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

July 31, 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.

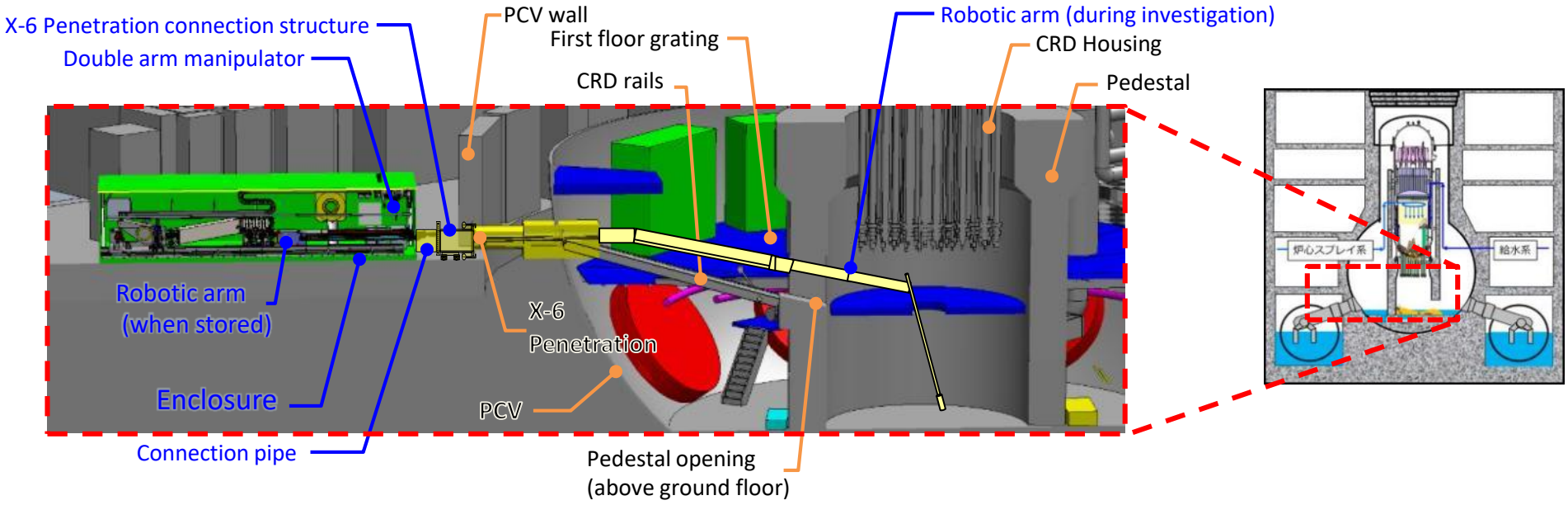
  ＜Already installed＞

  - 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 (February 2025).
- Work feasibility was checked by confirming that the AWJ tool attached to the arm could be remotely operated to remove obstructions and create an access route, data from inside the pedestal can be acquired and simulated debris sampled using sensors and devices attached to the arm, and that the dual arm manipulator could be used to remove and attach sensors and tools, etc.
- However, in order to take every precaution, parts that were found to have degraded with age are being replaced along with other similar parts in the process of performing a comprehensive inspection of the robotic arm.
- 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)	Underway
Combined verification tests	Movement checks after comprehensive inspection (maintenance)	TBD

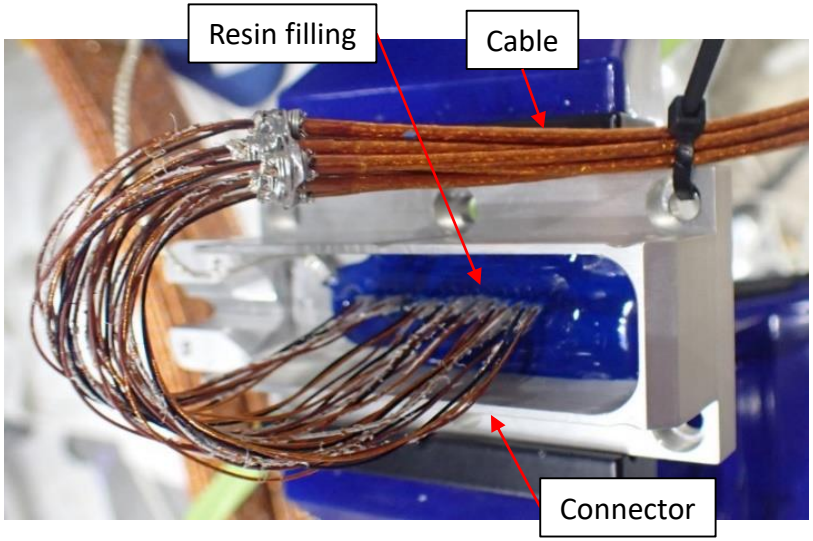
2-2. Status of the robotic arm comprehensive inspection (maintenance)

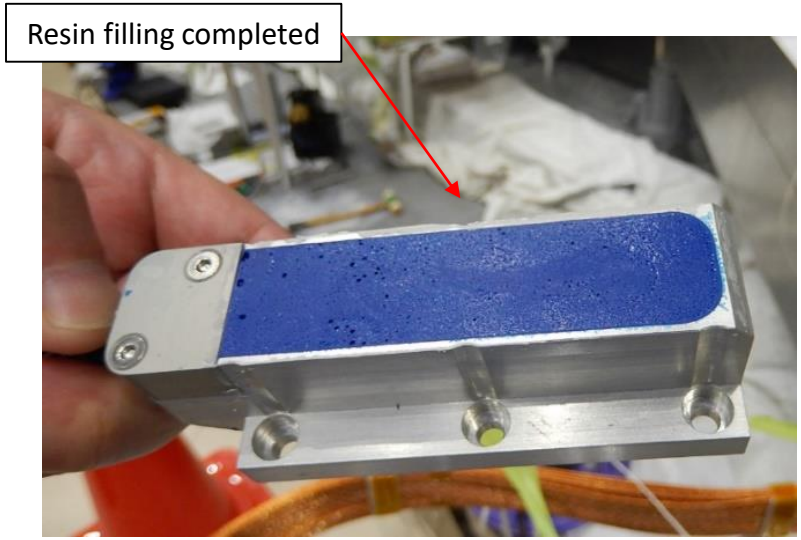
- Cables inside the robotic arm are being replaced.
- Cables inside the robotic arm are being removed and replaced with new cables after which connectors are installed (underway).

Arm maintenance/internal cable replacement

2-3. Status of the robotic arm comprehensive inspection (maintenance)

- In order to waterproof and fix the cables inside the arm and connectors connected to the motor cables, they have been put in connector cases, and after they have been soldered, the cases are being filled with resin.
- After the cables have been replaced, the arm will be assembled and movement checks performed.





Internal cable-connector treatment

3. Work schedule

- The second fuel debris trial retrieval using the telescopic device took place. The bottom of the pedestal was accessed through the opening 2 on April 17, and fuel debris was grasped. On April 23, the fuel debris sample was loaded into an indoor transportation container thereby concluding the second trial retrieval. Off-site transport was completed on April 25.
- In light of the age-related deterioration of certain components found during testing, a comprehensive inspection of all the internal cables of the robotic arm including replacement of all similar components, etc. is underway. The replacement of internal cables is currently underway.
- Going forward, robotic arm movement checks will be performed, and the arm will be installed to the enclosure. After the comprehensive inspection has been completed, once-through tests will be performed and preparations will be made for operations in the field.
- In light of the robotic arm test status, and to move forward with trial retrieval safely and carefully, the work schedule going forward will be subject to a detailed review.

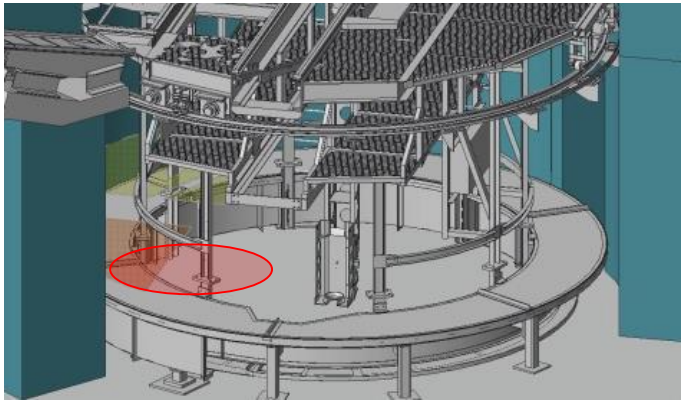
		FY2025			
		Q1	Q2	Q3	Q4
Telescopic device	Debris sampling	Second attempt			
Robotic arm	Inspection/maintenance, etc., and any additional development required based upon once-through tests/test results				
	Installation preparation, etc./ access route construction				
	Internal investigation/debris sampling				

: Completed

: Commencement and completion dates under review

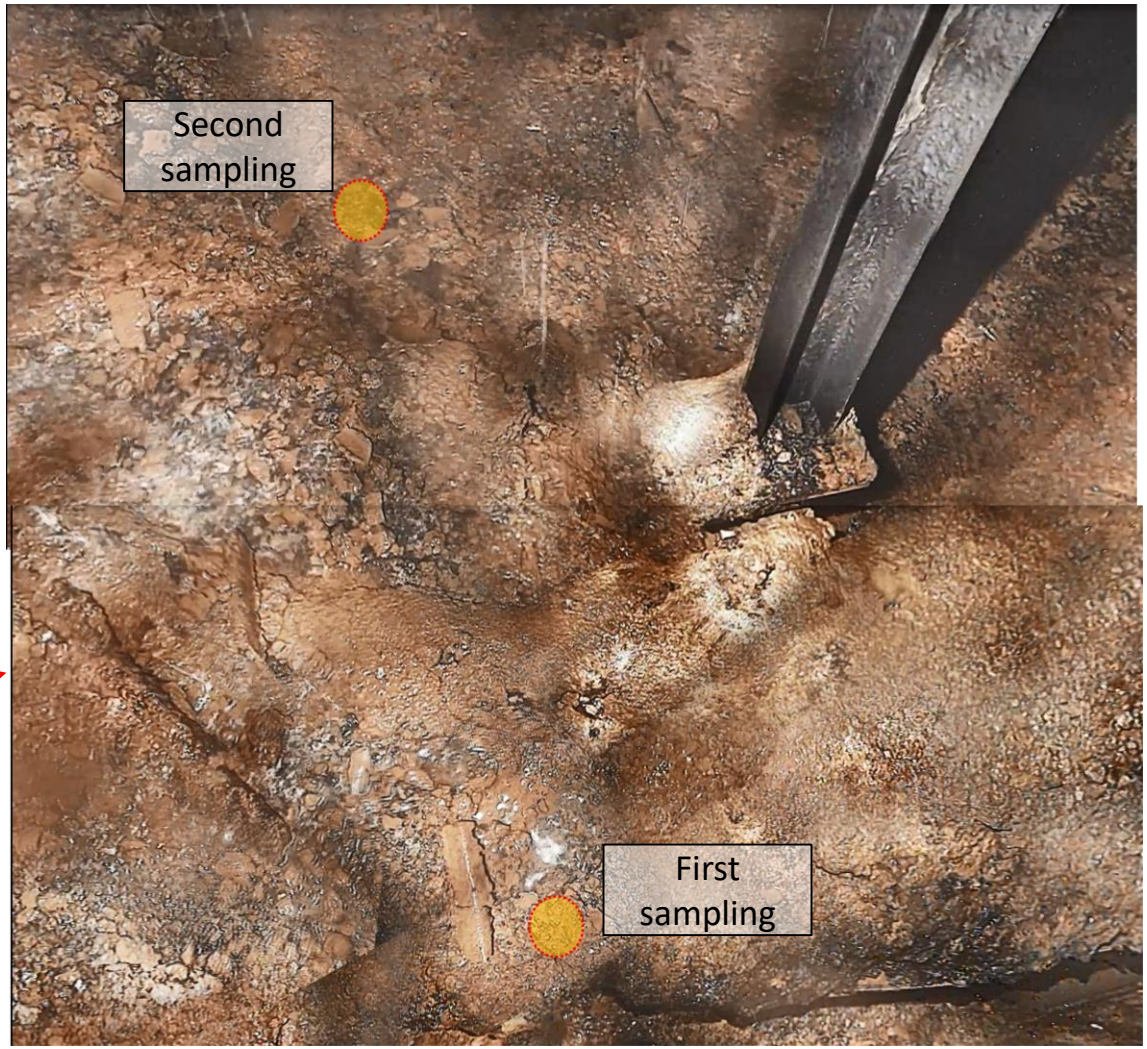
[Reference] Locations of fuel debris sampling using the telescopic device

- The following shows the estimated locations from which fuel debris was sampled during the first and second attempts to retrieve fuel debris using the telescopic device on an image from past internal investigations.



Inside the pedestal

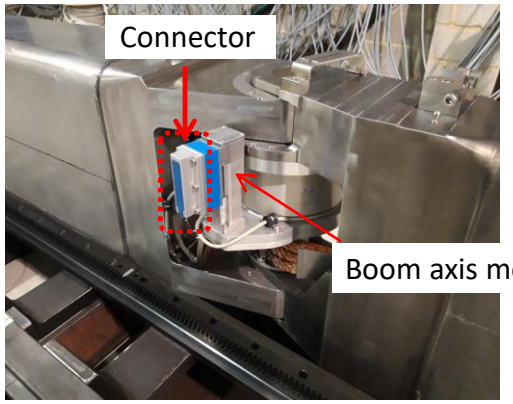
Panorama photo of the bottom of the pedestal



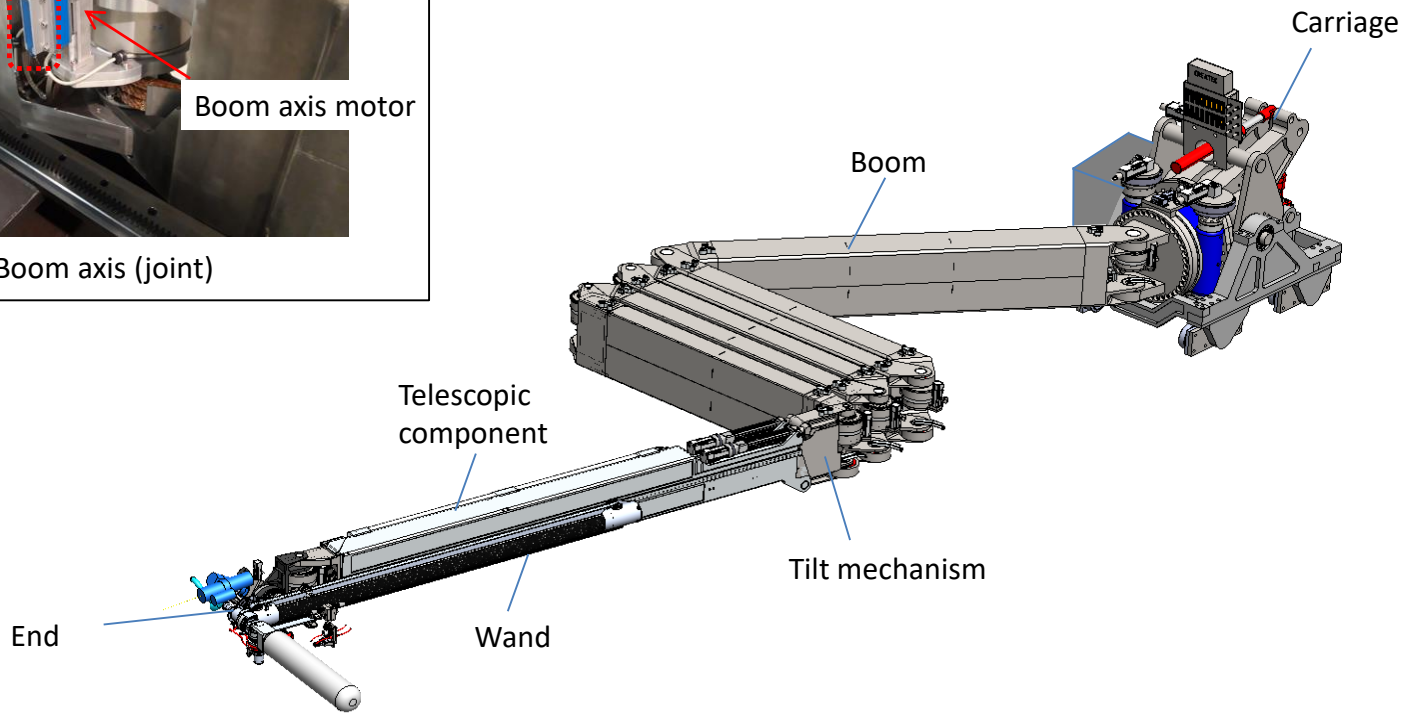
※ Camera images have been stitched together

[Reference] Robotic arm test status (maintenance)

- In light of the age-related deterioration of motor cables, etc., found during robotic arm movement tests, a comprehensive inspection (maintenance), which includes replacement of similar components, etc. is underway.
- In conjunction with this, maintenance is being performed on motors and reducers, etc., in preparation for use in the field.



Boom axis (joint)



Robotic arm diagram

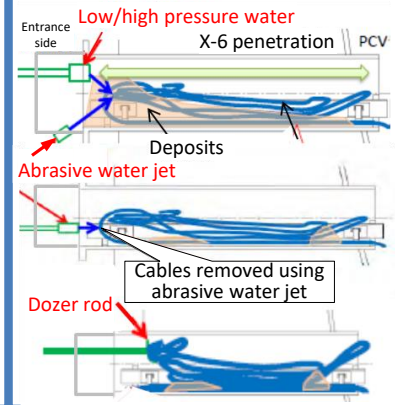
[Reference] Field Preparation Work Progress
Primary Steps of the Fuel Debris Trial Retrieval (Internal Investigations/Debris Sampling)

1. Isolation chamber installation

2. Opening of the X-6 penetration hatch

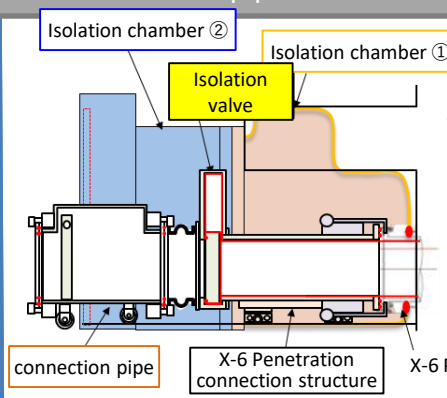
3. Removal of deposits from inside the X-6 penetration

Removing deposits/cables from inside the X-6 penetration



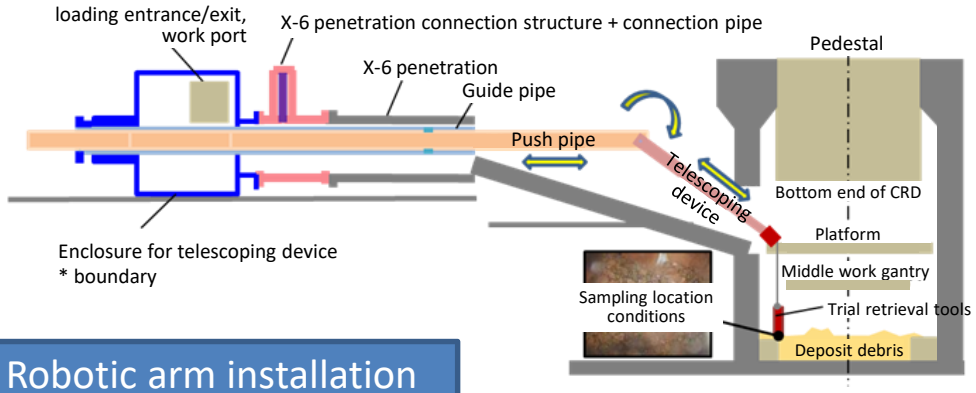
- Deposits pushed with low/high-pressure water
- Cables removed with Abrasive water jet
- Cables pushed with dozer rod

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

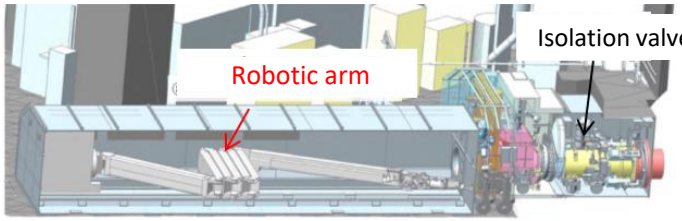


The connecting structure and connection pipe will be installed at the X-6 penetration and the boundary will be changed from the isolation chamber to the connection structure.

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

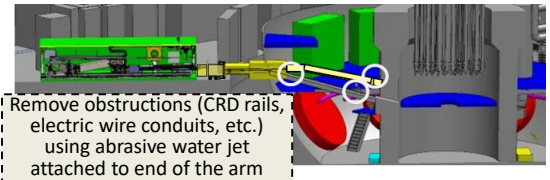


7. Robotic arm installation



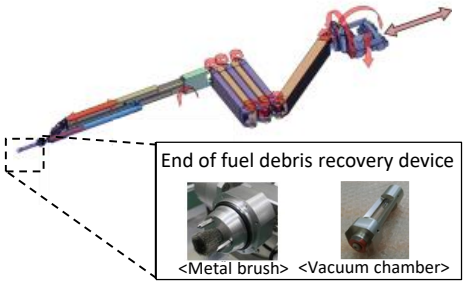
8. Internal investigation/debris sampling using robotic arm

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)

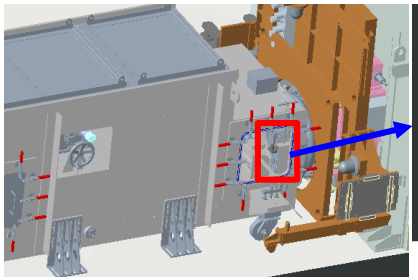
Isolation valve: Valve installed to separate the inside of the PCV from the outside

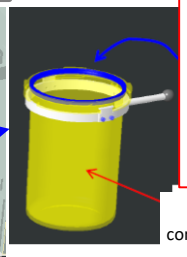
Abrasive Water Jet: Combines high pressure water with an abrasive to improve cutting ability

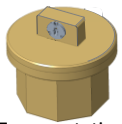
[Reference] Field Preparation Work Progress
Primary Steps of the Fuel Debris Trial Retrieval (Internal Investigations/Debris Sampling)

(From Step 6 on the previous slide)

9-1. Collection of fuel debris





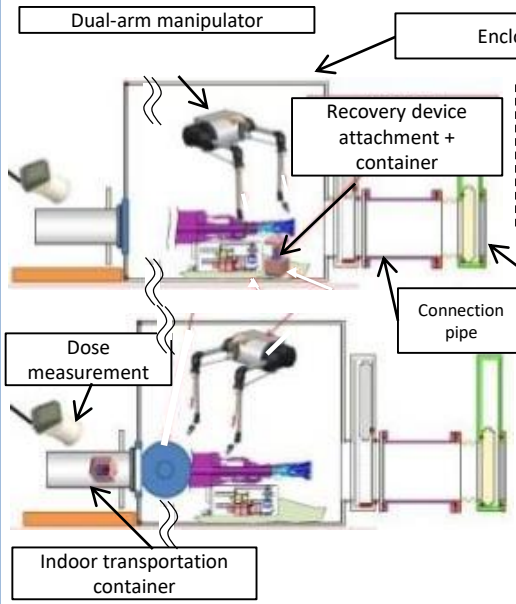


Transportation box

Indoor transportation container (DPTE container)

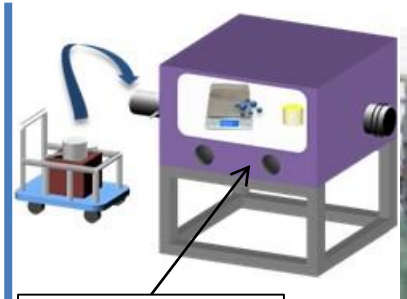
(From Step 8 on the previous slide)

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

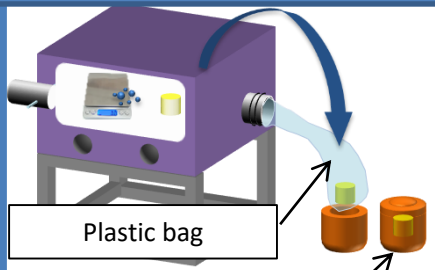


Glovebox

<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



Plastic bag

Off-site transportation container ※

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.