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

September 25, 2025

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.

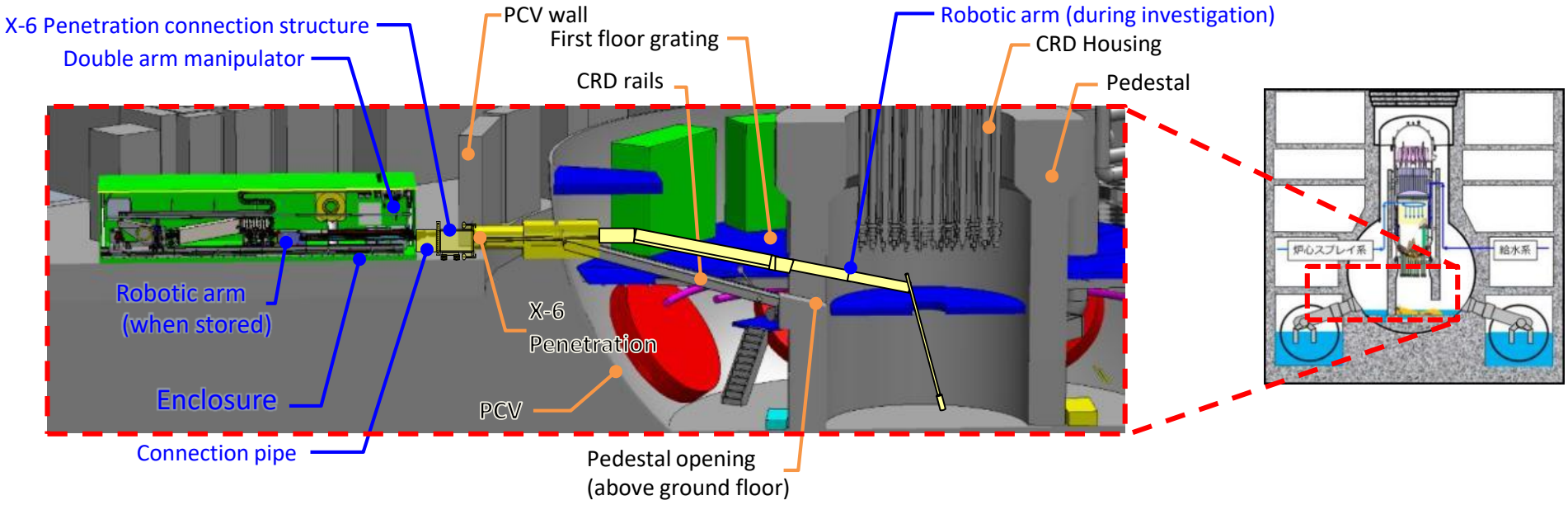
  ＜Already installed＞

  - The X-6 Penetration connection structure isolates the inside of the PCV from the outside
  - The connection pipe shields radiation
  - The telescopic device

  ＜To be installed＞

  - A metal box that contains 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. Status of robotic arm tests (Performance tests)

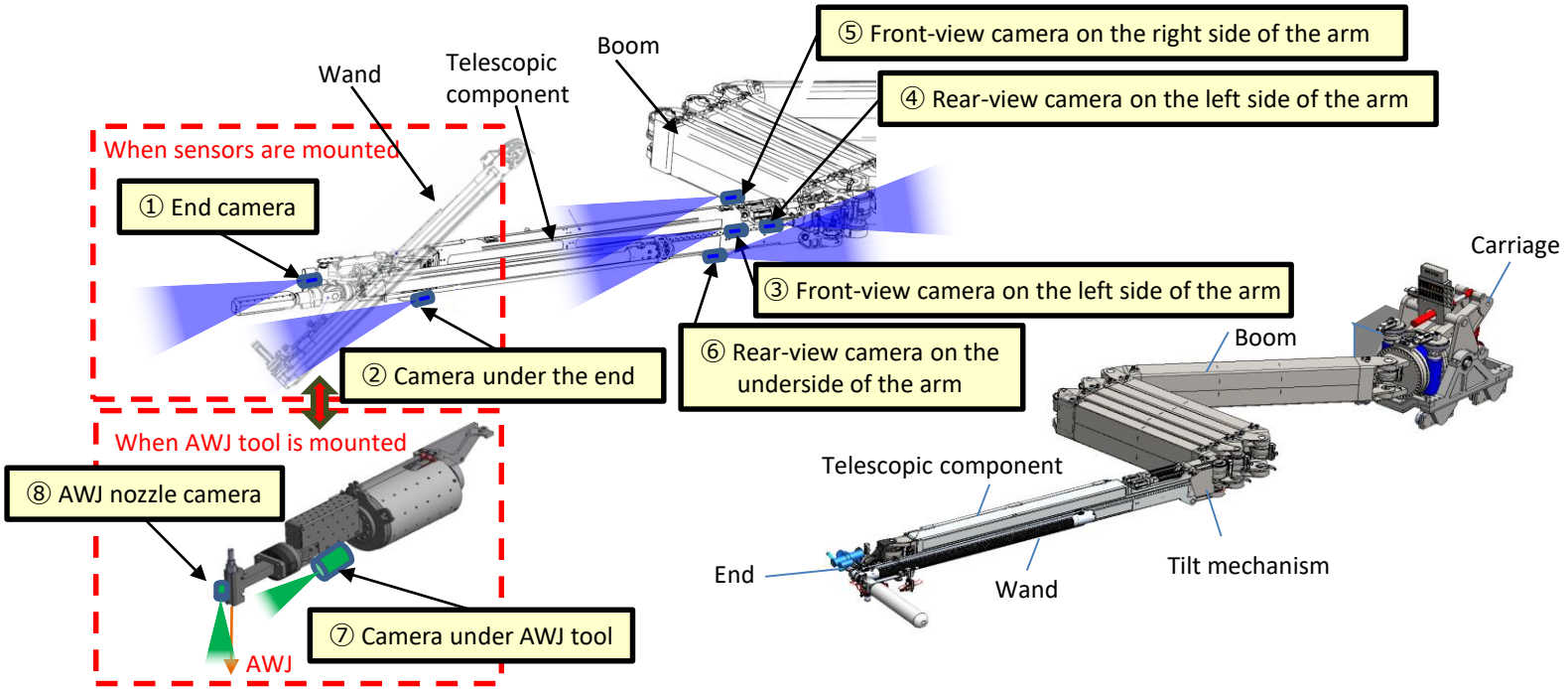
- Tests using a mockup of the Fukushima Daiichi on-site (combined once-through tests) were completed at the Naraha mockup facility in February 2025.
- The comprehensive inspection of the robotic arm, including replacement of parts that were found during testing to have deteriorated with age and other similar parts, has been completed as planned.
- Movement checks that were commenced after completion of the comprehensive inspection are underway.
- Furthermore, in addition to robotic arm developing, we are also confirming this technology applicability to the actual worksite by looking at procedures that simulate actual work tasks, operator operability, and equipment reliability.

Performance tests

Test category	Test	JAEA Naraha
Robotic arm-related	Ability to pass through the X-6 penetration	Completed
	Removing obstructions at the exit for the X-6 penetration using the AWJ	Completed（Work efficiency being examined）
	Function tests (deflection measurements, etc.)	Completed
	Ability to access the inside of the PCV (accessing the top and bottom of the pedestal)	Completed
	Removing obstructions inside of the PCV (Cutting obstructions inside the PCV after passing through the X-6 penetration)	Completed（Work efficiency being examined）
Dual arm manipulator-related	Connecting sensor tools to the arms	Completed
	Connecting/removing the external cables to/from the arms	Completed
	Bringing in and removing sensor tools	Completed
	Removing the fixed arm jig	Completed
	Replacing arm cameras/lighting	Completed
	Changing the position of the enclosure camera	Completed
	Forced withdrawal of the arm	Completed
Combined once-through tests (robotic arm + double arm manipulator)	Sensors/external cables, tools/Installing external cables at the arm	Completed
	Investigation of the top of the pedestal (sensors and wand are installed)	Completed
	Investigation of the bottom of the pedestal (sensors and wand are installed)	Completed
	Constructing an access route (removing obstructions using the AWJ)	Completed
Comprehensive inspection	Comprehensive inspection (maintenance)	Completed
Combined verification tests	Movement checks after comprehensive inspection (maintenance)	Underway

2-2. Cameras mounted on the robotic arm (horizontal deployment of the telescopic device)

- In light of the camera malfunctions on the telescopic device, irradiation tests of the cameras mounted on the robotic arm are being implemented and the radiation resistance as noted in the manufacturer's specifications could not be confirmed under conditions more severe than that of the field environment in some cases.
- During irradiation tests under conditions that match the actual field environment (inside the PCV), we were unable to confirm the radiation resistance as noted in the manufacturer‘s specifications in some cases as well. Since it has been impossible to acquire spare cameras, we have determined that we will need to change the cameras that will be subjected to high accumulated doses during field work to ones that have been adopted in our previous works.
- Going forward, the design of mounting brackets for some cameras will be changed and we will conduct visibility tests along with the changes as well as additional tests that involve using a manipulator to replace the cameras. Irradiation tests of the new cameras will also be carried out simultaneously.
- Based on the results of the irradiation tests of the new cameras, we shall secure enough spare cameras to enable us to replace the cameras mounted on the arm as necessary.



Cameras mounted on the robotic arm

3. Work schedule

- A comprehensive inspection including replacement of the internal cables of the robotic arm and all similar components, etc. was completed as scheduled. The movement checks after the comprehensive inspection is currently underway, and we are verifying that there are no issues with the arm's operation.
- Going forward, the arm will be installed to the enclosure and once-through tests will be performed and preparations will be made for operations in the field.
- In light of the camera malfunctions on the telescopic device, irradiation tests of the cameras mounted on the robotic arm are being implemented and the radiation resistance as noted in the manufacturer's specifications could not be confirmed under conditions more severe than that of the field environment in some cases.
- During irradiation tests under conditions that match the actual field environment (inside the PCV), we were unable to confirm the radiation resistance as noted in the manufacturer‘s specifications in some cases as well. In addition, since it has been impossible to acquire spare cameras, we have determined that we will need to change the cameras that will be subjected to high accumulated doses during field work to ones that have been adopted in our previous works.
- Going forward, the design of mounting brackets for some cameras will be changed and we will conduct visibility tests along with the changes as well as additional tests that involve using a manipulator to replace the cameras. Irradiation tests of the new cameras will also be carried out simultaneously.
- We expect to commence internal investigations and debris sampling using the robotic arm during FY2026, since visibility tests after the camera change and validation of the replacement work using a manipulator will be added.
- In light of the status of the robotic arm tests and the camera validation tests, and to move forward with trial retrieval safely and carefully, the work schedule going forward will be subject to a detailed review.

		FY2025				FY2026
		Q1	Q2	Q3	Q4	
Robotic arm	Inspection/maintenance, etc., and any additional development required based upon once-through tests/test results			Additional tests in conjunction with the camera change		
	Installation preparation, etc./ access route construction					
	Internal investigation/debris sampling					

: Completed

: Commencement and completion dates under review

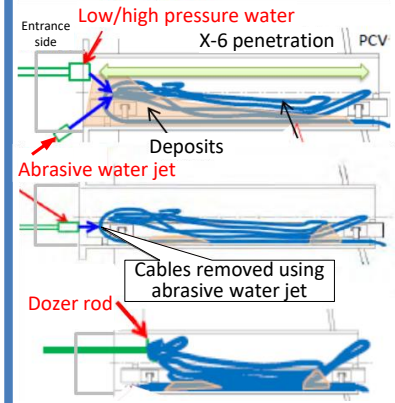
[Reference] Field Preparation Work Progress
Primary Steps of the Fuel Debris Trial Retrieval (Internal Investigations/Debris Sampling)

1. Isolation chamber installation

2. Opening of the X-6 penetration hatch

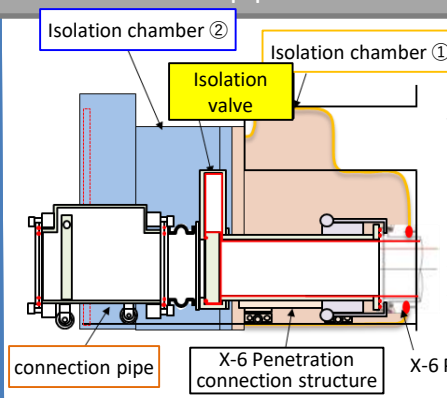
3. Removal of deposits from inside the X-6 penetration

Removing deposits/cables from inside the X-6 penetration



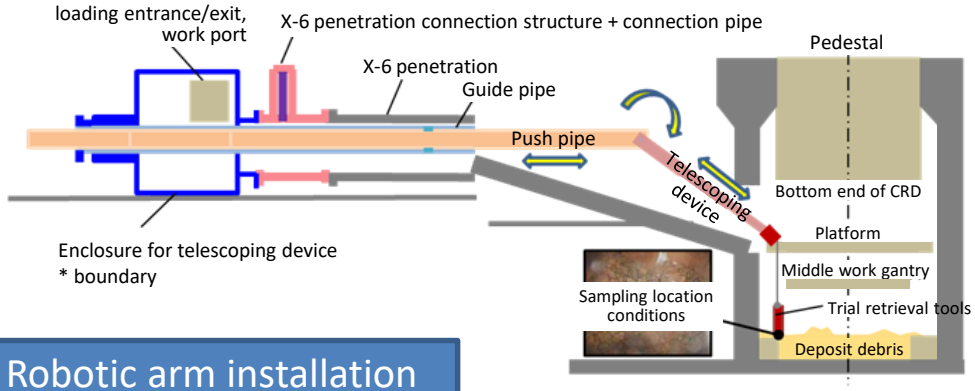
- Deposits pushed with low/high-pressure water
- Cables removed with Abrasive water jet
- Cables pushed with dozer rod

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

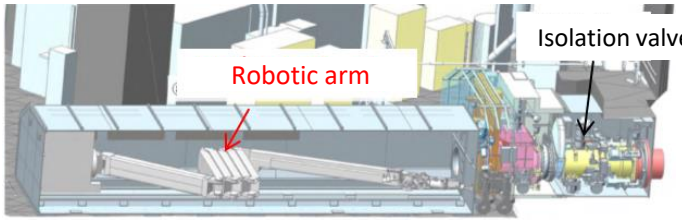


The connecting structure and connection pipe will be installed at the X-6 penetration and the boundary will be changed from the isolation chamber to the connection structure.

5. Installation of telescopic device
6. Trial retrieval (debris sampling using telescopic device)

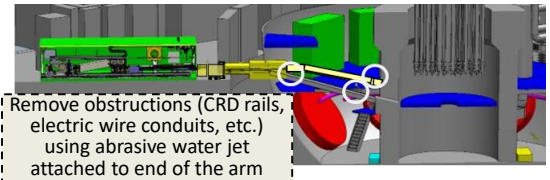


7. Robotic arm installation



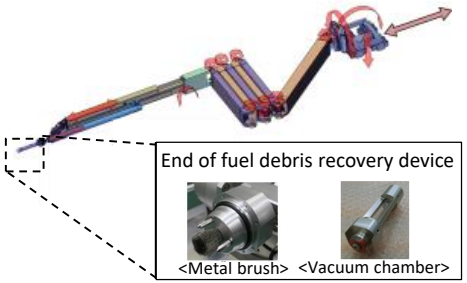
8. Internal investigation/debris sampling using robotic arm

① Internal investigation



Remove obstructions (CRD rails, electric wire conduits, etc.) using abrasive water jet attached to end of the arm

② debris sampling using robotic arm



(Note)

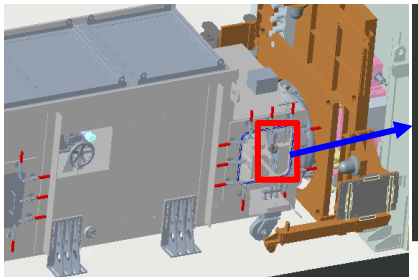
Isolation valve: Valve installed to separate the inside of the PCV from the outside

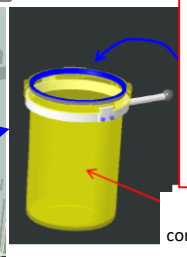
Abrasive Water Jet: Combines high pressure water with an abrasive to improve cutting ability

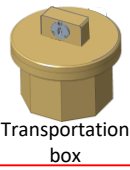
[Reference] Field Preparation Work Progress
Primary Steps of the Fuel Debris Trial Retrieval (Internal Investigations/Debris Sampling)

(From Step 6 on the previous slide)

9-1. Collection of fuel debris





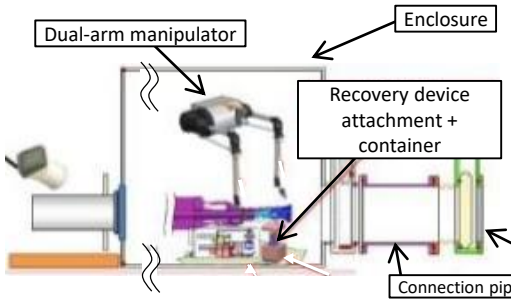


Transportation box

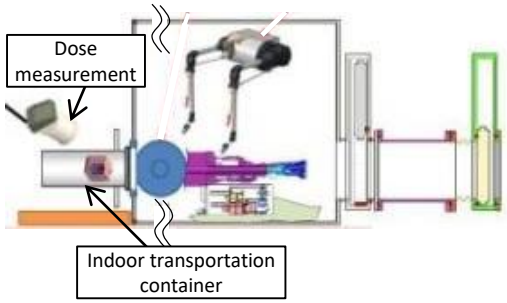
Indoor transportation container (DPTE container)

(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

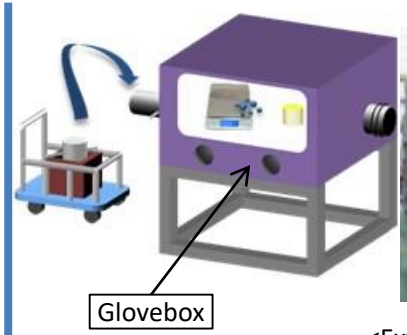


- The fuel debris recovery device attachment will be put into a container using the dual-arm manipulator inside the enclosure



- Inside the enclosure, the attachment will be put into an on-site transportation container after taking dose measurements
- This will be removed while attempting to prevent the spread of contamination

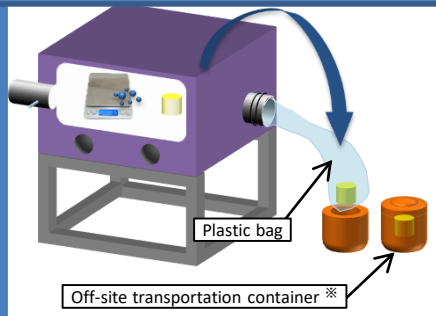
10. Insertion into glovebox/Measurement



<Exterior view of glovebox>

- 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

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



Carried to transport vehicle

- 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

※ Prior to transport, the surface dose/contamination density, etc. of the container shall be measured to ensure that it meets legal requirements

12. Off-site transport and off-site analysis

(Note)
DPTE Container is an abbreviation of “Double Porte pour Transfert Etanche”.
By opening/closing the lid of the container and double door of the glove box at the same time, it allows the items to be transferred while maintaining a sealed environment.