Fukushima Daiichi Nuclear Power Station Unit 2

Results of RPV internal investigation using the existing reactor water level instrument pipe

April 23, 2026

TEPCO

Tokyo Electric Power Company Holdings, Inc.

1. Overview

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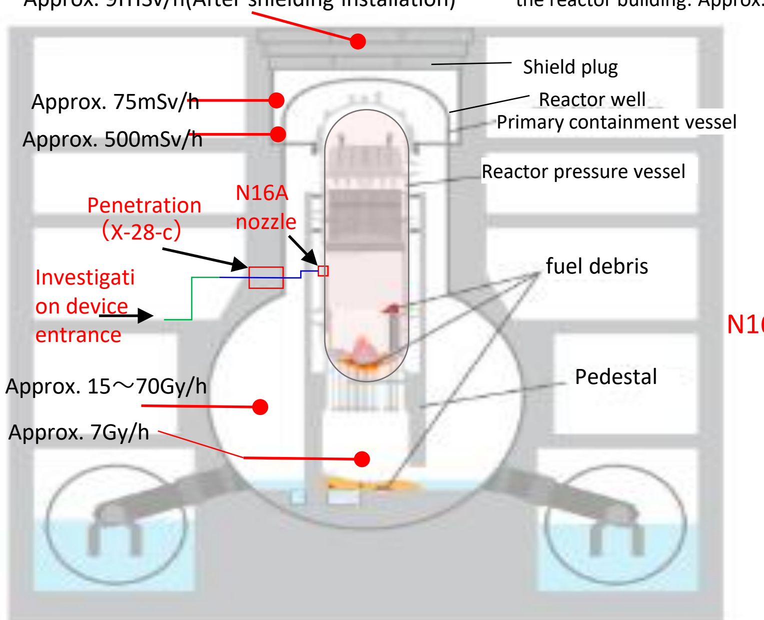
- On April 14, we began inserting a fiberscope with built-in small dosimeter into the reactor water level instrument pipe, which is connected to the N16A nozzle, and reached the N16A nozzle on April 15.
- On April 16, the fiberscope was inserted into the RPV to implement an internal investigation of the RPV. After examining the shroud, which is directly in front of the N16A nozzle, we confirmed the jet pump while the fiberscope was lowered to the bottom of the reactor and then obtained dose rate data and footage from inside the RPV approximately 6m below※ the N16A nozzle.

※The distance from the N16A nozzle (amount of descent) was estimated by the amount of fiberscope that had been inserted and does not consider bends in the fiberscope.

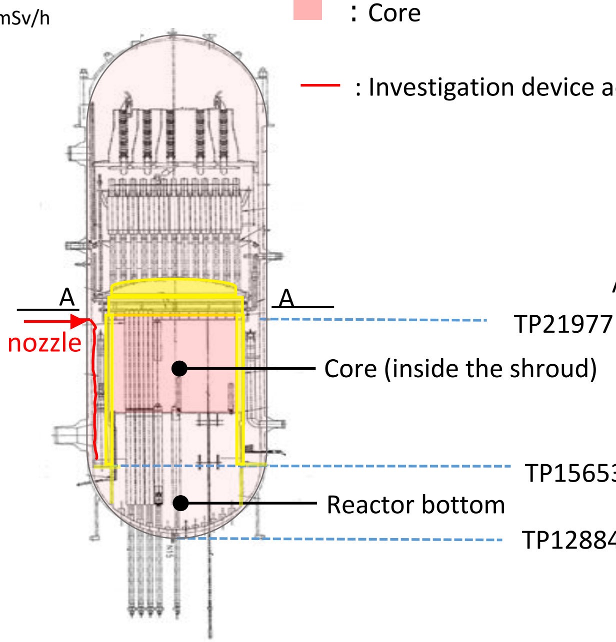
RPV: Reactor pressure vessel
JP：Jet pump

—— ： Existing reactor water level instrument pipe (25A, Approx. 8m)
—— ： New pipes (permanent, temporary) (25A, Approx. 7m)

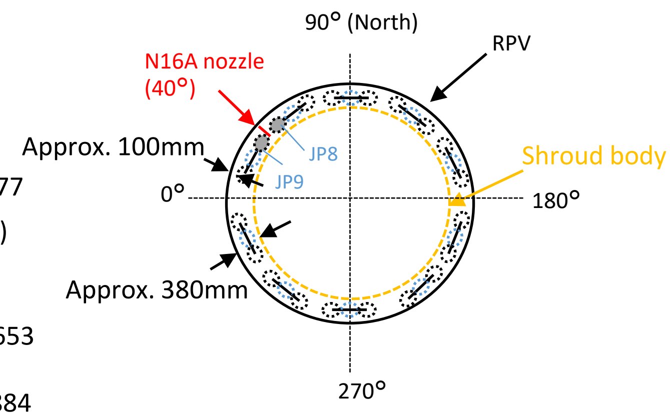
：RPV
：Shroud (Including head, body, and support)
：Core
—— : Investigation device access route (estimated)



Unit 2 reactor building conditions



Reactor internal structures and scope of investigation



The scope of visual confirmation and cross sectional diagram A-A

2-1. Investigation results (dose rate data from inside the RPV)

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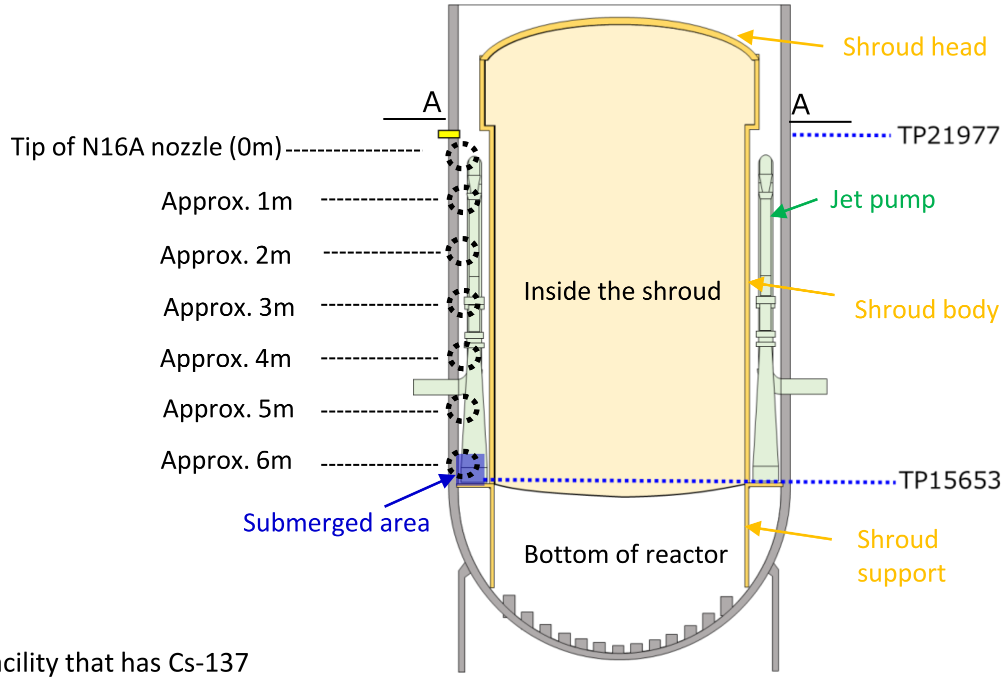
- Maximum dose rate (Cs-137 conversion) was approx. 4.7Gy/h (reference value※1).
- Dose rates tended to increase as the fiberscope was lowered until to approximately 4m below the N16A nozzle, after which the rate tended decrease.

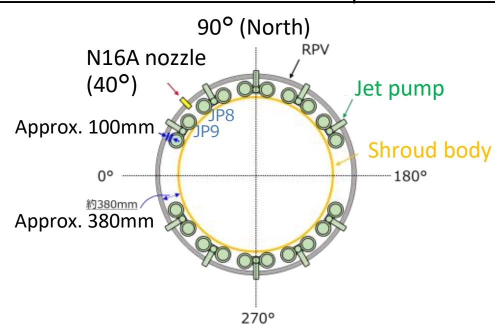
  ✓ Whereas it's difficult to estimate the position of fuel debris, we can infer that dose distribution tendencies (peak locations, etc.) differ from those of a normal reactor.

Distance from the N16A nozzle※2	Dose rates inside the RPV	
	Cs-137 conversion (Reference value※1)	Co-60 conversion (Reference value※1)
0m	Approx. 0.9Gy/h	Approx. 2.2Gy/h
Approx. 1m	Approx. 2.7Gy/h	Approx. 5.7Gy/h
Approx. 2m	Approx. 3.4Gy/h	Approx. 6.8Gy/h
Approx. 3m	Approx. 3.9Gy/h	Approx. 7.7Gy/h
Approx. 4m	Approx. 4.7Gy/h	Approx. 9.1Gy/h
Approx. 5m	Approx. 2.1Gy/h	Approx. 4.6Gy/h
Approx. 6m	Approx. 0.6Gy/h	Approx. 1.5Gy/h



Reactor internal structures and scope of investigation

The small dosimeter used for this investigation was calibrated in an irradiation facility that has Cs-137 and Co-60 radiation sources. The relationship between dose rate and the current outputted from the small dosimeter was drawn as an approximation curve and the difference with conventional radiation intensity was calculated. The size of this discrepancy was treated as the margin of error. The margin of error is approximately 17% for Cs-137 and approximately 39% for Co-60.



The scope of visual confirmation and cross sectional diagram A-A

※1 The small dosimeter used for this investigation is unique in that the response changes depending on the spectrum, so the dose rates of radiation sources observed in the field are displayed as reference values as if those radiation sources were Cs-137 and Co-60.

※2 The distance from the N16A nozzle (amount of descent) was estimated by the amount of fiberscope that had been inserted and does not consider bends in the fiberscope. Furthermore, the built-in small dosimeter sensor is located approximately 60mm behind the tip of the fiberscope.

2-2. Investigation results (footage from inside the RPV (1))

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- Shroud and jet pump footage were examined. No significant defamation of the shroud was found within the scope of the investigation.
  - ✓ The obtained footage will be subject to image processing in order to identify visible structures.

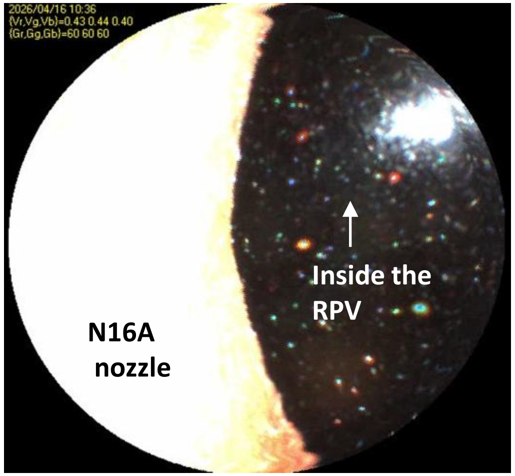


Photo ① In front of N16A nozzle

Photo ② N16A nozzle tip (0m)

Photo ③ Approx. 1m below N16A nozzle

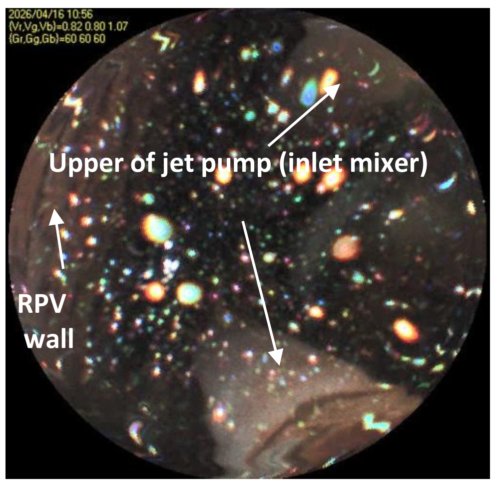
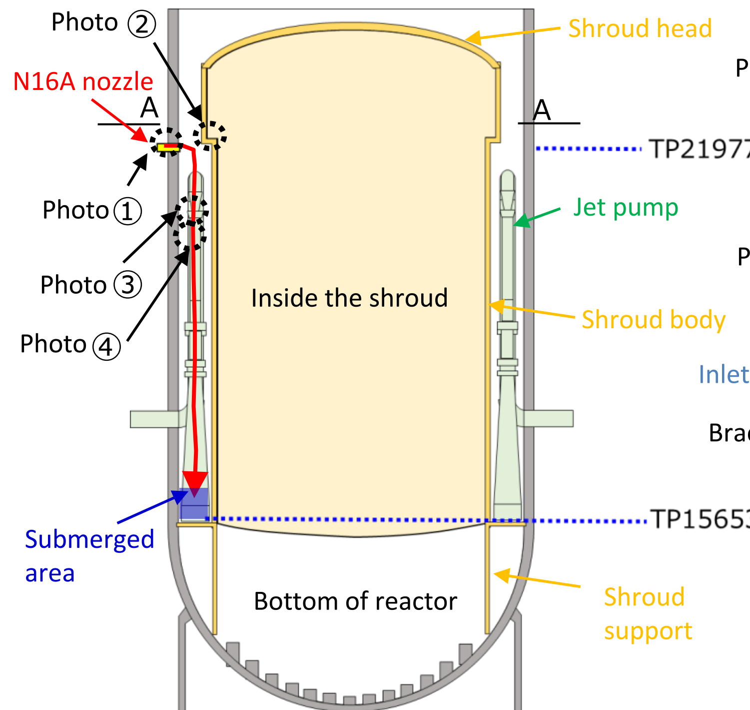
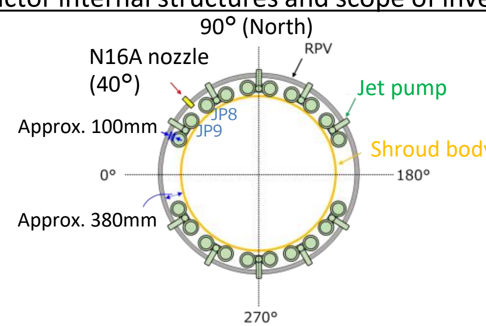


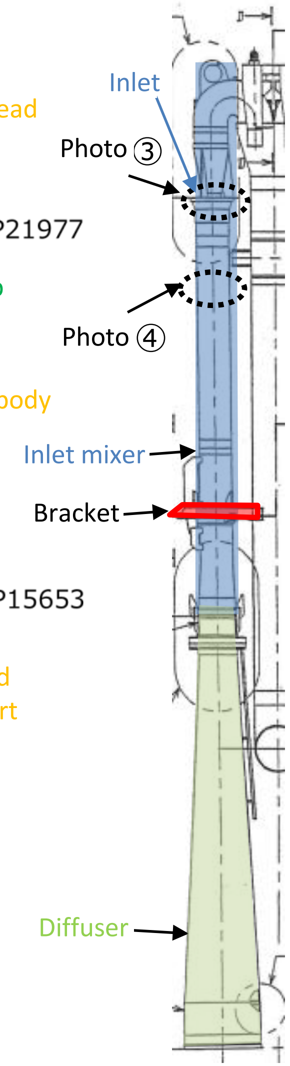
Photo ④ Approx. 1.5m below N16A nozzle



Reactor internal structures and scope of investigation



The scope of visual confirmation and cross sectional diagram A-A



Jet pump (external view)

※ The names of structures in the photos are estimates at this point in time

2-3. Investigation results (footage from inside the RPV (2))

- Shroud and jet pump footage were examined. No significant defamation of the shroud was found within the scope of the investigation.
- Approx. 6m below the N16A nozzle, the outer circumference of the shroud went from non-submerged to submerged※.
  - ✓ The obtained footage will be subject to image processing in order to identify visible structures.

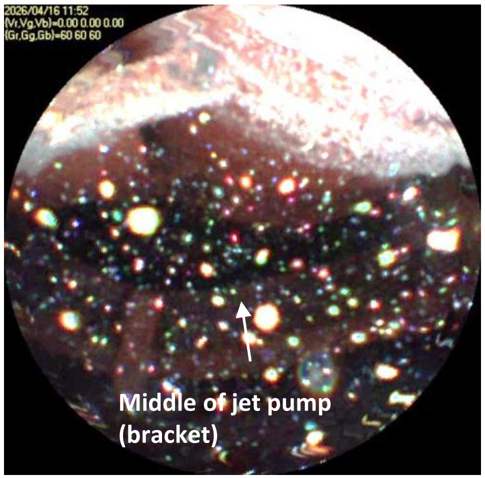


Photo ⑤ Approx. 3m below the N16A nozzle

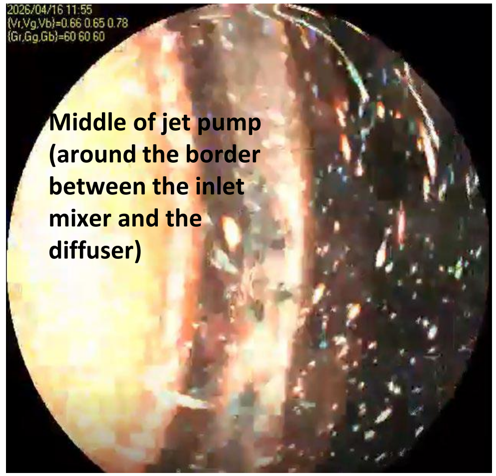


Photo ⑥ Approx. 4m below the N16A nozzle

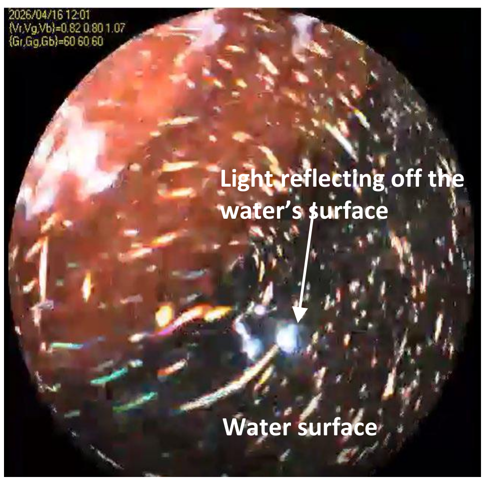


Photo ⑦ Approx. 5.5m below the N16A nozzle

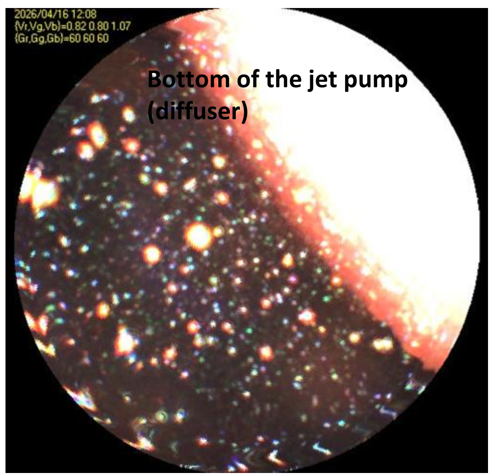
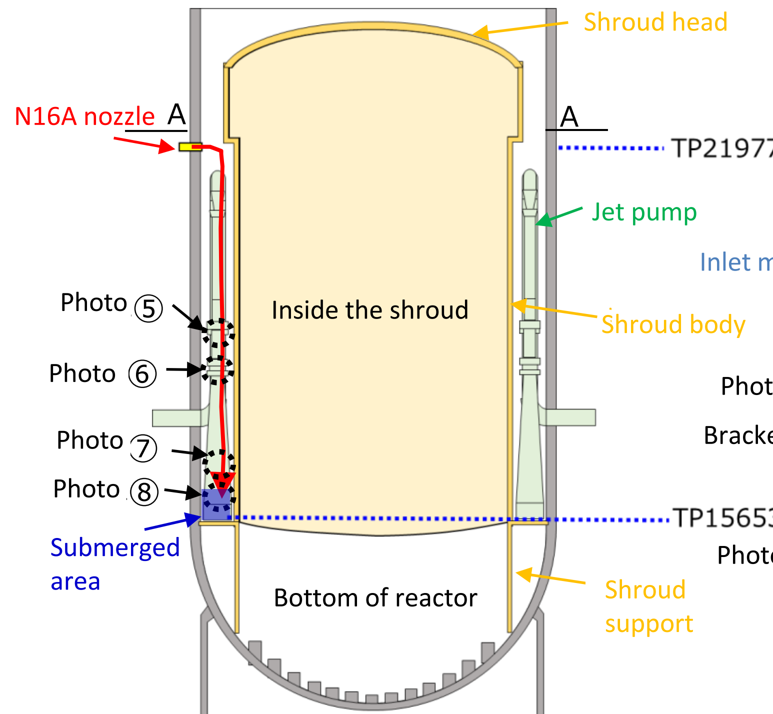
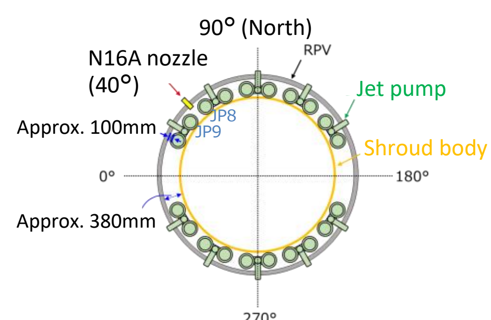


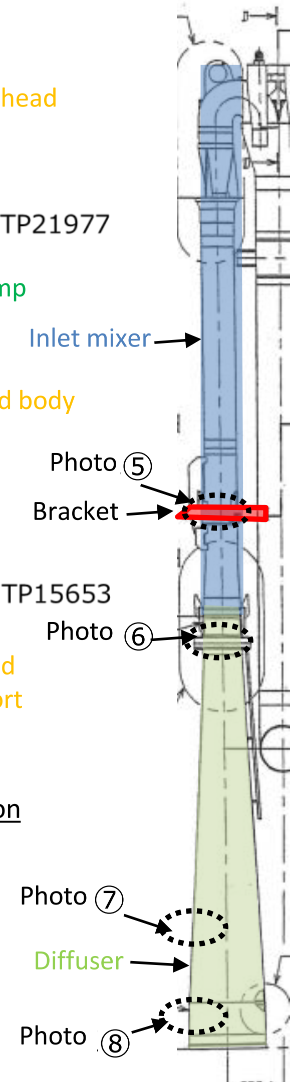
Photo ⑧ Approx. 6m below the N16A nozzle (submerged)



Reactor internal structures and scope of investigation



The scope of visual confirmation and cross sectional diagram A-A



Jet pump
(external view)

※ As the fiberscope reached the water, the light on the tip of the fiberscope could be seen reflecting off the water's surface after which the light disappeared and floating objects were observed

※ The names of structures in the photos are estimates at this point in time

3. Summary

- We were able to implement an internal investigation of the RPV using a fiberscope with a built-in small dosimeter and obtain dose rate data and footage.

- We confirmed that the existing reactor water level instrument pipe can be used to access the RPV and also that boundary equipment, such as straub couplings and water seal boundaries, can be practical application in the field.

- No large damage was found to the shroud or jet pump within the scope of the investigation.

- Whereas it’s difficult to estimate the position of fuel debris, we can infer that dose distribution tendencies (peak locations, etc.) differ from those of a normal reactor.

- The knowledge obtained through this investigation will be leveraged to perform further investigations and also to perform investigations at other reactors as we move forward with decommissioning.

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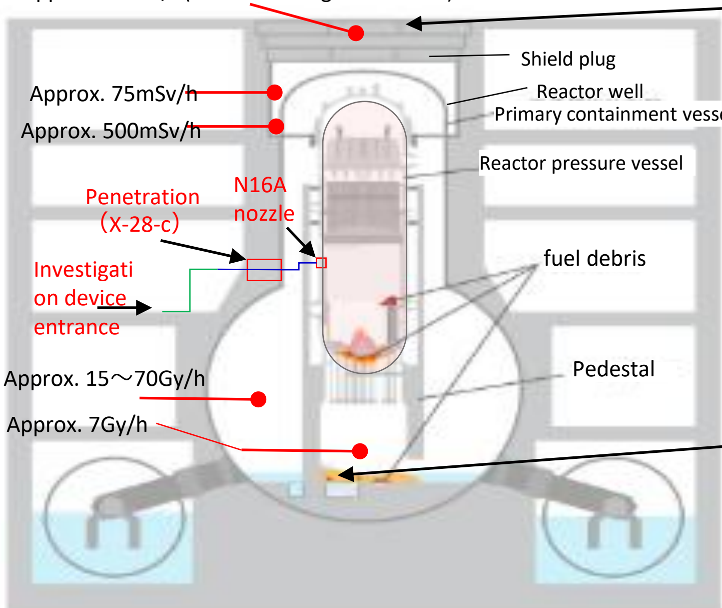
[Reference 1] Background and objectives

- Investigations required to retrieve the fuel debris that remains in the RPV have not been implemented.
- Firstly, an investigation of the inside of the RPV (outside the shroud) will be conducted using the existing Unit 2 reactor water level instrument pipe (N16A nozzle) that can be accessed quickly.
- The objective of the investigation is to use a radioactive resistant fiberscope to examine the outside of the shroud and measure dose in order to acquire information needed to perform further investigations in the future.
- Quickly ascertaining information on conditions inside the RPV, which experienced high temperatures and high pressures during the accident, is important for smoothly proceeding with decommissioning.

RPV: Reactor pressure vessel

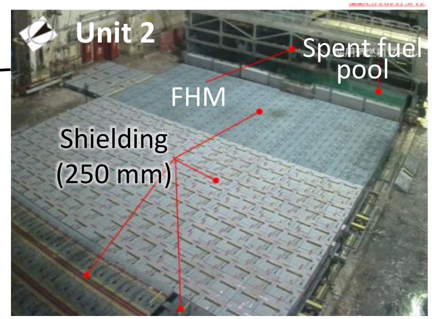
: Existing reactor water level instrument pipe

: New pipes (permanent, temporary)

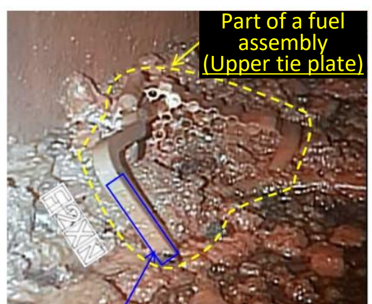


Unit 2 reactor building conditions (the inside of the RPV has not been examined)

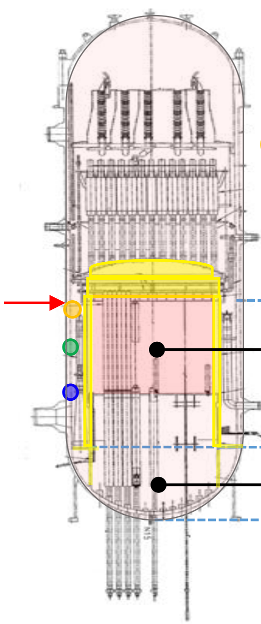
Photographed on May 12, 2022



Shielding on the operation floor



Part of a fuel assembly found outside the RPV (Upper tie plate)



※ The target distance may not be able to be reached due to conditions inside the water level instrument pipe and the state of reactor internal structures

Reactor internal structures and scope of investigation

[Reference 2] Plan overview

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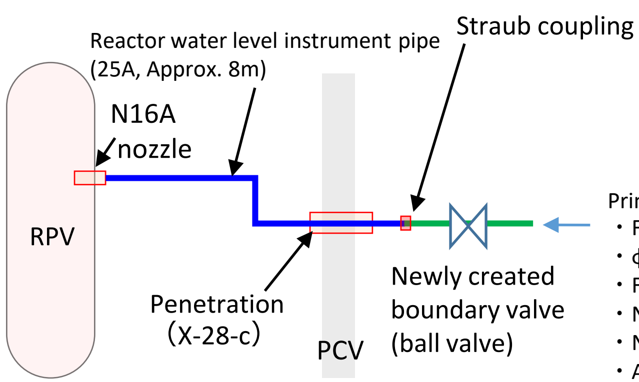
- In consideration of the field environment, the accessibility of the investigation device, the method for securing an RPV boundary, and objects that are visible, nozzle N16A, which is connected to the reactor water level instrument pipe, has been selected as the point of manual insertion of a fiberscope that will be used to perform an investigation of the inside of the RPV (first half of FY2026)
  - The development and manufacturing of a radiation resistant fiberscope※1 (which has a small internal dosimeter) that can pass through obstructions inside the pipe and access the inside of the RPV has been completed.
  - The investigation work area on the northwest side of the second floor of the reactor building has been prepared※2 and it has been confirmed that there are no significant clogs that would impact the investigation.
- Since the pipe must be cut in order to insert the fiberscope, after the investigation a new boundary will be created by newly installing a boundary valve in the pipe and the integrity of that boundary will be confirmed.

※1 Investigation device specifications are as noted below

※2 Shielding will be installed in order to reduce worker exposure during sampling from the pipes cleaning work

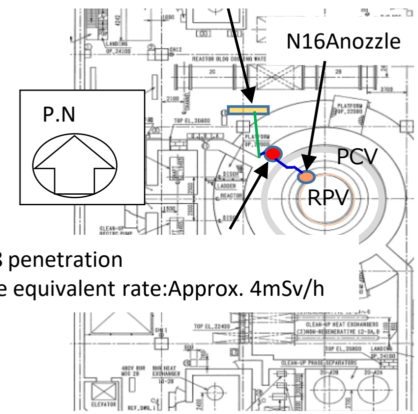


Concept diagram of RPV internal investigation

Primary specifications of the investigation device
- Fiberscope 30m
- ϕ5mm and ϕ6mm composite
- Footage acquired through laser illumination
- No pan/tilt functions
- No focus function
- Angle of view:30 degrees
- Dose rate ： Approx. 2.35kGy/h(no noise)
- Cumulative dose: Approx. 1.2MGy

PCV: Primary containment vessel
R/B: Reactor building

Work trestle
(extension of existing inspection trestle)
Dose equivalent rate: Approx. 4mSv/h



X-28 penetration
Dose equivalent rate:Approx. 4mSv/h

Unit 2 R/B 2nd floor

[Reference 3] Anticipated accomplishments

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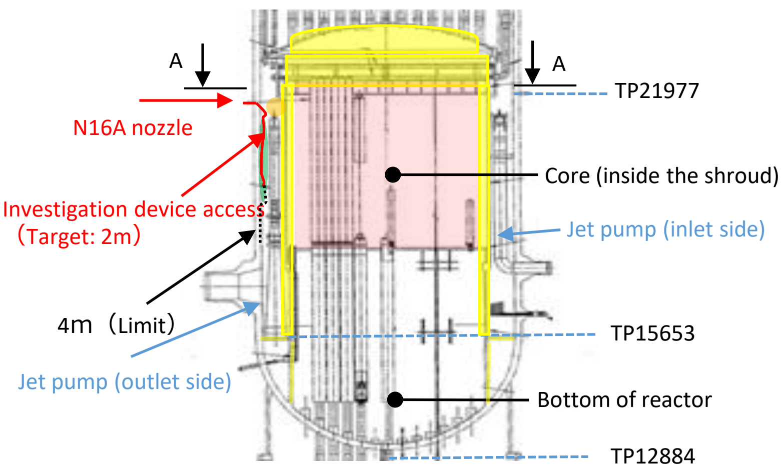
- The results obtained (footage, dose data, method feasibility) will be reflected in the decommissioning plan and enable us to move steadily forward with decommissioning.

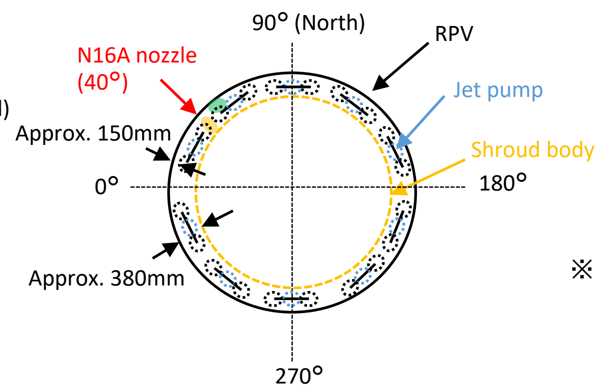
	Anticipated accomplishments	How they will be leveraged for decommissioning
Footage	・Significant deformation or tilting of reactor internal structures (shroud, etc.) ・Existence or non-existence of debris around the shroud and a water surface ・Status of reactor cooling water injection by the feed water system or core spray system	・Information used to decide the methods employed for the next investigation and retrieval ・Used for accident analysis (including predictions on how the accident unfolded at other units) ・Used to examine the effectiveness of cooling
Doses (γ-rays)	・Dose distribution inside the reactor (at the upper, middle, and bottom of the shroud)	・Used to estimate remaining fuel ・Reflected in the specifications of equipment used for investigations and during retrieval
Method feasibility	・Practical application of investigation equipment, such as fiberscopes, etc., in the field ・Practical application of boundary equipment, such as straub couplings and water seal boundaries, etc., in the field ・Practical application of manual work (freezing, investigation tasks) in the field	・Used to deliberate the same actions at other units ・Repurposing for other investigations, the removal of obstructions, retrieval

- The plan is to check the conditions inside the reactor near N16A nozzle and lower the fiberscope to the bottom of the reactor as far as possible.

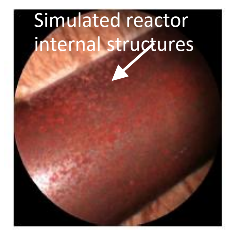
● : Scope of visual confirmation (if the tip of the investigation device reaches the vicinity of the N16A nozzle)
● : Scope of visual confirmation (if the tip of the investigation device reaches a point 2 meters below the N16A nozzle)
■ : Shroud body (including supports)
■ : Core



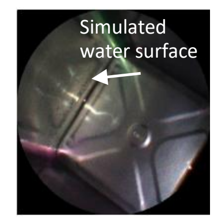
Investigation device access route and scope of visual confirmation (estimated)



The scope of visual confirmation (estimated) and cross sectional diagram A-A



Anticipated footage (Near the N16A nozzle)



Anticipated footage (4m below the N16A nozzle)

※ Footage confirming the visibility of the investigation device:
After the tip of the investigation device reaches the inside of the RPV it will be vertical around the vicinity of the N16A nozzle, but because bends will develop in the fiberscope as it maneuvers around obstructions inside the pipe, at the point two meters below the N16A nozzle, it may bend to face north of the nozzle.

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[Reference 4-1] Task details (pre-investigation preparations~investigation)

- Since the pipe must be cut in order to insert the fiberscope, after the investigation a new boundary will be created by installing a boundary valve in the pipe and the integrity of that boundary will be confirmed.
- In order to reduce the risk of gasses from inside the RPV leaking into the work area, the pipe will be frozen and the pressure of the PCV reduced when installing the new boundary valve.

① Freezing and pipe cutting

- The pipe will be flooded with filtered water. A freezing jig will be used to completely freeze the pipe after which the existing valve will be cut out with a pipe cutter.
- The inside surface of the pipe shall be examined to ensure that there are no adhesions that may impact the investigation.

② installation of a new boundary valve (permanent equipment)

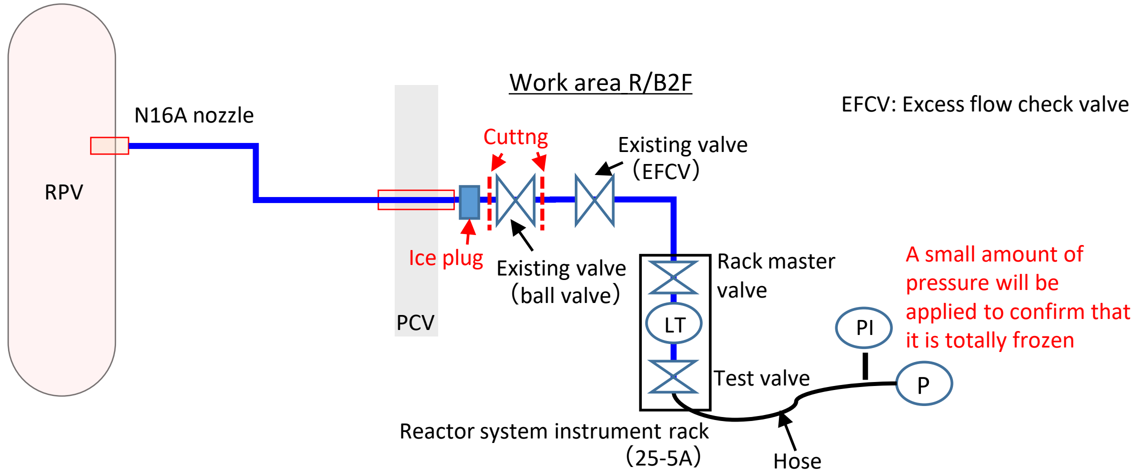
- The new boundary valve will be joined using a straub coupling.
- A leak test (atmospheric pressure) will be performed with the ice plug in place.

③ Installation of insertion spool (temporary)

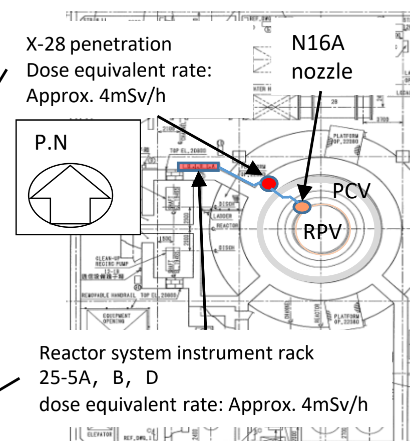
- The inside of the existing pipe will be cleaned.
- During the investigation an insertion spool would be installed in order to from a water seal boundary.
- A leak test (atmospheric pressure) of the temporary pipe will be performed
- A water seal boundary will be constructed.

④RPV Internal investigation (insertion and recovery)

- The new boundary valve will be opened and the integrity of the water seal boundary checked.
- An investigation device will be inserted up to the flow limiting orifice to examine the inside. If there are no abnormalities, the device will be inserted up to the N16A nozzle.
- The investigation will begin when the device reaches the N16A nozzle.
- After the investigation the investigation device will be withdrawn inside the investigation device recovery unit



Concept diagram of pipe freezing/cutting (X-28-c)



Unit 2 R/B 2nd floor

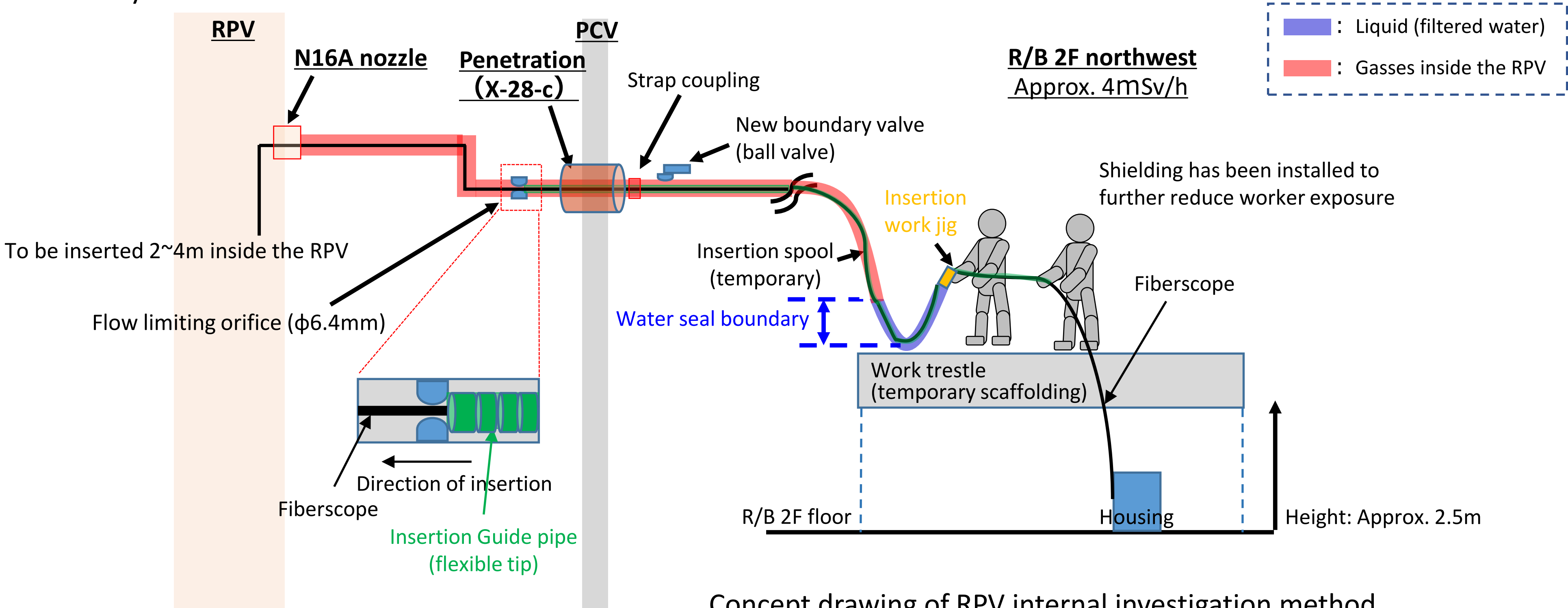
Refrigerant (dry ice + alcohol) replace regularly

Pipe cutter

A tool that does not create sparks has been chosen

[Reference 4-2] Task details (investigation)

- While the investigation is underway, a water seal boundary will be maintained and the pressure of the PCV will be reduced in order to prevent gasses inside the RPV from leaking into the work area.
- From the top of the work trestle, an insertion work jig, which is a tool for assisting insertion of the investigation device, will be used to manually insert the insertion guide pipe (flexible tip, coil spring) and investigation device simultaneously. (After passing through the flow limiting orifice, only the fiberscope will continue to be inserted)
- After reaching the inside of the RPV the investigation device will be used to touch reactor internal structures and there is a high possibility that it will be subject, such as jet pump, to αβ contamination, so in order to ensure worker safety, whether the device can be recovered or not will be decided at each step of the way as the device is withdrawn into the investigation device recovery unit.



Concept drawing of RPV internal investigation method

[Reference 5] Small dosimeter overview

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- Structure

  ・The small dosimeter is comprised of two sensors, an optical fiber (signal line) equipped with a scintillator and just an optical fiber (reference line).

- Measurement principle

  ・The scintillator emits light when exposed to γ-rays that is converted to current by the photomultiplier tube housed in the small dosimeter. The current value (A) is converted to dose rate (Gy/h).

  ・The signal line output corresponds to scintillator luminescence and the luminescence of the optical fiber itself, so the reference line output value (which corresponds to the luminescence of the optical fiber (Conversion value)) is deducted from the signal line output value to obtain the net value for scintillator luminescence.

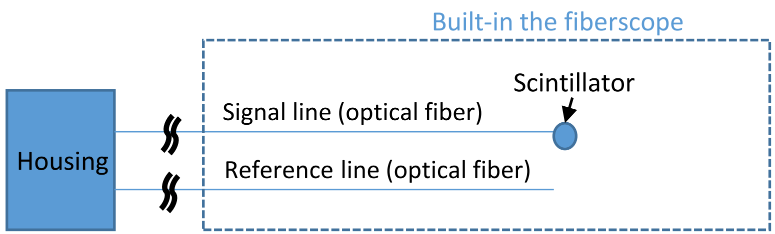
- Other information

  ・Only γ-rays can be measured. (Since the energy spectrum cannot be measured, the types of nuclides cannot be identified from the γ-rays energy.)

  ・In consideration of the types of nuclides in the RPV the small dosimeter was calibrated using Cs-137 and Co-60 radiation sources.

- Location of the built-in sensor

  ・The scintillator, which is the sensor for the small dosimeter, is located approximately 60mm behind the tip of the fiberscope.



Small dosimeter diagram