Implementation Status of the Fukushima Daiichi Nuclear Power Station Unit 1 Primary Containment Vessel Internal Investigation (ROV-A2) (Preliminary report)

< Reference Material >
March 14, 2022
Tokyo Electric Power Company Holdings, Inc.
Fukushima Daiichi D&D Engineering Company

- In order to deliberate equipment and methods for recovering deposits from inside the primary containment vessel (hereinafter referred to as, “PCV”), internal investigations of the PCV shall be conducted to obtain information, such as the amount and origins of such deposits. Going forward, separately developed remotely operated vehicles (hereinafter referred to as, "submersible ROV") will be used to perform a detailed visual investigation of the inside and the outside of the pedestal※1, measure the thickness of deposits, detect deposit debris, sample debris, and create 3-D maps of the deposits. In preparation for these investigations, we used submersible ROV-A to install guide rings ※2 inside the PCV between February 8~10.

(Announced prior to February 10)

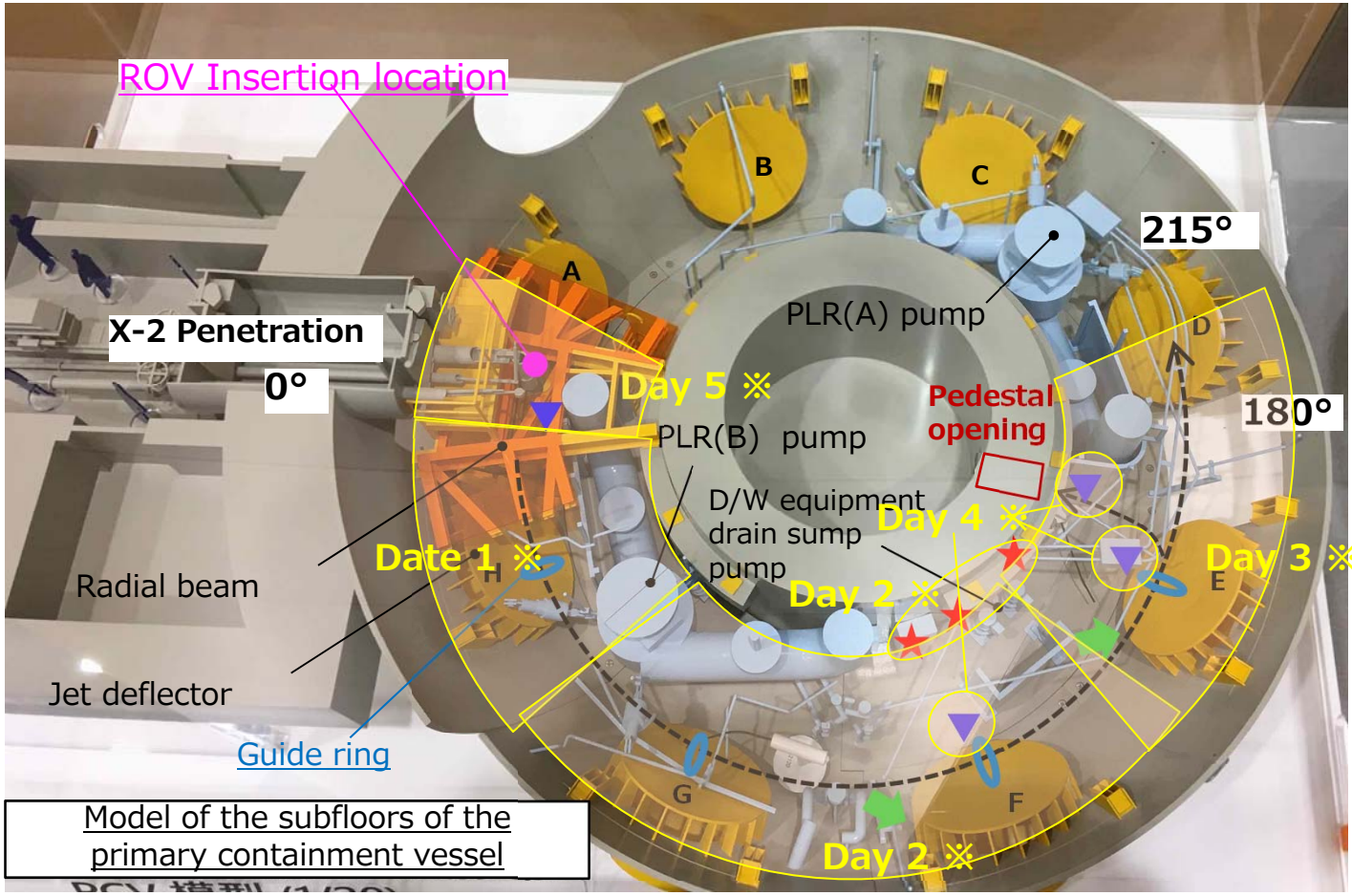
- After that, in preparation for the detailed visual inspection of the outside perimeter of the pedestal, which will be conducted using submersible ROV-A2, we leveraged the knowledge we gained through previous investigations to formulate countermeasures, such as shutting off the noise propagation line from other equipment as much as possible. And, on March 10, we turned on the power to each piece of equipment in the same order, and under the same conditions, as the actual investigation, and inserted submersible ROV-A2 into the PCV side. There were no abnormalities and each piece of equipment performed correctly.
- Now that these preparations have been completed, today (March 4) at 11:13 AM, submersible ROV-A2 was inserted through the X-2 penetration ※3 to commence a detailed visual inspection of the outside perimeter of the pedestal.
- In addition to checking the conditions of existing structures and the extent to which debris has been dispersed around the perimeter of the pedestal, submersible ROV-A2 will also be used to measure neutrons in order to narrow down the scope of the deposit debris detection (nuclide analysis/neutron measurement) investigation that will be conducted using submersible ROV-D.
- This investigation was performed after constructing boundaries※4 to prevent gases inside the PCV from leaking to the outside, and there have been no significant fluctuations in data from monitoring post or dust monitors, or with plant parameters from before the investigation to the present, so there have been no radiological impact on the surrounding environment. We will continue to prioritize safety while carefully conducting these investigations.

※1 Pedestal: Work space and platform below the primary containment vessel
※2 Guide ring: Ring installed to prevent the cables attached to the submersible ROV from getting twisted.
※3 X-2 penetration: Hole used by workers to enter the PCV
※4 Boundary: PCV containment function

Location of the detailed visual inspection of the perimeter of the pedestal and inspection schedule

< Main targets of the investigation >

- Examine the condition of existing structures
- Examine the extent of dispersal of debris, debris height, and slope
- Examine the conditions around the pedestal opening and also the condition of the concrete wall near the pedestal opening （★Location）
- Condition of deposits around the jet deflectors （ Location）
- Measure neutron flux above deposits （▼ Location）



Model of the subfloors of the primary containment vessel

※ The investigation schedule may be changed in accordance with the progress of other investigations

Source : International Research Institute for Nuclear Decommissioning (IRID)

Sequence of events during the internal investigation of the PCV (As of 4:30 PM March 14)

【March 14】

10:05 AM PCV internal investigation preparations begin
(Power is turned on for each piece of equipment)

10:58 AM It is confirmed that dose data built-in to the submersible ROV-A2 and the timestamp on submersible ROV camera monitors are displaying correctly

11:13 AM **PCV internal investigation (ROV-A2) commences**
(Isolation valve on the X-2 penetration is opened)

2:36 PM Submersible ROV-A2 arrives at the surface of the water inside the PCV

4:06 PM Operations check of submersible ROV-A2 begins

4:21 PM Operations check of submersible ROV-A2 concludes
(No abnormalities)

Internal investigation of the Unit 1 PCV (March 14)

Photo 1. Work in the remote operations room

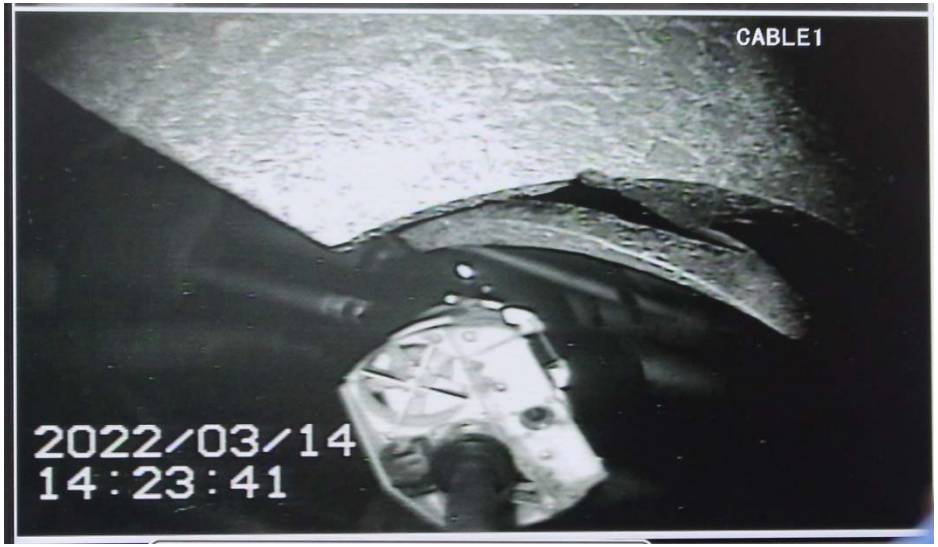


Photo 2. Lowering the submersible ROV

Photo 3. ROV arrives at the surface of the water at the bottom of the PCV

Photo 4. Conditions at the point of lowering

Work structure of Internal investigation of the Unit 1 PCV

■ Staff allocation

Area in front of the outside of the PCV (X-2 penetration): 6 teams each comprised of 8 people

Field headquarters: approx. 10 people mainly supervisors

Remote control room: 4 teams comprised of 4 operators each (1 team leader, 3 member operators) + approx. 18 supervisors

■ Equipment

Area in front of the outside of the PCV (X-2 penetration): R gear (i.e., Anorak, coveralls, full face mask, helmet, cotton gloves, 3 sets of rubber gloves, 3 pairs of socks, shoe covers, R shoes)

Field headquarters: Y gear (i.e., coveralls, full face mask, helmet, cotton gloves, 2 sets of rubber gloves, 2 pairs of socks, Y shoes)

■ Dose

Planned dose ：3mSv/day per person

APD set value ：1.5mSv

【Reference】
Performance checks prior to the Unit 1 PCV internal investigation

■ Date/Time
12:59 PM~8:56 PM, March 10

■ Objective
- In preparation for the Unit 1 PCV internal investigation (detailed visual inspection of the outside perimeter of the pedestal using submersible ROV-A2), submersible ROV-A2 was inserted into the area between the interior and exterior doors of the X-2 penetration upon checking the welds between the cable drum and the seal box, and also between the isolation valve and the glovebox, in order to confirm that the PCV is sealed, and it was confirmed that all pieces of equipment to be used during the investigation are operating normally.

■ Results
- Power was turned onto each piece of equipment in the same order, and under the same conditions, as the actual investigation, and it was confirmed that there are no abnormalities with equipment, such as dosimeter data and monitoring monitors, etc., and that all equipment is performing normally.
- When the B10 detector (neutron detector) was started up while in between the interior and exterior doors of the X-2 penetration in order to conduct a performance check, the detector indicated a maximum value of 10 counts per minute (cpm). Since nothing was detected outside the X-2 penetration, it is assumed that the neutron detector is working normally and that neutrons were detected. During past investigations (June 2018), no significant measurements of neutron rays around the X-2 penetration were recorded, but measurements taken this time in March 11 using rem counter, indicated 0.25μSv/h around the exterior door of the X-2 penetration. However, when measurement equipment was moved away from the door, levels fell to 0.00μSv/h so it was determined that the impact on the work environment from neutrons is extremely limited and will not affect workers or the surrounding environment.

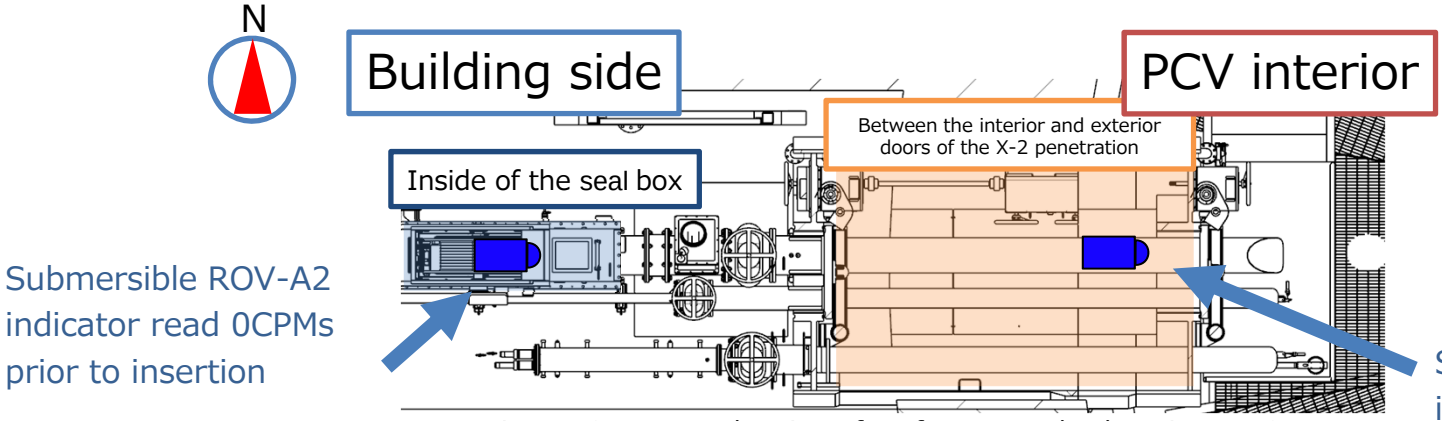
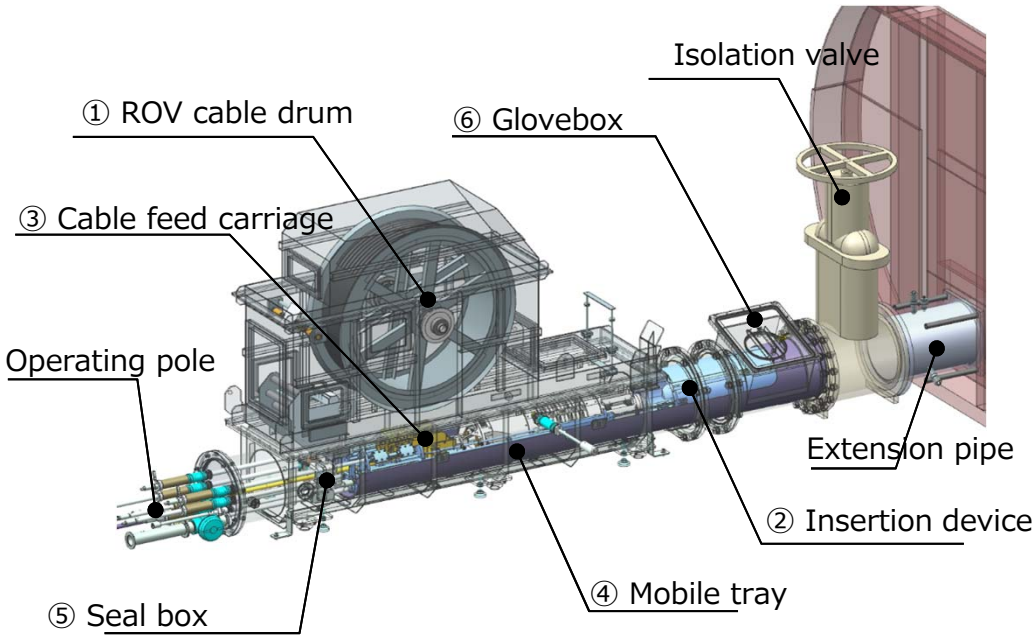
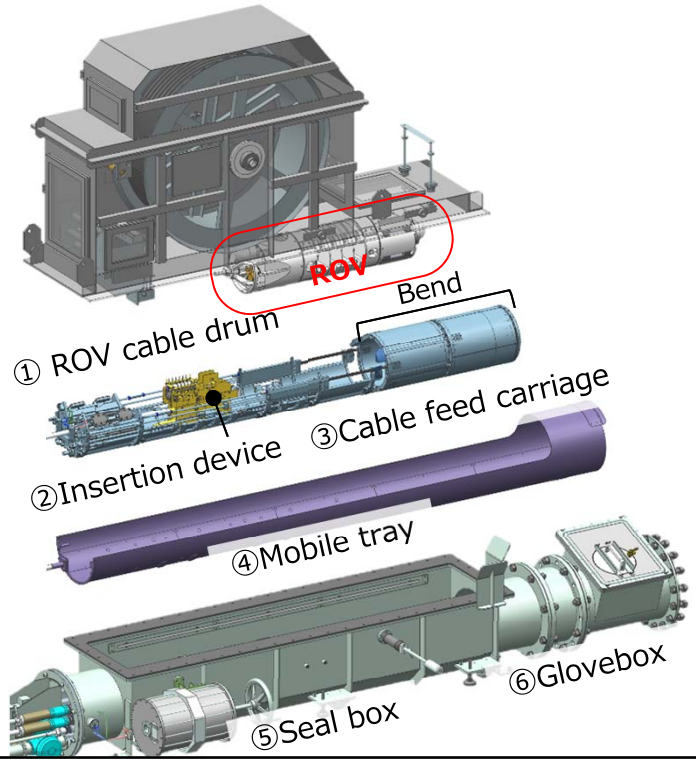


Figure. Concept a drawing of performance checks prior to PCV internal investigation

【Reference】 Investigation device details
Seal box and other equipment

Inserts/extracts the ROV into/from the PCV.
Creates a PCV boundary along with the ROV cable drum.



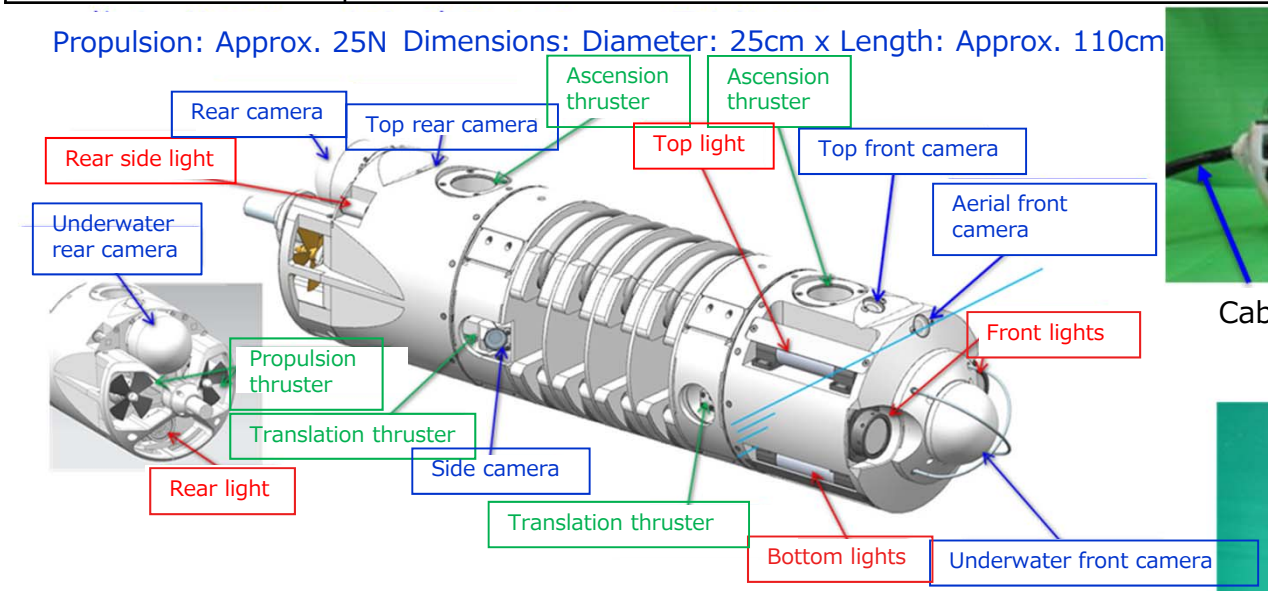


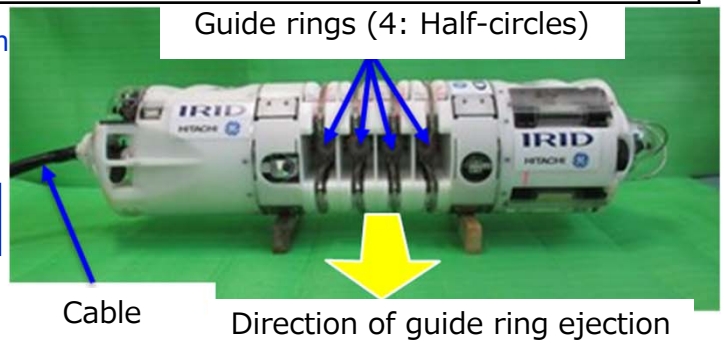
Name of component		Role
①	ROV Cable drum	Part of the ROV that feeds and retracts the ROV cable.
②	Insertion device	Inserts the ROV into the PCV via guide rings and bends to stand the ROV vertically once inside.
③	Cable feed carriage	Works in tandem with the cable drum to assist with the cable.
④	Mobile tray	Device for carrying the insertion device up to the guide pipe.
⑤	Seal box	Houses the ROV cable drum and constitutes a boundary.
⑥	Glovebox	Used to set the cable fee carriage and to cut the cable in the event of an emergency.

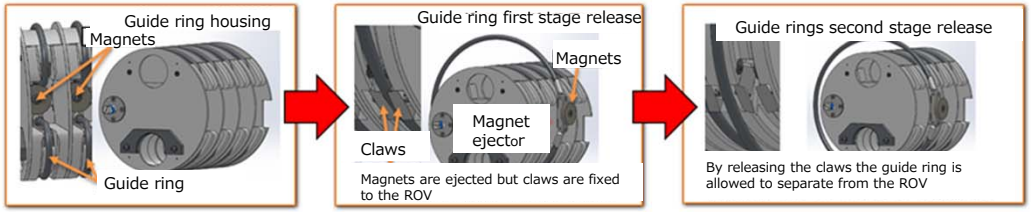
Source: International Research Institute for Nuclear Decommissioning (IRID)

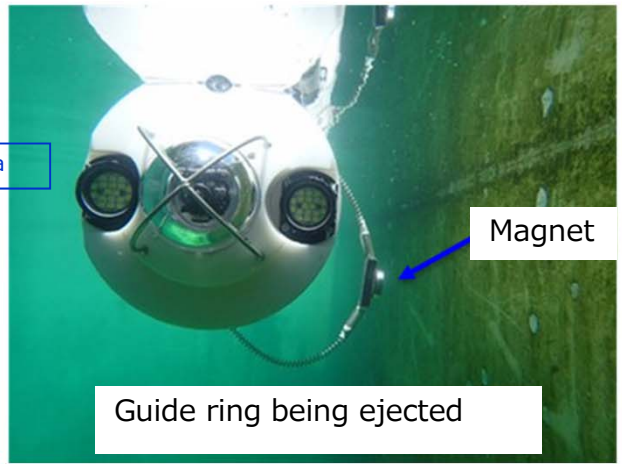
【Reference】 Investigation device details
ROV-A guide ring installation device

Investigation device	Instruments	Details
ROV-A Guide ring installation	ROV protection （Fiber-optic γ-ray dosimeter※） ※ : Same as that used for the external investigation of the pedestal	Guide rings (internal diameter: 300mm (design value)) are attached to the jet deflectors to prevent structures from interfering with the cable
	Quantity: 1 for the north and 1 for the south; Cruising time: Approx. 80 hours/unit　Since this is the first ROV to be inserted, low-friction and relatively hard polyethylene cables (φ24mm) will be employed	







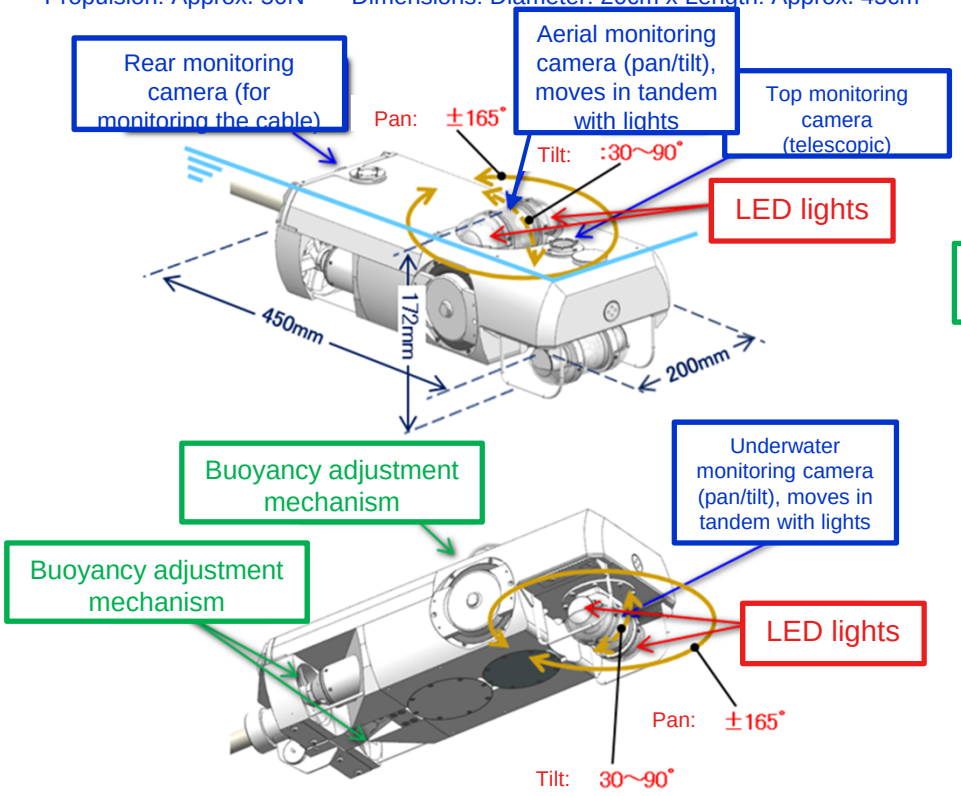


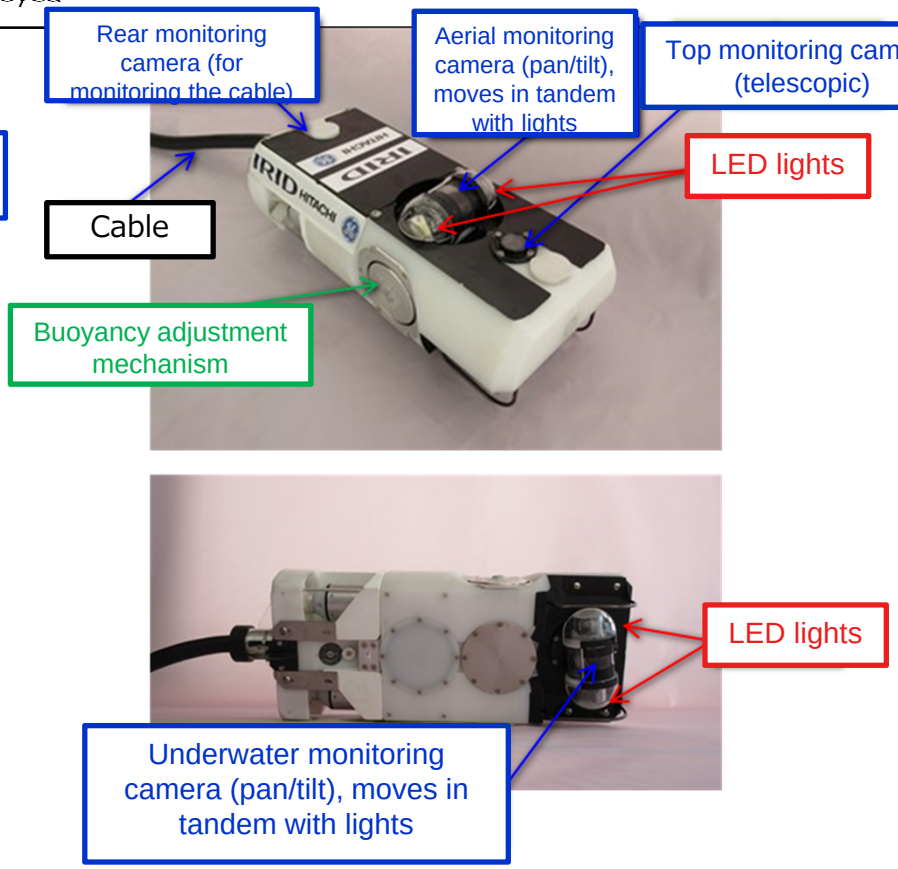
Source: International Research Institute for Nuclear Decommissioning (IRID)

【Reference】 Investigation device details
ROV-A2 For detailed visual investigation

Investigation device	Instruments	Details
ROV-A2 Detailed visual investigation	ROV protection（Fiber-optic γ-ray dosimeter※, Improved mini B10 detector) ※ : Same as that used for the external investigation of the pedestal	Uses cameras to perform a visual investigation of the extensive basement area and of the status of the detached CRD housing inside the pedestal （※） （※If it can be accessed）
	Quantity: 2 units; Cruising time: Approx. 80 hours/unit Since the units need to be agile for the investigation flexible PVC cables (φ23mm) will be employed	

Propulsion: Approx. 50N　Dimensions: Diameter: 20cm x Length: Approx. 45cm

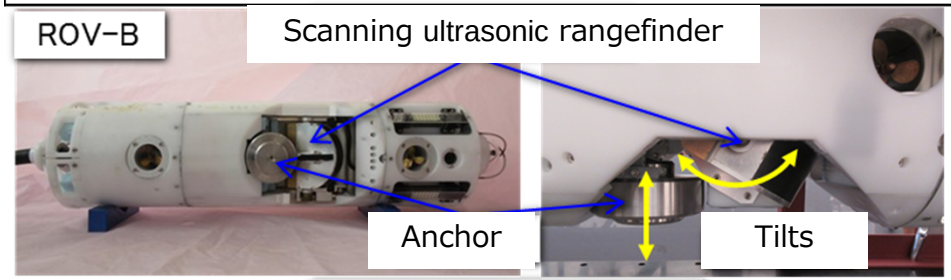


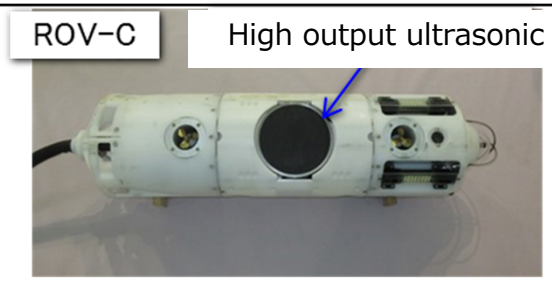


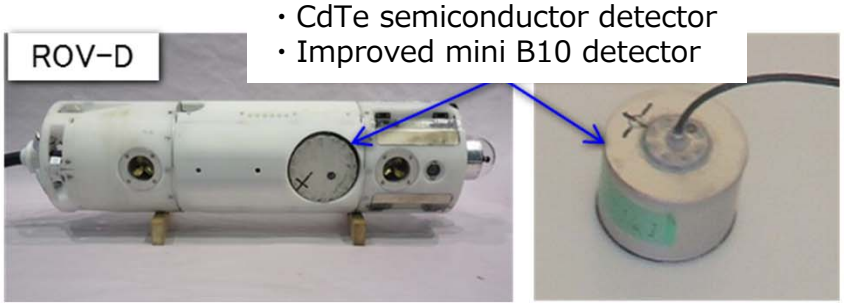
Source: International Research Institute for Nuclear Decommissioning (IRID)

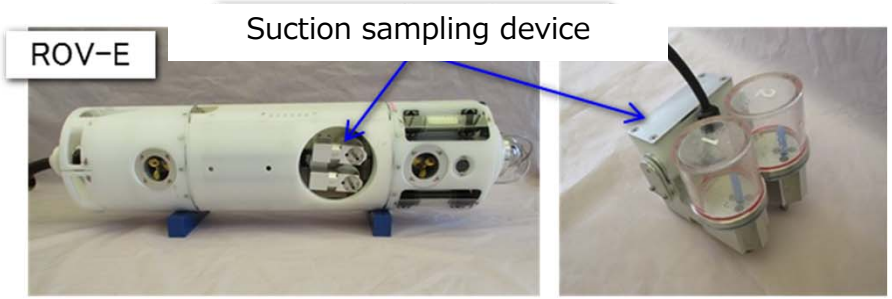
【Reference】 Investigation device details
ROV-B~E for different investigations

Investigation device	Instruments	Details
ROV-B 3-D mapping of deposits	・Scanning ultrasonic rangefinder ・Water temperature gauge	Scanning ultrasonic rangefinder used to examine the height distribution of deposits.
ROV-C Deposit thickness measurements	・High output ultrasonic sensor ・Water temperature gauge	High output ultrasonic sensor used to measure the height of deposits and examine objects underneath them in order to estimate debris height and distribution.
ROV-D Deposit debris detection	・CdTe semiconductor detector ・Improved mini B10 detector	Debris detection sensors will be dropped on the surface of the deposits to analyze nuclides and measure neutron flux in order to examine if debris exists inside the deposits.
ROV-E Deposit sampling	・Suction sampling device	The deposit sampling device will be dropped on the surface of the deposits to take samples from the surface of the deposits.
Quantity: 2 each; Cruising time: Approx. 80 hours/unit Since the units need to be agile for the investigations flexible PVC cables (ROV-B : φ33mm、ROV-C : φ30mm、ROV-D : φ30mm、ROV-E : φ30mm) will be employed		









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