# Installation of Permanent Monitoring Instruments and Inside Investigation of Unit 2 PCV at Fukushima Daiichi Nuclear Power Station

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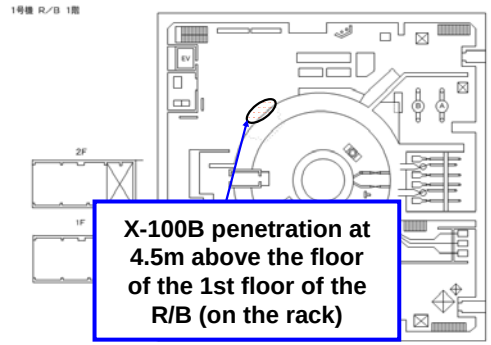
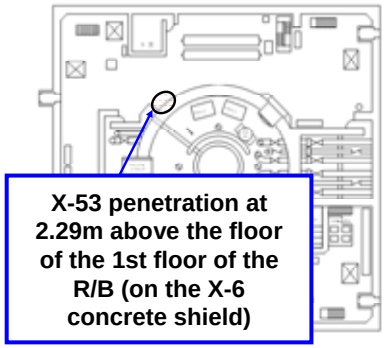
Tokyo Electric Power Company

TEPCO 東京電力

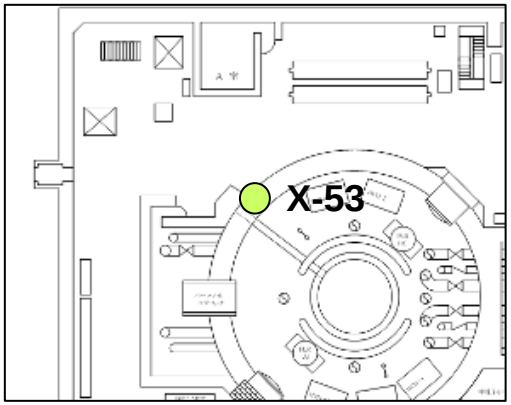
# 1. Past Investigations

| Unit | Unit 1 | Unit 2 | | Unit 3 |
|---|---|---|---|---|
| Number of investigations | 1 (First) | 1 (First) | 2 (Second) | 1 (First) |
| Supporting manufacturer | Hitachi-GE Nuclear Energy, Ltd. | Toshiba Corporation | | To be determined |
| Penetration targeted for investigation |  X-100B (Upper part of the equipment hatch) |  X-53 (Upper part of X-6 CRD inspection hatch) | | X-53 (Planned) |
| Investigation items | - Visual image acquisition<br>- Ambient temperature/dose measurement<br>- Water level and temperature measurement<br>- Sampling of accumulated water<br>- Permanent thermometer installation | - Visual image acquisition<br>- Ambient temperature measurement | - Water level and temperature measurement<br>- Ambient dose measurement | * Dose reduction measures need to be implemented due to the high radiation dose. |
| Timing | October 9-13, 2012 | January 19, 2012 | March 26-27, 2012 | — |
| Number of PCV thermometers (subject to the technical specification watch list) | 12 | 7 | | 10 |

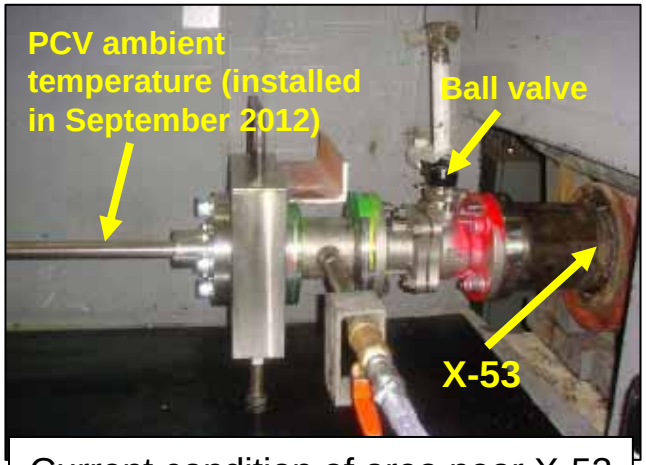
# 2. Investigation Items

After removing the PCV ambient thermometer installed in penetration X-54 (on the first floor of the Reactor Building) in September 2012, enlarge the existing φ23 hole size to φ50 in order to insert investigation equipment, etc. to investigate the following.

| Investigation item | Contents of investigation | Investigation equipment |
|---|---|---|
| Investigation of the Inside of the PCV (Government project) | - Investigation of CRD replacement rail<br>- Investigation of area near the pedestal opening | CCD camera, dosimeter, thermometer |
| Sampling of accumulated water | - Sampling and analysis of accumulated water | CCD camera, water sampling device |
| Installation of permanent monitoring instrument | - Continuous monitoring of ambient temperature and accumulated water temperature<br>- Continuous monitoring of the accumulated water level | CCD camera, thermocouple, water leakage sensor |




1st floor of Unit 2 R/B



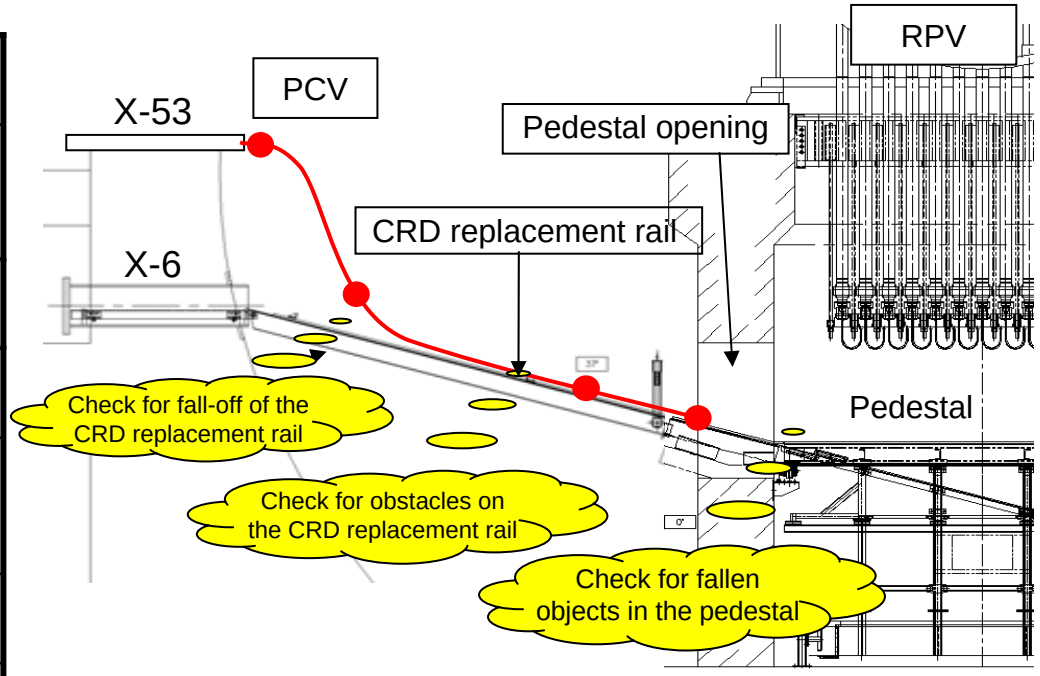

Current condition of area near X-53

# 3. Overview of the Investigation of the Inside of the PCV

The CRD replacement rail and the area near the pedestal opening will be investigated by inserting investigation equipment through X-53. The results obtained will be provided as inputs for the investigation of the inside of the PCV to be performed through X-6*.
*The investigation equipment will be inserted from X-6 to the CRD replacement rail and the inside of the pedestal.

## Investigation items

| Scope of investigation | Investigation items | Investigation equipment |
|---|---|---|
| CRD replacement rail | Appearance (near the CRD rail) | CCD camera |
| | Atmosphere dose | Dosimetry equipment |
| | Atmosphere temperature | Thermocouple thermometer |
| Area near the pedestal opening | Appearance (in the pedestal) | CCD camera |
| | Atmosphere dose | Dosimetry equipment |
| | Atmosphere temperature | Thermocouple thermometer |

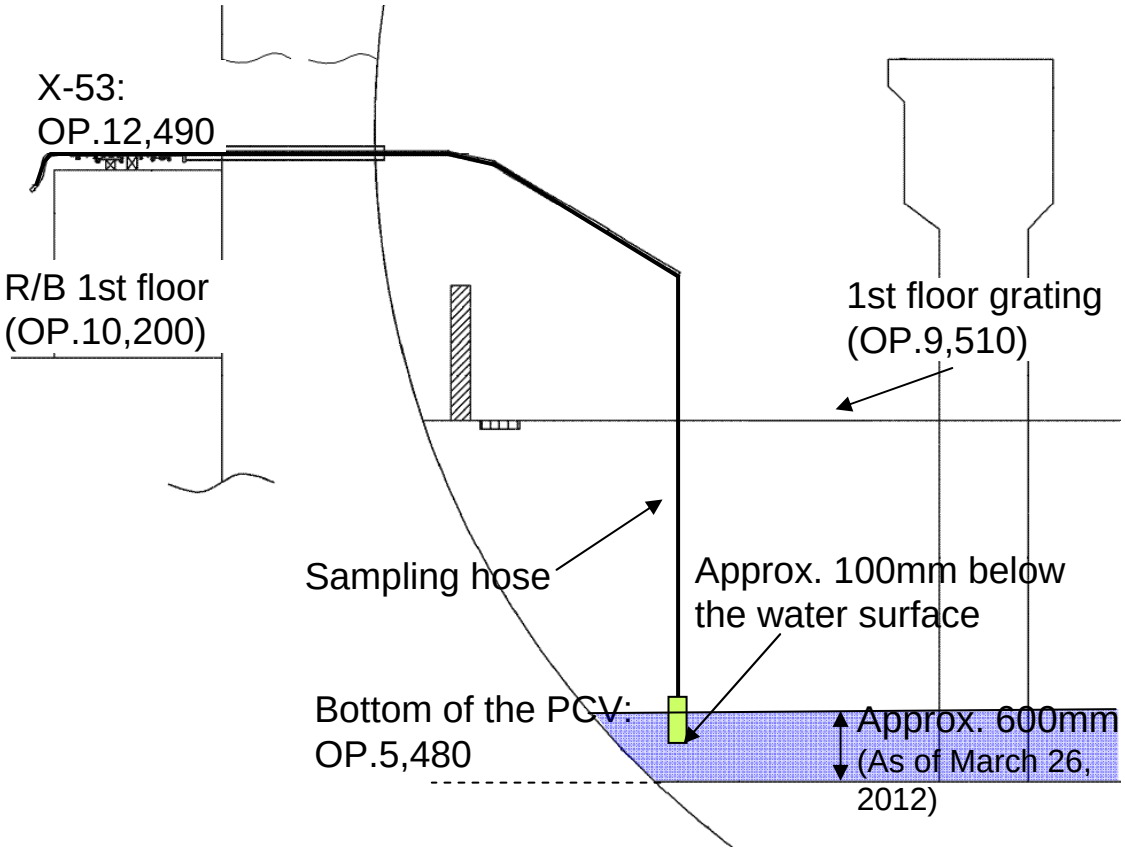



Scope of investigation of the inside of the PCV to be performed through X-53

# 4. Overview of Sampling of Accumulated Water in the PCV

Sampling hose will be inserted from X-53 to sample water at approx. 100mm below the water surface. The analysis items are planned to be the same as those performed for Unit 1.

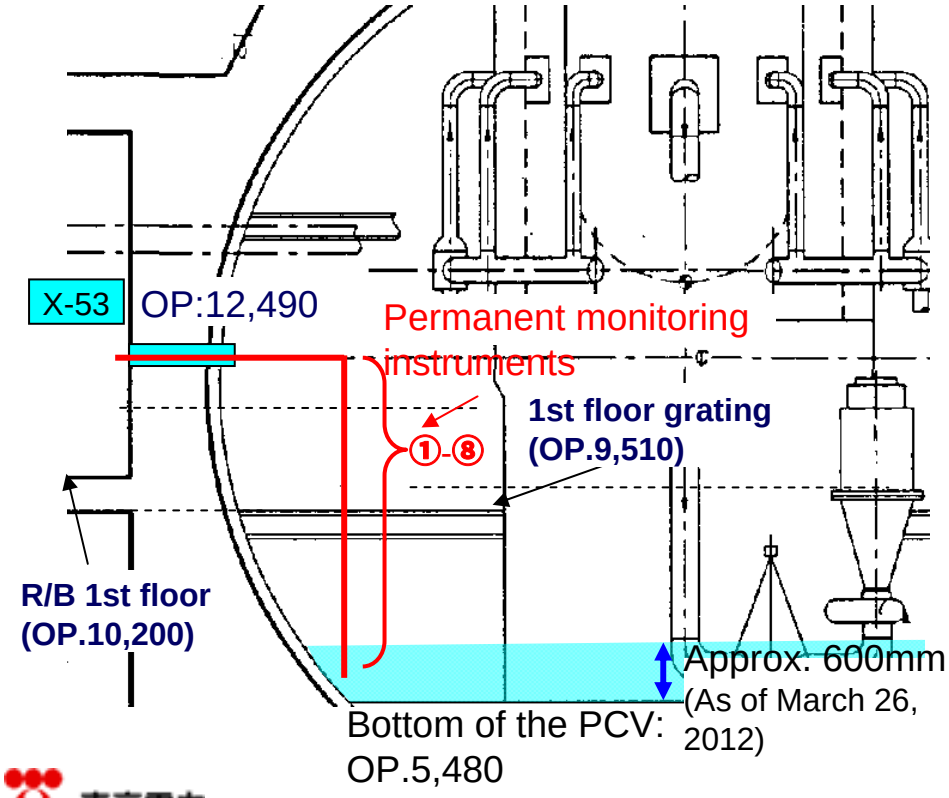
| Analysis items (Planned) | |
|---|---|
| pH | |
| Conductivity [μS/cm] | |
| Chloride concentration [ppm] | |
| γ radioactivity density [Bq/cm$^3$] | Cs134 |
| | Cs137 |
| | I-131 |
| Tritium concentration [Bq/cm$^3$] | |
| Sr89/90 densities [Bq/cm$^3$] | |
| α radioactivity density [Bq/cm$^3$] | |



# 5. Overview of Permanent Thermometer Installation in the PCV

Monitoring instruments will be inserted from X53 through the grating on the first floor in the D/W. The monitoring instruments will allow for the understanding of the temperature distribution in the height direction and water temperature measurement which will contribute to enhanced reliability of cooling monitoring.

Thermometer: Thermocouple
Water gauge: Electrode type




| | Monitoring item | | Installation location | Purpose of installation |
|---|---|---|---|---|
| | Temp. | Water level | | |
| ① | OK | — | OP.12,150 | Ambient temperature measurement (same level as the D/W HVH supply side) |
| ② | OK | — | OP.10,750 | Ambient temperature measurement (same level as the D/W HVH return side) |
| ③ | OK | — | OP.8,100 | Ambient temperature measurement |
| ④ | OK | OK | OP.6,430 | Ambient temperature measurement |
| ⑤ | OK | OK | OP.6,230 | Ambient temperature measurement |
| ⑥ | OK | OK | OP.6,030 | Water level and temperature measurement |
| ⑦ | OK | OK | OP.5,830 | Water level and temperature measurement |
| ⑧ | OK | OK | OP.5,630 | Water level and temperature measurement |

# 6. Overview of Work Implementation Procedure

Work implementation procedure

Preparation

1. Remove the existing PCV ambient thermometer

2. Remove the existing unit

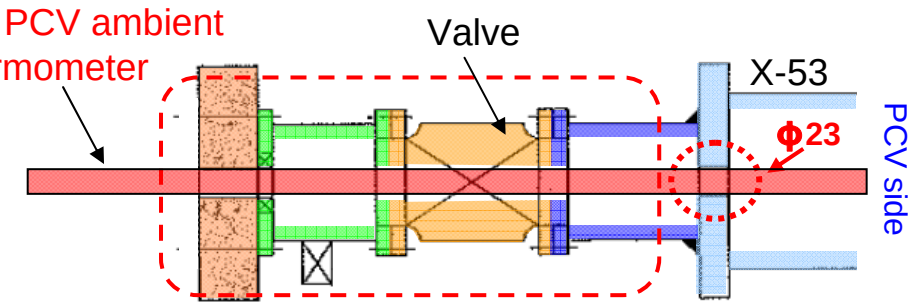
3. Install the new unit

4. Enlarge the X-53 hole diameter (from ϕ23 to ϕ50)

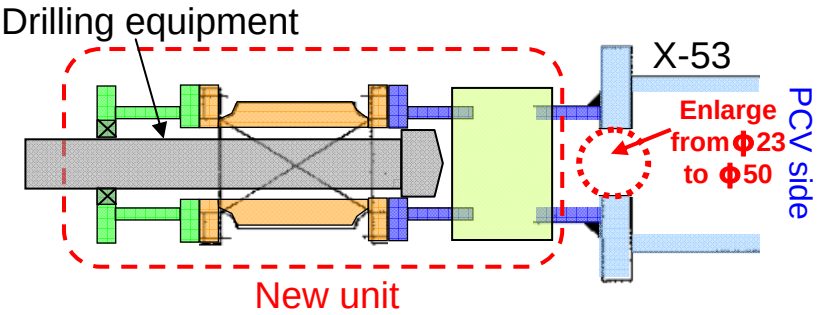
5. Investigation of the inside of the PCV

6. Sampling of the accumulated water in the PCV

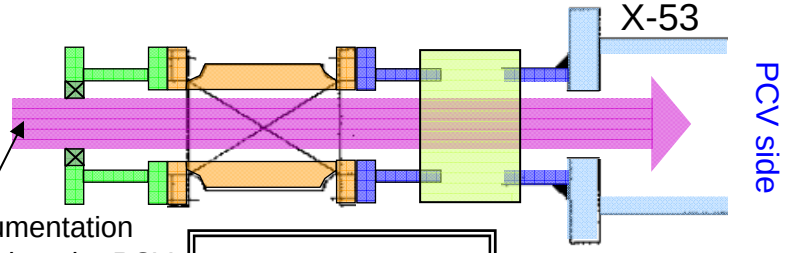
7. Install the permanent monitoring instruments in the PCV




Before procedure 1

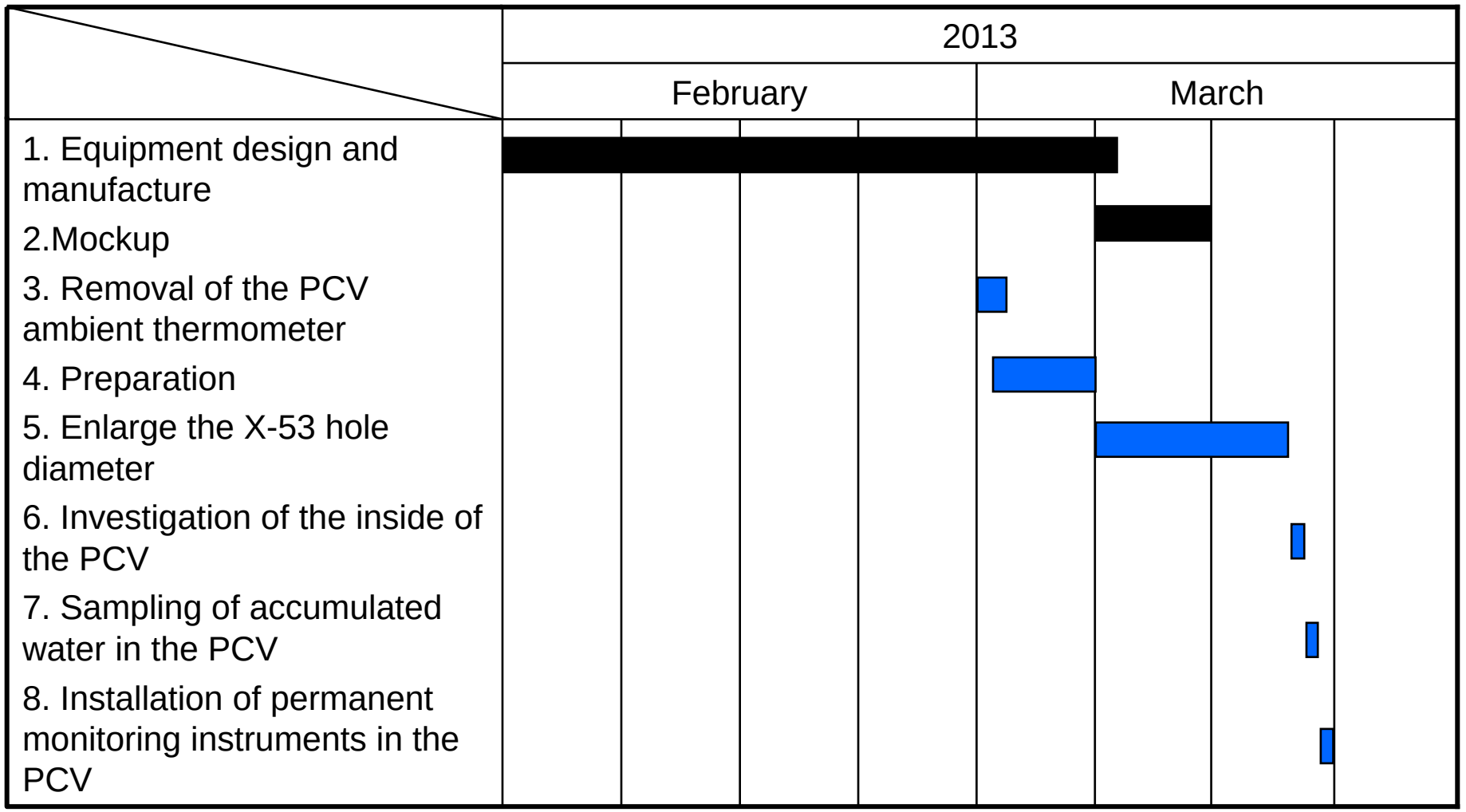



During procedure 4




Procedures 5-7

# 7. Schedule (Draft)



# Reference

# (Reference) Overview of the Equipment Used for the Investigation of the Inside of the PCV

Since X-53 and X-6 are approx. 1m (in a horizontal direction) and 2m (in a vertical direction) from each other, the investigation equipment will be guided onto the CRD replacement rail utilizing the multijoint guide pipe in order to investigate the CRD replacement rail and the area near the pedestal opening.

Specification of the investigation equipment

| Equipment | Specification |
|---|---|
| CCD camera | Size: φ19mm<br>Angle of view: Approx. 43 degrees (horizontal)/ Approx. 33 degrees (vertical) |
| Dosimeter | Detector: Ionization chamber<br>Size: φ6mm<br>Measurement range: 0-1000Gy/h |
| Thermometer (Thermocouple) | Measurement range: up to 200℃ |

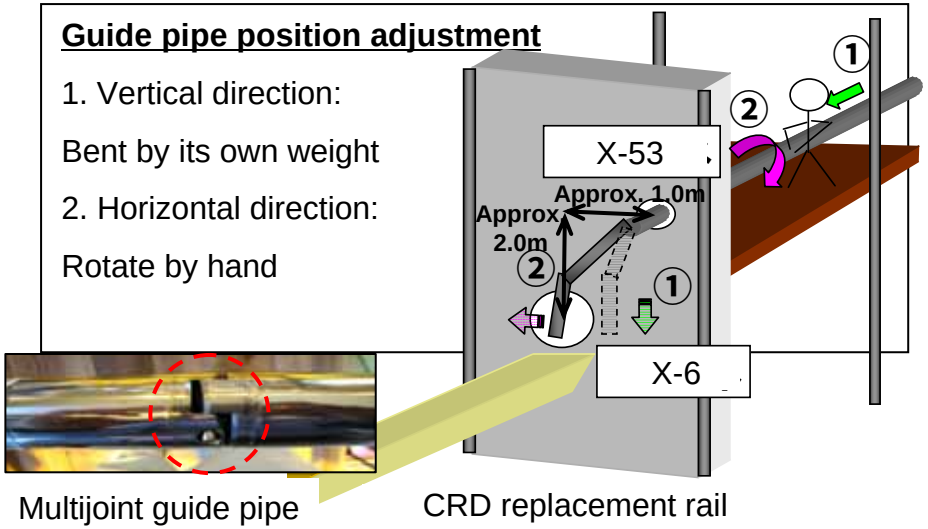
**Guide pipe position adjustment**

1. Vertical direction:

Bent by its own weight

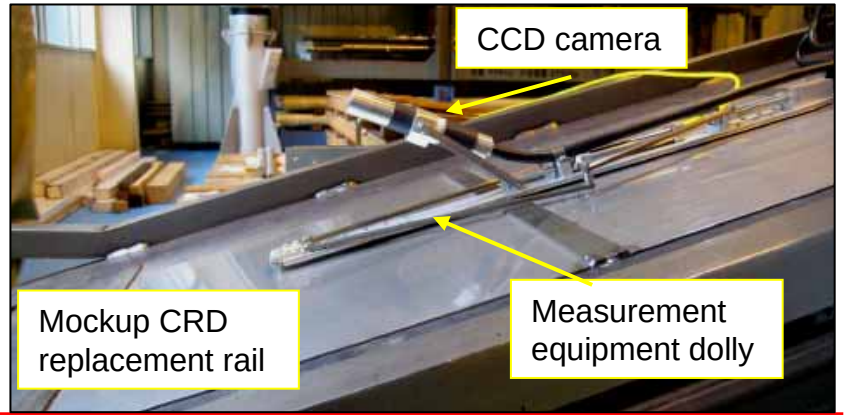
2. Horizontal direction:

Rotate by hand




- CCD camera will be used instead of endoscope and tilt function has been added to enlarge the field of view.
- The size of the investigation equipment has been reduced (smaller and thinner) to avoid obstacles in the PCV.
- The amount of time spent for investigation is reduced by inserting the camera, dosimeter and thermocouple together all at once.

**Mockup for investigation equipment insertion**



# (Reference) Removal of the PCV Ambient Thermometer

Though the two PCV ambient temperatures to be removed are subject to the technical specification watch list stipulated by Article 138 of the technical specification, the removal of these thermometers will not affect the monitoring of reactor cooling due to the following reasons.

- There are five other PCV monitoring thermometers.
- The temperature trend of the other five monitoring thermometers has been stable and it is hard to think that they fail all at the same time.