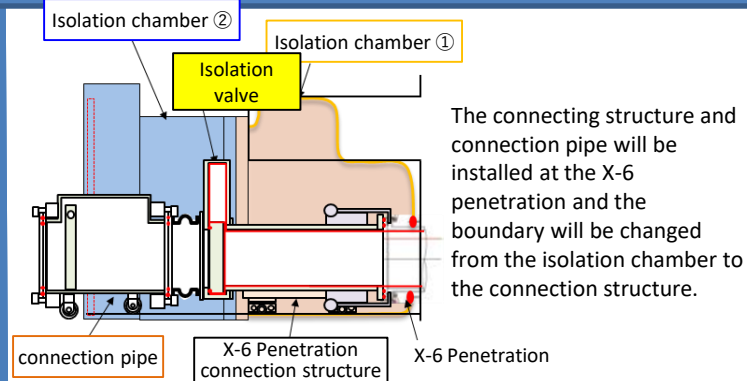
3. Removal of deposits from inside the X-6 penetration

Removing deposits/cables from inside the X-6 penetration



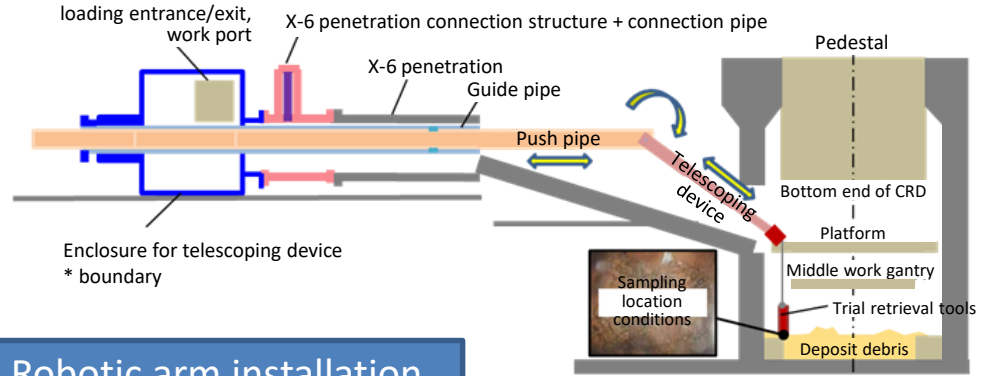
- Deposits pushed with low/high-pressure water
- Cables removed with Abrasive water jet
- Cables pushed with dozer rod

4. Installation of X-6 penetration connection structure and connection pipe

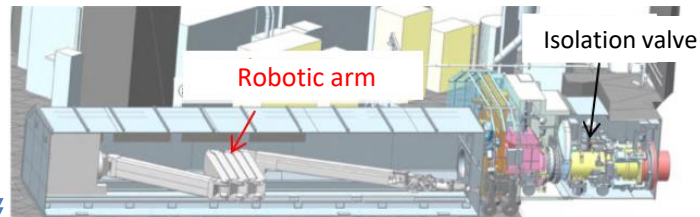


5. Installation of telescopic device

6. Trial retrieval (debris sampling using telescopic device)

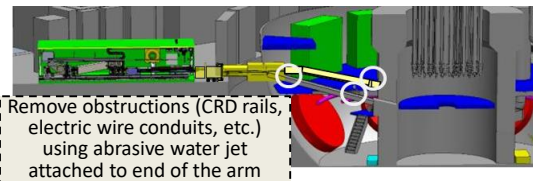


7. Robotic arm installation



8. Internal investigation/debris sampling using robotic arm

① Internal investigation

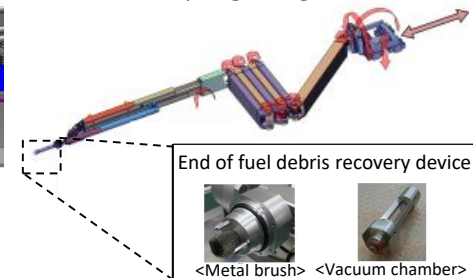


(Note)

Isolation valve: Valve installed to separate the inside of the PCV from the outside

Abrasive Water Jet: Combines high pressure water with an abrasive to improve cutting ability

② debris sampling using robotic arm

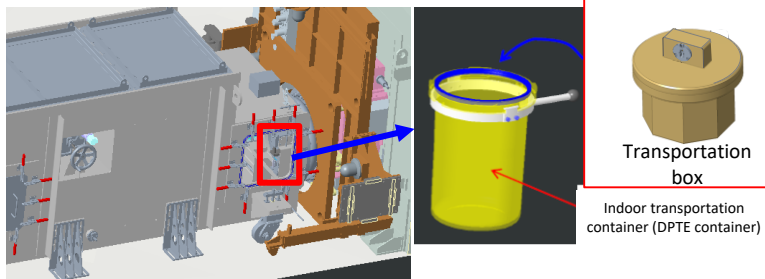


2-2. Field Work Progress

Primary Steps of the Fuel Debris Trial Retrieval (Internal Investigations/Debris Sampling)

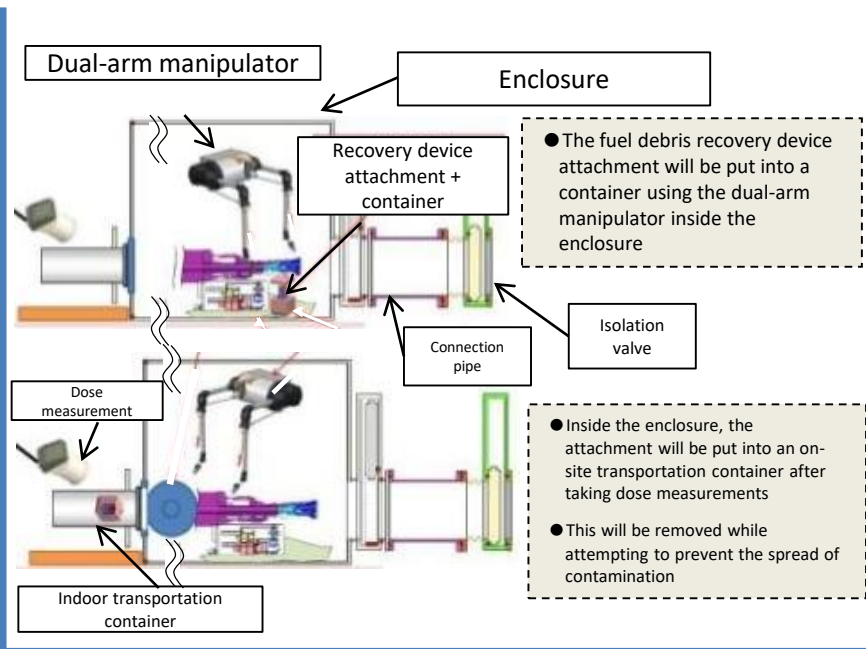
↓(From Step 6 on the previous slide)

9-1. Collection of fuel debris

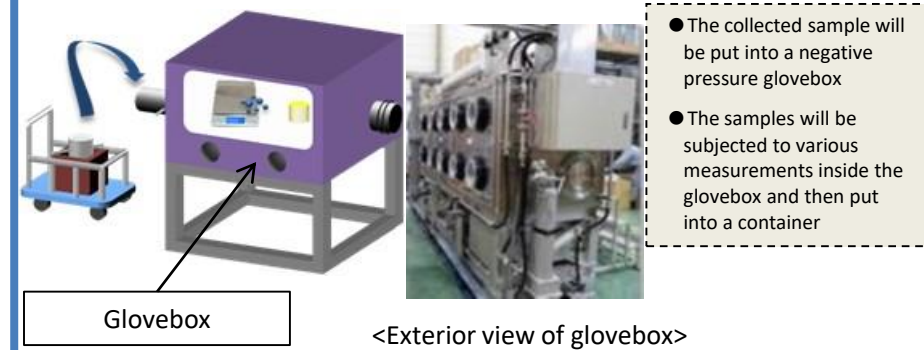


↓(From Step 8 on the previous slide)

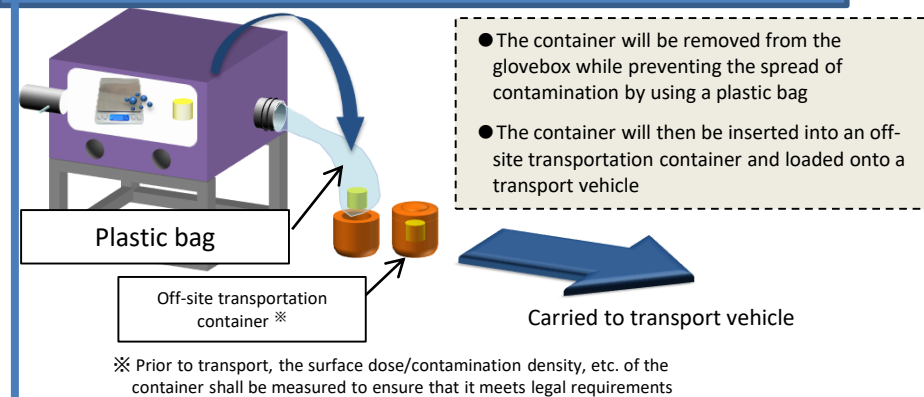
9-2. Inserting the fuel debris recovery device attachment into a container, Inserting into an on-site transportation container/Dose measurements



10. Insertion into glovebox/Measurement



11. Container removal/Insertion into transportation container /Removal from premises



12. Off-site transport and off-site analysis

3-1. Status of Mockup of the Telescopic Trial Retrieval Equipment

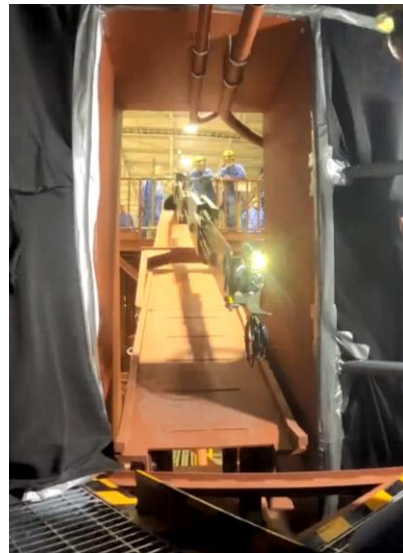
- Mockup testing is currently underway at the manufacturer's factory in preparation for the Unit 2 fuel debris trial retrieval .



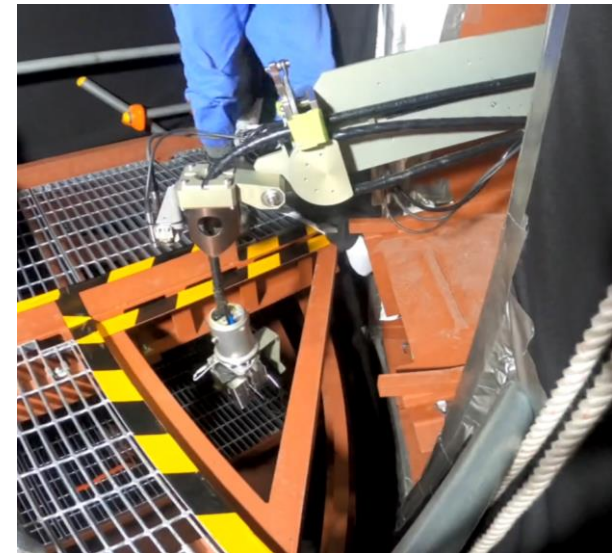
Telescopic trial retrieval equipment (photo taken from above the equipment)



Inserting the guide pipe



Inserting the equipment into the pedestal opening

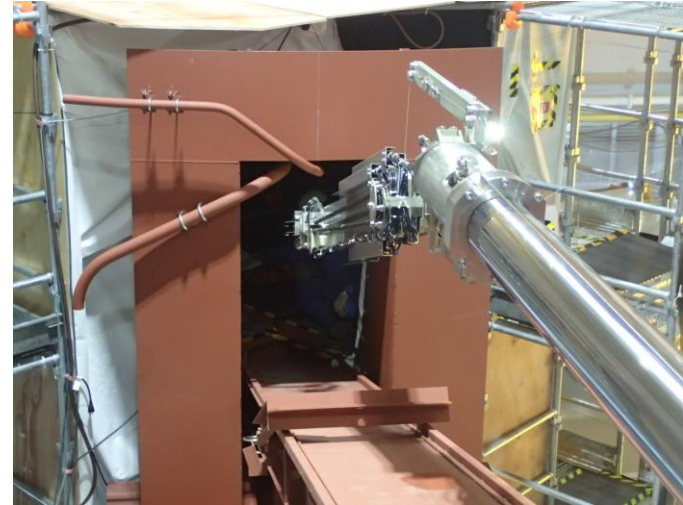


Suspending and lowering the end jig through the grating opening

3-2. Status of Mockup of the Telescopic Trial Retrieval Equipment



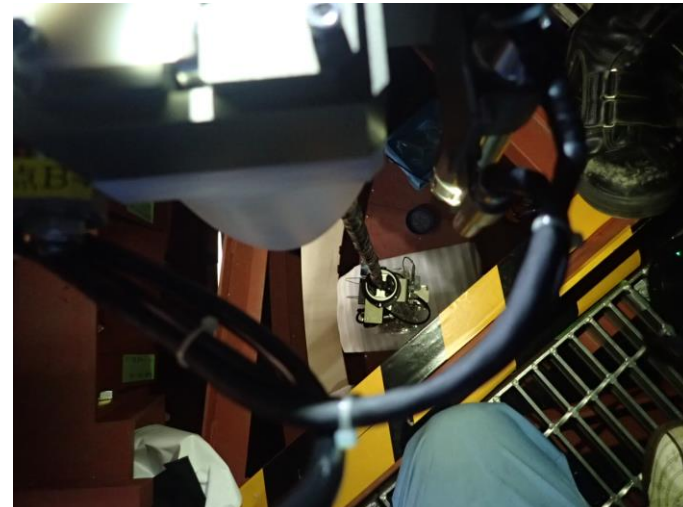
Enclosure and rear house



Inserting the equipment into the pedestal opening



Inserting end jig into the pedestal



Suspending and lowering the end jig through the grating opening

4-1. Deposit Removal Status

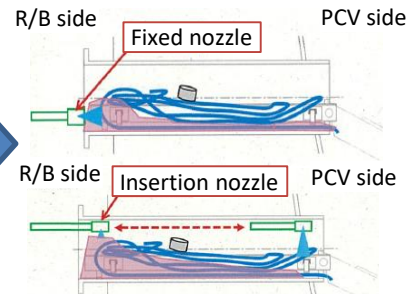
- ◆ During the removal of deposits from inside the X-6 penetration, deposit removal equipment will be set up inside an isolation chamber that serves as a boundary with PCV so that we can safely and carefully continue to remove deposits while preventing the gases inside the PCV from leaking out and impacting the surrounding environment.
- ◆ As with all tasks performed to date, we shall take dust measurements during this task using dust monitors and continually monitor dust concentrations in order to confirm that gases inside the PCV are not leaking out and impact on the surrounding environment.



Installation of deposit removal equipment (low pressure water)



Spray jig installation
※Connected to X-53 penetration



Deposit removal equipment (low pressure water)

※Remotely operated
Deposits are pushed with the dozer rod after which low pressure water is sprayed to remove the deposits

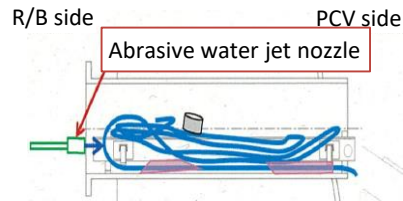


Removal of deposit removal equipment (low pressure water)

Red outline indicates current progress;
Installation of X-6 penetration connection structure and connection pipe are underway



Installation of deposit removal equipment (high pressure water, abrasive water jet)



Deposit removal equipment (high pressure water, abrasive water jet)

※ Remotely operated
Deposits are pushed with the dozer rod after which high pressure water/abrasive water jet is sprayed to remove the deposits



Removal of deposit removal equipment (high pressure water, abrasive water jet)

On to next step
Installation of X-6 penetration connection structure

※Photos were taken using the mockup

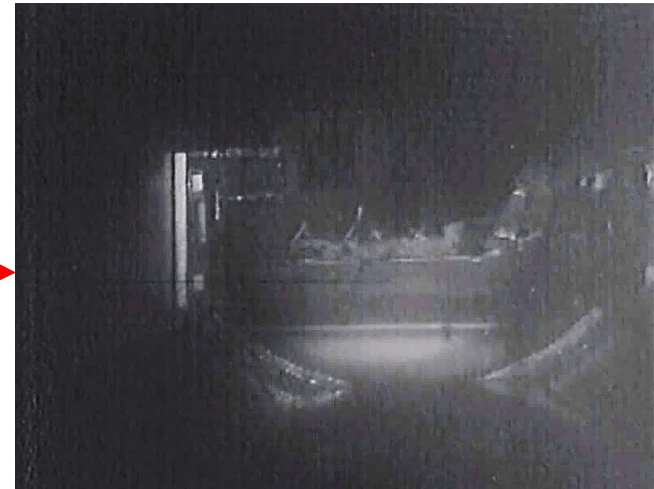
4-2. Field work Progress Status

(Removing Deposits from within the X-6 Penetration (High-pressure water/AWJ): AWJ work)

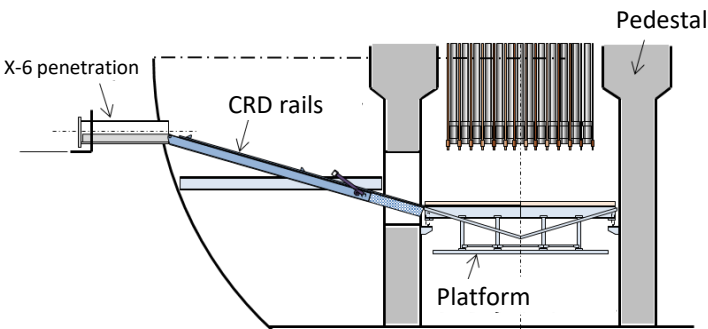
- The removal of deposits inside the X-6 penetration has been completed and we have confirmed that there is no significant hindrance to accessing the PCV with the telescopic device and the robotic arm.



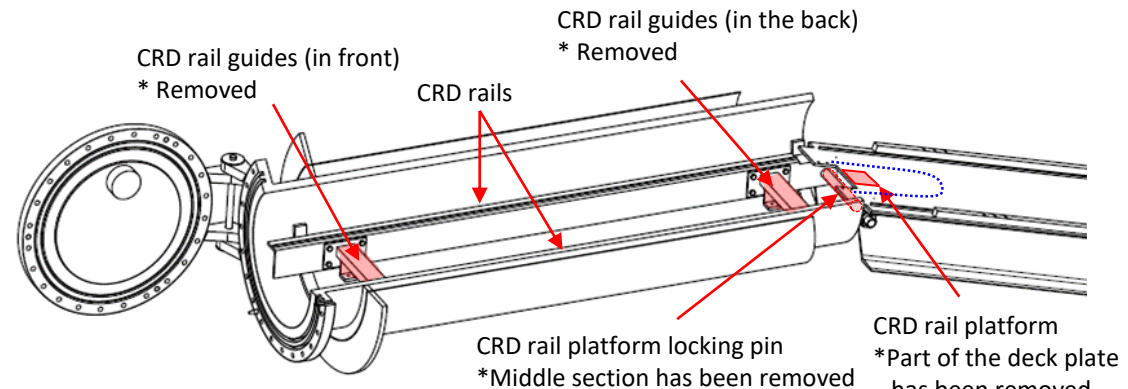
Condition of the X-6 penetration after the deposit removal (from the front to the back)



Condition of the X-6 penetration after the deposit removal (in the back)



Cross-sectional view of the X-6 penetration/reactor pressure vessel pedestal



Birds eye view of the X-6 penetration

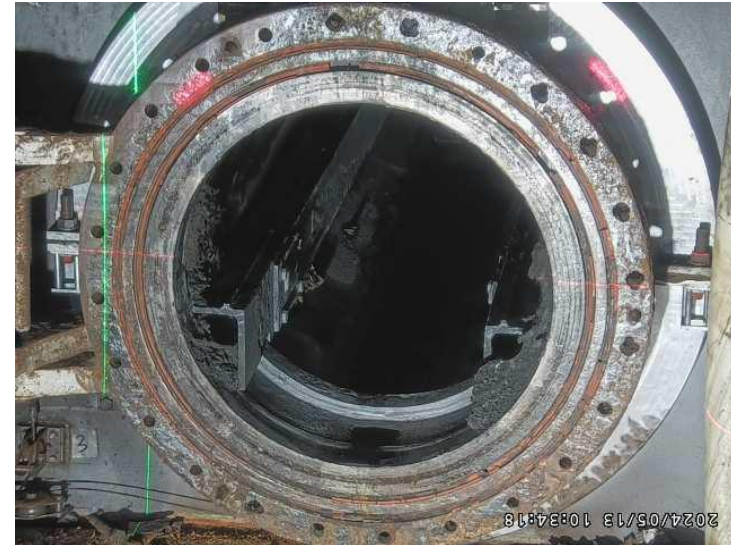
4-3. Field work Progress Status

(Removing Deposits from within the X-6 Penetration (High-pressure water/AWJ): AWJ work)

- The deposit removal equipment (high-pressure water/AWJ) was detached from the X-6 penetration and dismantled.
- Going forward, we are working on the installation of the X-6 penetration connection structure and the connection pipe.



X-6 penetration
(before the removal of deposits)



X-6 penetration (after the removal of deposits)

5. Schedule

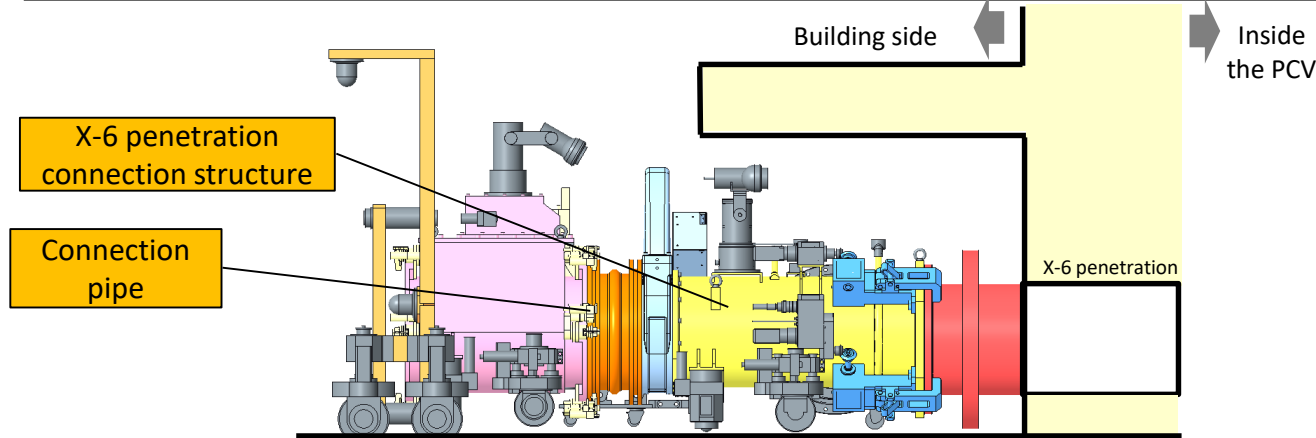
- Deposits had been removed using high-pressure water/AWJ and we have confirmed that there is no significant hindrance to accessing the PCV (going through the X-6 penetration) with the telescopic device and the robotic arm. The deposit removal device was detached and we are working on the installation of the X-6 penetration connection structure and connection pipe.
- We are planning to begin the trial retrieval of fuel debris at some point between August and October 2024.
- We will continue to steadily move forward and prioritize safety during the trial retrieval of fuel debris.

	FY2023	FY2024				FY2025
	4Q	1Q	2Q	3Q	4Q	
Deposit removal						
Telescopic device manufacturing/installation preparations						
Trial retrieval (fuel debris sampling using the telescopic device)						
Robotic arm testing, additional development as required by testing results						
Robotic arm installation preparations/robotic arm access route construction						
Use of robotic arm for internal investigations/fuel debris sampling						

Reference. X-6 penetration connection structure and connection pipe

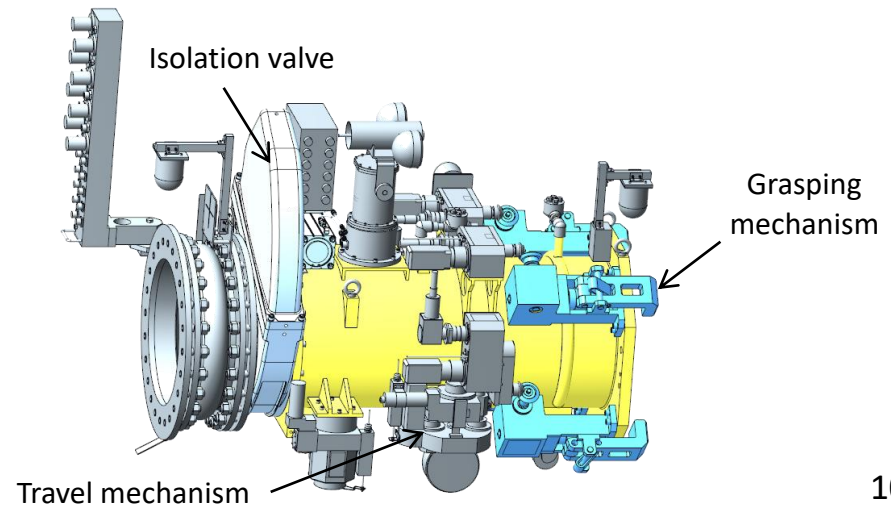
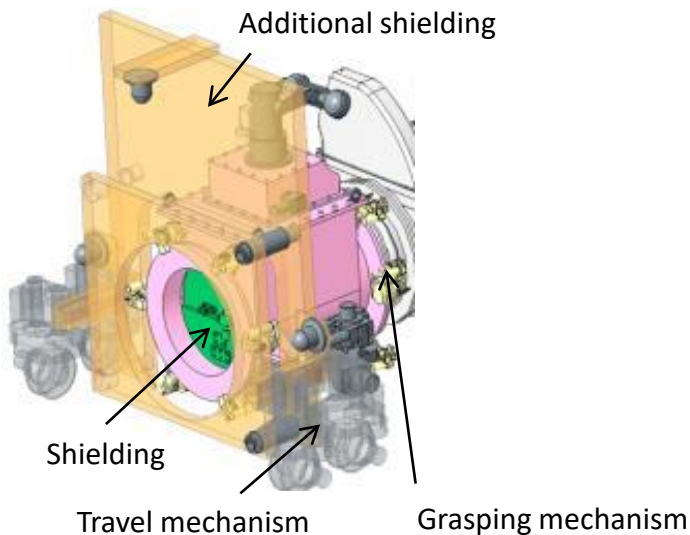
The following mechanism is being installed in order to construct an access route for trial retrieval and to create a PCV boundary

- X-6 penetration connection structure: Connected to the X-6 penetration in order to create a PCV boundary by using an isolation valve to isolate the PCV
- Connection pipe: Used to shield radiation from inside the PCV and reduce dose levels in front of the X-6 penetration



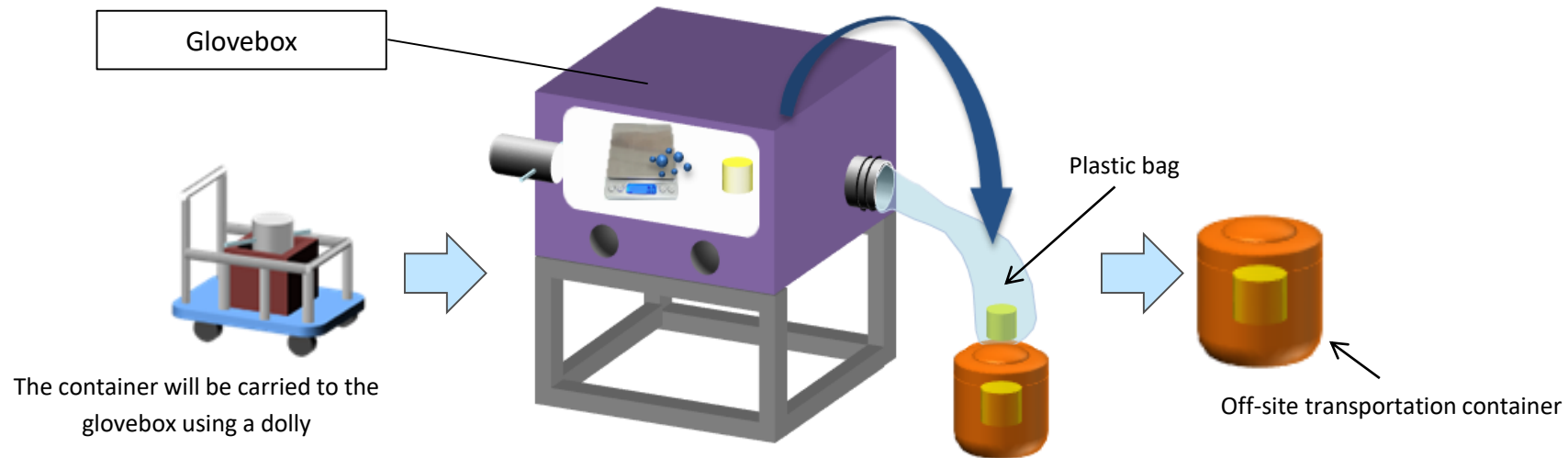
➤ Connection pipe

➤ X-6 penetration connection structure



Reference. Glovebox

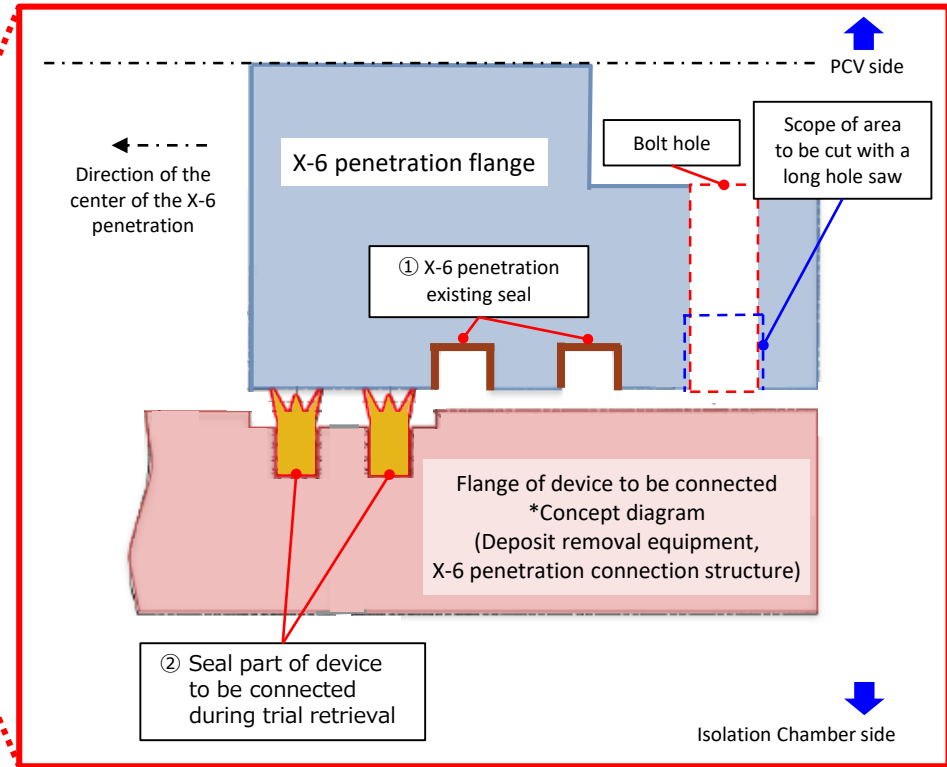
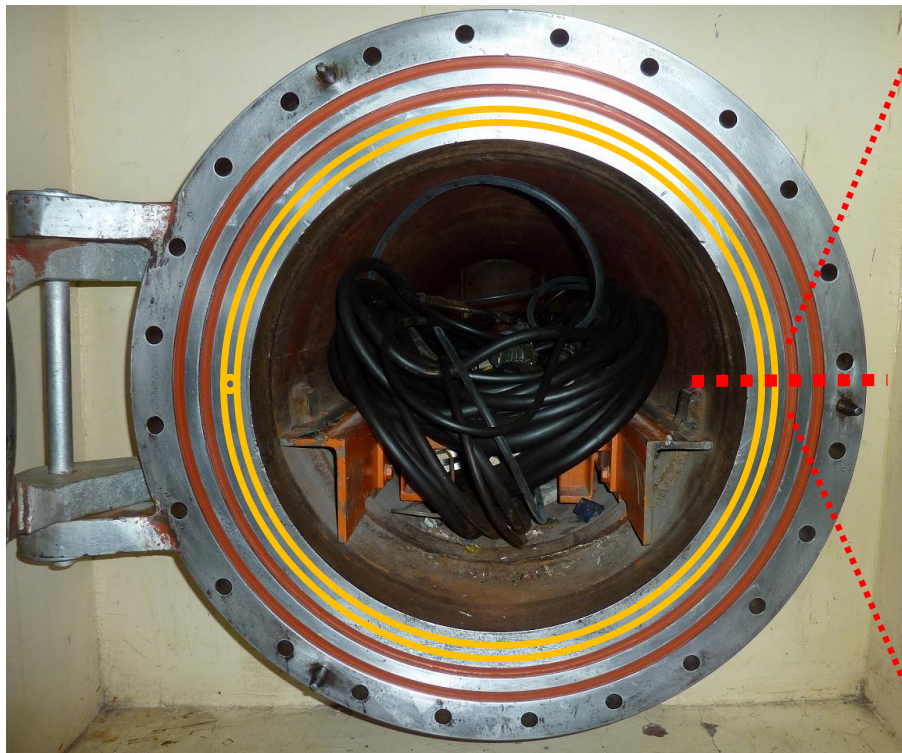
- The sampled fuel debris will be subjected to dose measurements when it is taken out from the enclosure of the telescopic device or the robotic arm, and then transported to a glovebox inside the reactor building where it will be subjected to various measurements. After measurements have been taken, measures to prevent the spread of contamination shall be implemented and it will be transported off-site



- The collected samples will be put into a negative pressure glovebox
- The samples will be subjected to various measurements inside the glovebox and then put into a container
- The container will be removed from the glovebox while preventing the spread of contamination by using a plastic bag
- The container will then be inserted into an off-site transportation container and loaded onto a transport vehicle

Reference. Sealing of the Device Connected to the X-6 Penetration

- A deposit removal equipment and X-6 penetration connection structure will be connected to the hatch flange after it is opened



X-6 penetration hatch prior to the accident (open)

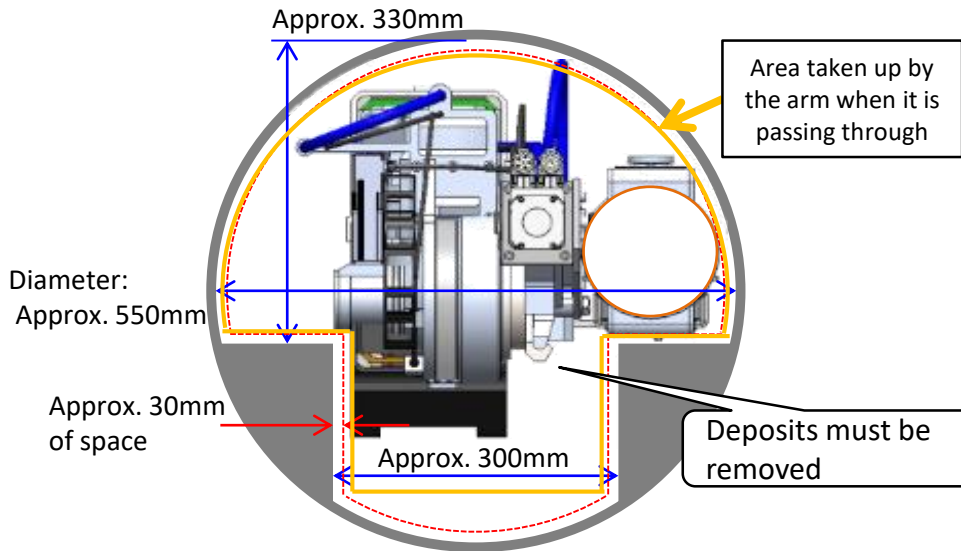
Location of seals when connecting devices to the X-6 penetration (as seen from above)

- : ① X-6 penetration existing seal
- : ② Seal of the devices connected to during trial retrieval
- * Deposit removal equipment, X-6 penetration connection structure

Reference. Robotic arm and telescopic arm when passing through the X-6 penetration

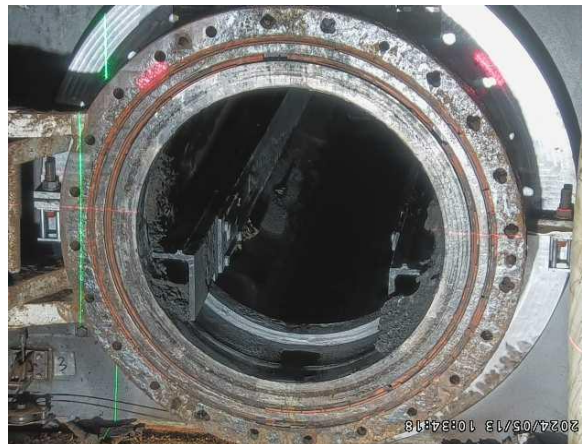
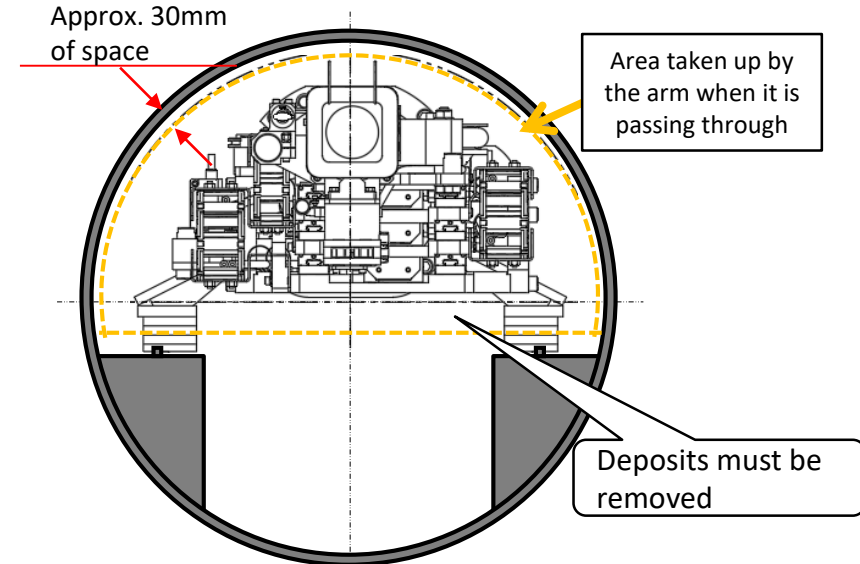
Robotic arm

(cross-section of the X-6 penetration when the arm is passing through)



Telescopic arm

(cross-section of the X-6 penetration when the arm is passing through)



X-6 penetration after the removal of deposits

Reference. Environmental Impact (1/2)

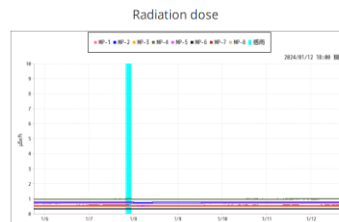
- The removal of deposits from inside the Unit 2 X-6 penetration has been ongoing since January 10, and we have not seen any radiological impact on the surrounding environment.
- During investigations, gases from inside the primary containment vessel have been prevented from leaking to the outside environment through the construction of a boundary.
- There have been no significant fluctuations in data from monitoring posts or dust monitors neither prior to or after work.
- Data from monitoring posts/dust monitors near site borders can be found on TEPCO's website
Reference URL: https://www.tepco.co.jp/en/hd/decommission/data/monitoring/monitoring_post/index-e.html
<https://www.tepco.co.jp/en/hd/decommission/data/monitoring/dustmonitor/index-e.html>

Radiation Dose measured at Monitoring Post of Fukushima Daiichi Nuclear Power Station

The following is the radiation doses of the air measured by the monitoring posts (MP1-8) at Fukushima Daiichi Nuclear Power Station.

Monitoring post (MP1 - MP8)

Monitoring points



MP Unit : μSv/h Wind Velocity Unit : m/s
C: Measurement value (2024/01/12 18:00)

MP-1	MP-2	MP-3	MP-4	MP-5	MP-6	MP-7	MP-8	風向	風速	備考
0.317	0.193	0.490	0.987	0.703	0.315	0.566	0.330	北北西	1.4	無

Radioactive Concentration measured at Dust Monitors near the Site Boundary of Fukushima Daiichi Nuclear Power Station

The following are radioactive concentrations in the air measured near the monitoring posts (MP1-8) at the site boundary of Fukushima Daiichi Nuclear Power Station.

Monitoring points



Radiation concentration



Radioactive Particles Monitor Unit : Bq/m³ Wind Velocity Unit : m/s
a: Measurement value (2024/01/25 09:50)

nearMP1	nearMP2	nearMP3	nearMP4	nearMP5	nearMP6	nearMP7	nearMP8	Wind Direction	Wind Velocity
1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	northwest	4.4

Reference. Environmental Impact (2/2)

- The removal of deposits from inside the Unit 2 X-6 penetration has been ongoing since January 10, and during investigations plant parameters are continuously monitored. We have seen **no significant fluctuations in primary containment vessel temperature neither prior to or after work**, and there's been **no change in the status of cold shutdown state**.
- Primary containment vessel temperature data can be found on TEPCO's website.
Reference URL: https://www.tepco.co.jp/en/hd/decommission/data/plant_data/unit2/pcv_index-e.html

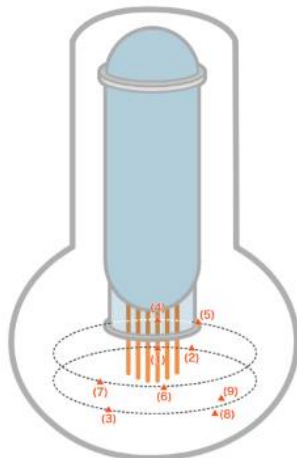
[Reference] Screen image of our website

Temperatures measured inside the Unit 2 Primary Containment Vessel at Fukushima Daiichi Nuclear Power Station

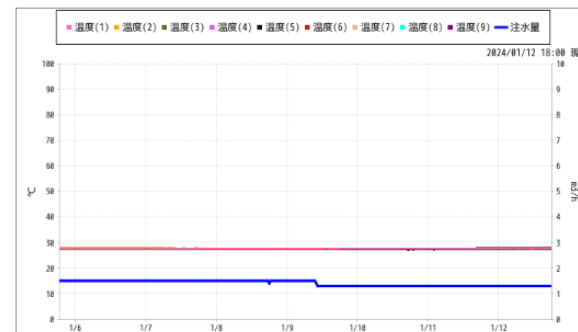
Here are the measurement results of temperatures inside the Unit 2 Primary Containment Vessel at Fukushima Daiichi Nuclear Power Station.

Monitoring points

Unit 2 reactor containment vessel



Temperature



Temperature Unit: °C. Water Injection Unit: m³/h

○ Measurement value (2024/01/12 18:00)

温度(1)	温度(2)	温度(3)	温度(4)	温度(5)	温度(6)	温度(7)	温度(8)	温度(9)	注水量
27.5	27.8	27.9	27.7	27.4	27.3	27.2	-	-	1.3