

# Fukushima Daiichi Nuclear Power Station Unit 3 Design Deliberation for Fuel Debris Retrieval Method (~~Draft~~)

**TEPCO**

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Tokyo Electric Power Company Holdings, Inc.

July 24, 2025

Change since the Sub-Committee for the Evaluation of Fuel Debris Retrieval Methods on July 23, 2025

- Cover page : Delete “draft”
- P13 diagram : Revise “Retrieval via top access (East-West work platform plan)” to “Retrieval via top access (East-West framework plan)”  
: Revise “Construction of additional building and work platform” to “Construction of additional building and framework”

## 1. Background information

[Reference] Recommendations for retrieval method selection (from the Subcommittee for the Evaluation of Fuel Debris Retrieval Methods Report)

## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

2.1 Status of discussions since receiving recommendations for retrieval method selection

2.2 Retrieval method selection deliberation plan

2.3 Fuel debris retrieval scenarios

2.4 Schedule leading up to the start of full-scale retrieval (preparatory process)

2.5 Issues requiring additional review during the preparatory process

## 3. Summary

# 1. Background information

- The series of fuel debris retrieval tasks that end with storage pose many technical challenges, and retrieval method selection is of great importance not only because technical feasibility is a factor, but also because the selected method will have an impact on the decommissioning process and resources. For this reason, the "Sub-Committee for the Evaluation of Fuel Debris Retrieval Methods"(hereinafter, Sub-Committee) was established under the NDF's Decommissioning Engineering Committee in 2023 to comprehensively deliberate and assess the retrieval of fuel debris from Unit 3 while prioritizing safety.
- After 12 rounds of discussion by the Sub-Committee, a report was compiled in March 2024 containing recommendations for retrieval method selection.
- TEPCO has been deliberating fuel debris retrieval method designs from Unit 3 based on the contents of the aforementioned report while taking into consideration the suggestions made by Sub-Committee members upon updating the Sub-Committee on the status of these deliberations approximately every quarter.
- The results of the aforementioned design deliberation have recently been compiled.

- Regardless of the retrieval method selected, it is vital that effort be made to ascertain the conditions inside the reactor and to reflect this information in design and safety assurance.



- **Begin design deliberation/R&D that combine the non-submerged method with its method options.**
- **At the same time, conduct small-scale internal investigations utilizing top access points.**

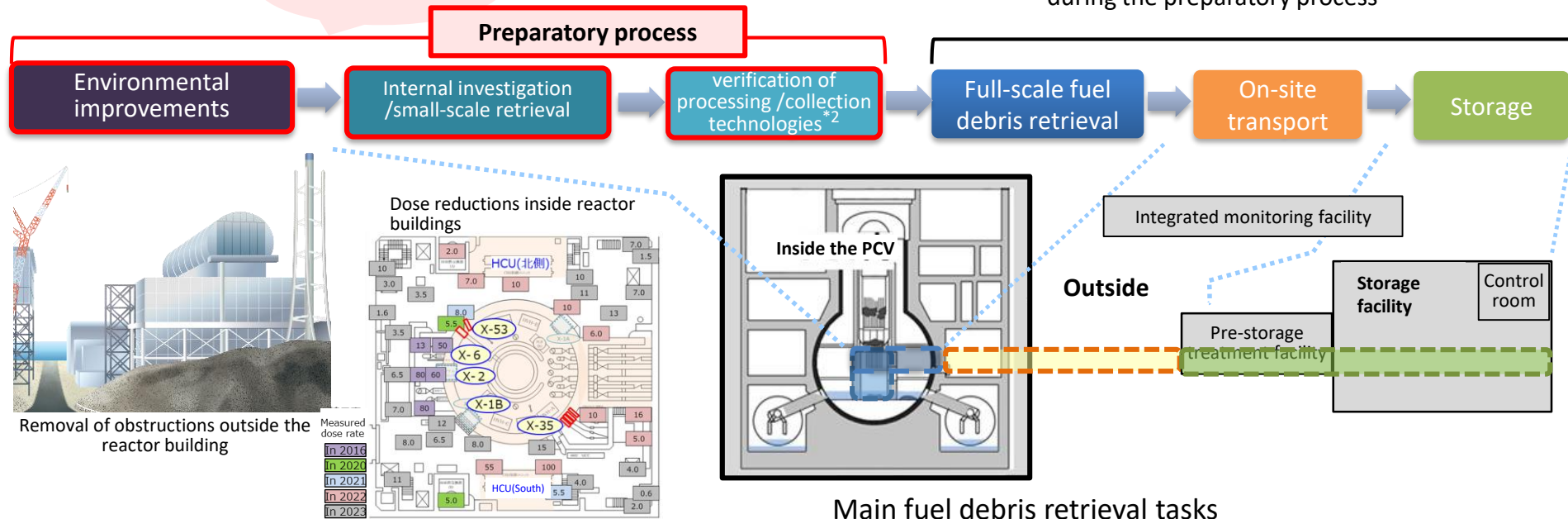
## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.1 Status of discussions since receiving recommendations for retrieval method selection **TEPCO**

- The main process for retrieving fuel debris has been established and deliberated (see the figure below).
- The Sub-Committee mainly discussed preparatory processes, such as internal investigations, small-scale retrieval, and the verification of processing/collection technologies, etc., as well as the schedule for doing so, because these issues can be presented with a certain degree technical basis after the fuel debris retrieval method has been established.
- Due to the many uncertainties about the conditions inside the PCV and the properties of the fuel debris, the process after the retrieval of the fuel debris will be reviewed based on information obtained during the preparatory process.

Only preparatory tasks and schedules can be presented with technical basis.

Review based on the information obtained during the preparatory process



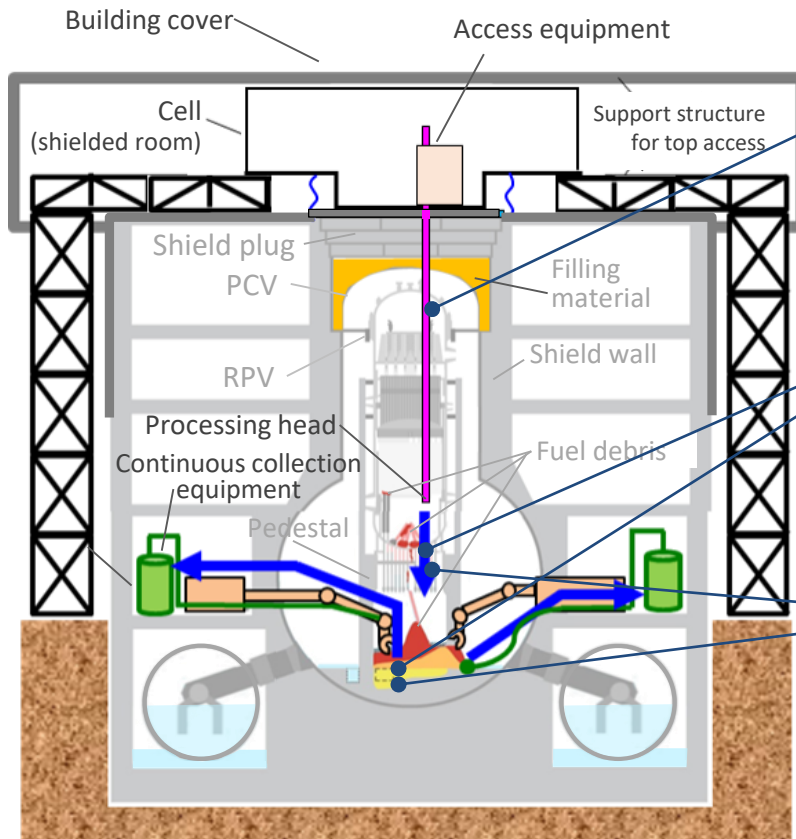
\*1: Small amount of fuel debris is collected and analyzed to ascertain composition and properties

\*2 Collect more data on dust dispersion and water quality fluctuation countermeasures related to processing and collection, etc., as well as storage

## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.2 Retrieval method selection deliberation plan (1/4)

- The concept of the fuel debris retrieval method is as follows.



➡ Fuel debris retrieval route

#### Gain access through a small opening

- ✓ Use the shielding functions of the existing shield walls
- ⇒ Minimize the size of the cells to be added

#### Standardize/simplify the handling of fuel debris (processing, collection, etc.)

- ✓ Process fuel debris into small pieces
- ✓ Continuously collect small pieces of fuel debris

#### Combine the use of top/side access openings

- ✓ Lower fuel debris processed by utilizing top access through an opening at the bottom of the RPV ⇒ Continuous collection in combination with side access
- ✓ Enables continuous collection even with side access alone

## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.2 Retrieval method selection deliberation plan (2/4)

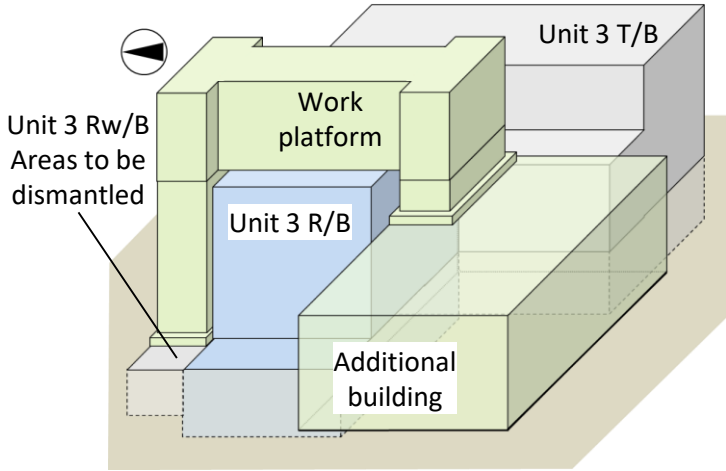
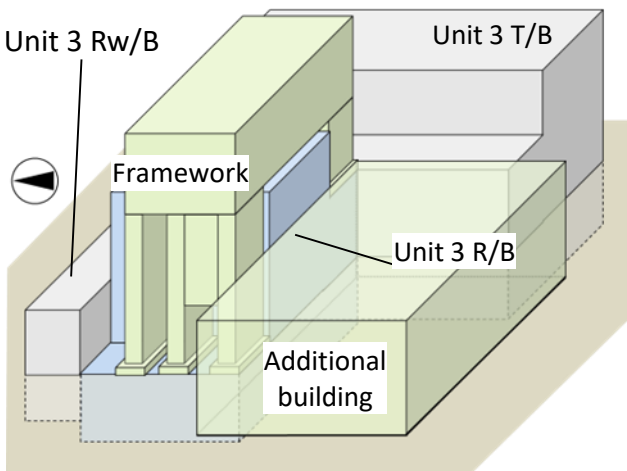
- Creating the appropriate environment (e.g., reducing doses and removing obstructions) is necessary for moving forward with fuel debris retrieval.

#### Promoting environmental improvements

- ✓ Outside the reactor building, buildings and structures that interfere with the installation of new structures have been removed.
- ✓ Inside the reactor building, the focus was put on reducing dose levels.

#### [Outside the reactor building]

- Examples of newly installed structures (support structures for top access)

Example of deliberations	North-South work platform plan	East-West framework plan
Schematic diagram	 <p>A 3D schematic diagram showing a North-South view of the reactor building area. It features a green 'Work platform' on top of a blue 'Unit 3 R/B' (Reactor Building). To the right is a grey 'Unit 3 T/B' (Turbine Building). In front of the R/B is a green 'Additional building'. A line points to a grey structure labeled 'Unit 3 Rw/B Areas to be dismantled'. A north arrow is in the top left.</p>	 <p>A 3D schematic diagram showing an East-West view of the reactor building area. It features a green 'Framework' structure on top of a blue 'Unit 3 R/B'. To the right is a grey 'Unit 3 T/B'. In front of the R/B is a green 'Additional building'. A line points to a grey structure labeled 'Unit 3 Rw/B'. A north arrow is in the top left.</p>
Expected major issues	■ Interference with Unit 3 radioactive waste treatment building (Rw/B)	■ Restrictions on the weight of installed equipment due to the load capacity of the reactor building



## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

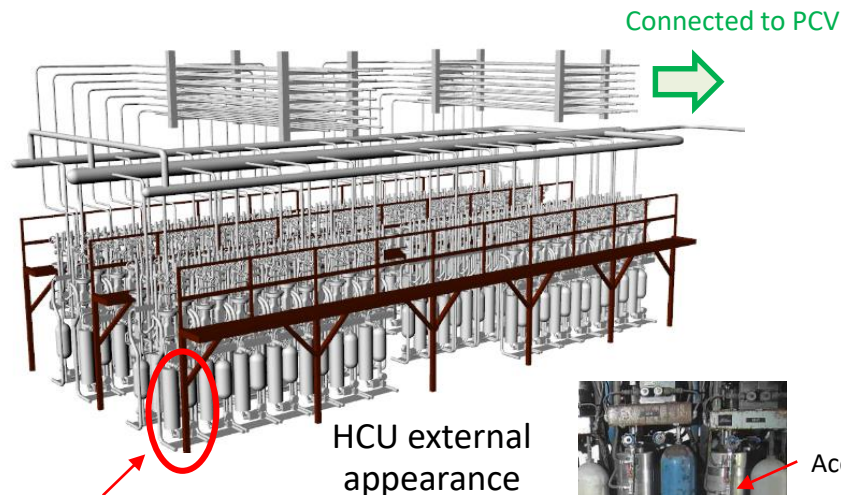
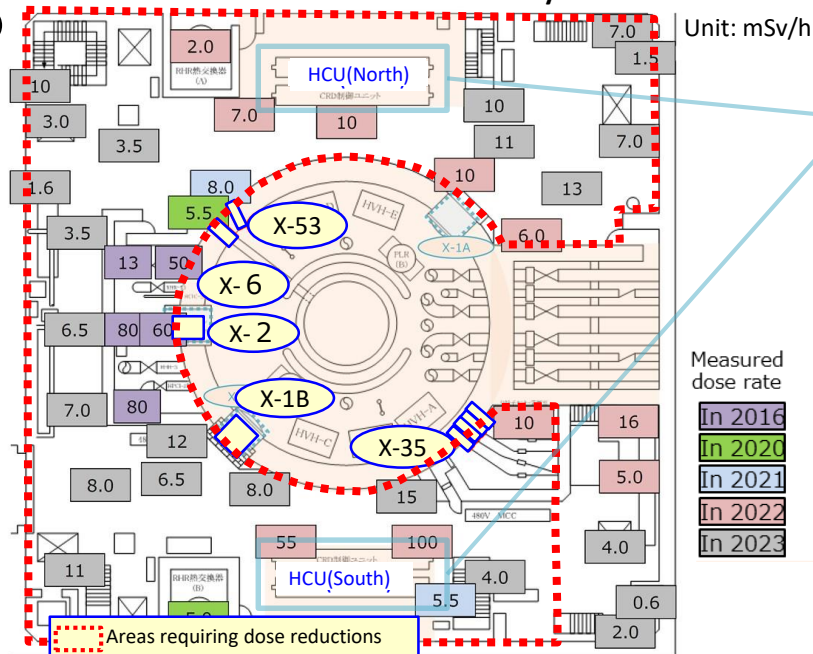
### 2.2 Retrieval method selection deliberation plan (3/4)

## Advancement of environmental improvement (cont.)

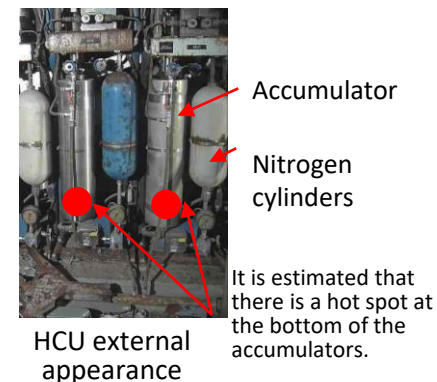
### [Inside the reactor building]

#### [First floor of the reactor building]

#### Areas where dose reductions are necessary



There are a total of 137 accumulators and nitrogen cylinders on the north and south sides.



#### [Major issues expected]

- The radiation level on the first floor of the reactor building is generally high. (Decontamination efforts to date have not been able to sufficiently reduce dose levels.)  
⇒ Going forward, hot spots will be identified and dose reduction measures, such as removal and shielding, etc., repeatedly implemented.

#### [Major issues expected]

- The HCU (CRD control unit) highly radioactive
- ✓ There are 137 units on the north and south sides of the HCU, each requiring individual handling.
- ✓ Dose levels are high because the HCU system is connected to the PCV.
- ⇒ Identify contaminated areas in the HCU, and reflect this information in the construction plan in the form of shielding or removal, etc..

\*: Dose reduction measures will be implemented on the second floor as necessary.

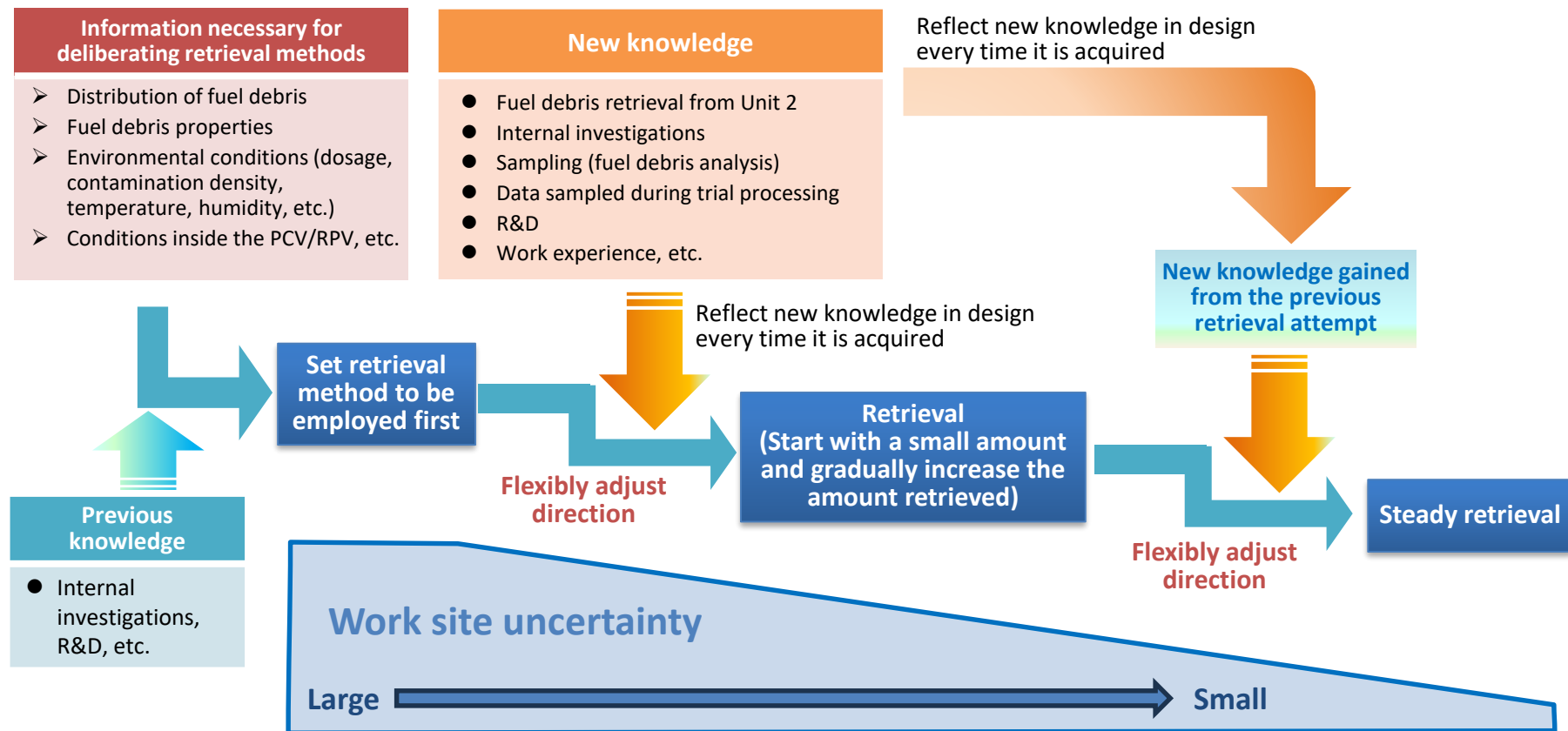


## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.2 Retrieval method selection deliberation plan (4/4)

#### Step-by-step approach

- ✓ After setting the retrieval method to be employed first, the direction of the task will be flexibly adjusted based on information that is gradually obtained.
- ✓ Small amounts will be retrieved first and the scale of retrieval gradually increased. Based on operational experience and new knowledge pertaining to the properties of the fuel debris, work tasks and equipment, etc. will be flexibly revamped culminating in steady retrieval.

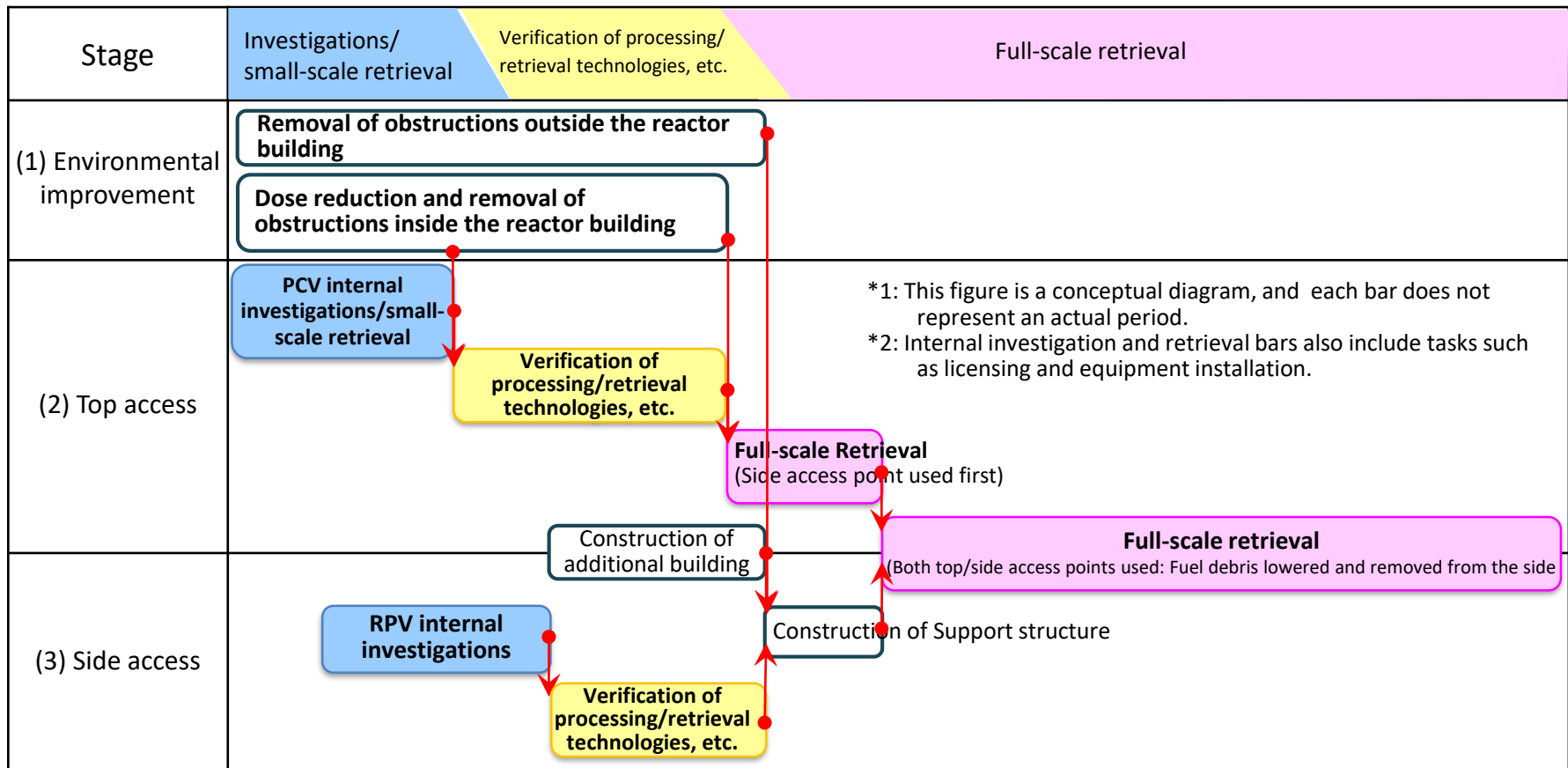


Step-by-step approach (conceptual drawing)

## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.3 Fuel debris retrieval scenarios (1/3)

- The overall fuel debris retrieval scenario involves promoting "environmental improvements" while simultaneously conducting "internal investigations/small-scale retrieval" and "verification of processing/retrieval technologies\*," which will be followed by "full-scale retrieval." The process will be carried out step by step, utilizing the information and experience gained at each stage.  
\*Collect more data on dust dispersion and water quality fluctuation countermeasures related to processing and collection, etc., as well as storage
- Access to the PCV shall be gained from above (operating floor) and from the side (penetration on the first floor of the R/B). Fuel debris shall be retrieved either by utilizing the top or side access points independently or a combination of the top/side access points. In the following example, retrieval shall be started using the side access point, after which both the top/side access points will be used in combination once the top access point is ready.



## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.3 Fuel debris retrieval scenarios (2/3)

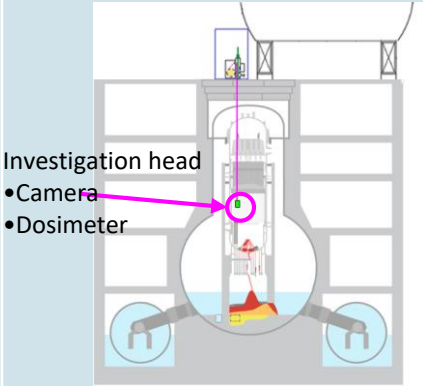
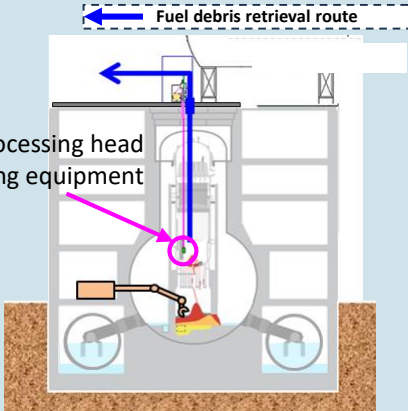
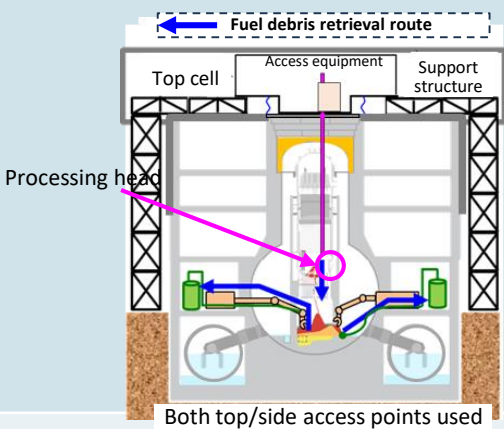
Table. Overview of each stage of fuel debris retrieval via side access

Stage	Internal investigation + small-scale retrieval	Verification of processing/ retrieval technologies, etc.	Full-scale retrieval
Schematic diagram			
Purpose	<ul style="list-style-type: none"> <li>To obtain information needed to verify processing/retrieval technologies</li> </ul>	<ul style="list-style-type: none"> <li>To obtain information needed for full-scale retrieval</li> </ul>	<ul style="list-style-type: none"> <li>To complete retrieval of fuel debris from inside and outside the pedestal</li> </ul>
Details	<ul style="list-style-type: none"> <li>Obtain data on the conditions and environments inside and outside the pedestal</li> <li>Obtain information on the distribution and quantity of fuel debris inside the PCV</li> <li>Small-scale retrieval of fuel debris, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Identify obstructions and examine the impact of dust during fuel debris processing</li> <li>Review data on water quality changes</li> <li>Retrieve particulate fuel debris, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Construct PCV internal access routes other than X-6 penetration</li> <li>Remove obstructions to secure a route for transporting objects from the pedestal access hatch</li> <li>Process fuel debris inside the PCV</li> <li>Continuously collect fuel debris inside the PCV, etc.</li> </ul>
Required environmental improvements	<ul style="list-style-type: none"> <li>Dose reduction and removal of obstructions around X-6 penetration</li> </ul>	<ul style="list-style-type: none"> <li>Reduce doses and remove obstructions in the west part of the first floor of the R/B</li> </ul>	<ul style="list-style-type: none"> <li>Reduce doses and remove obstructions around X-1B and TIP room</li> </ul>

## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.3 Fuel debris retrieval scenarios (3/3)

Table. Overview of each stage of fuel debris retrieval via top access

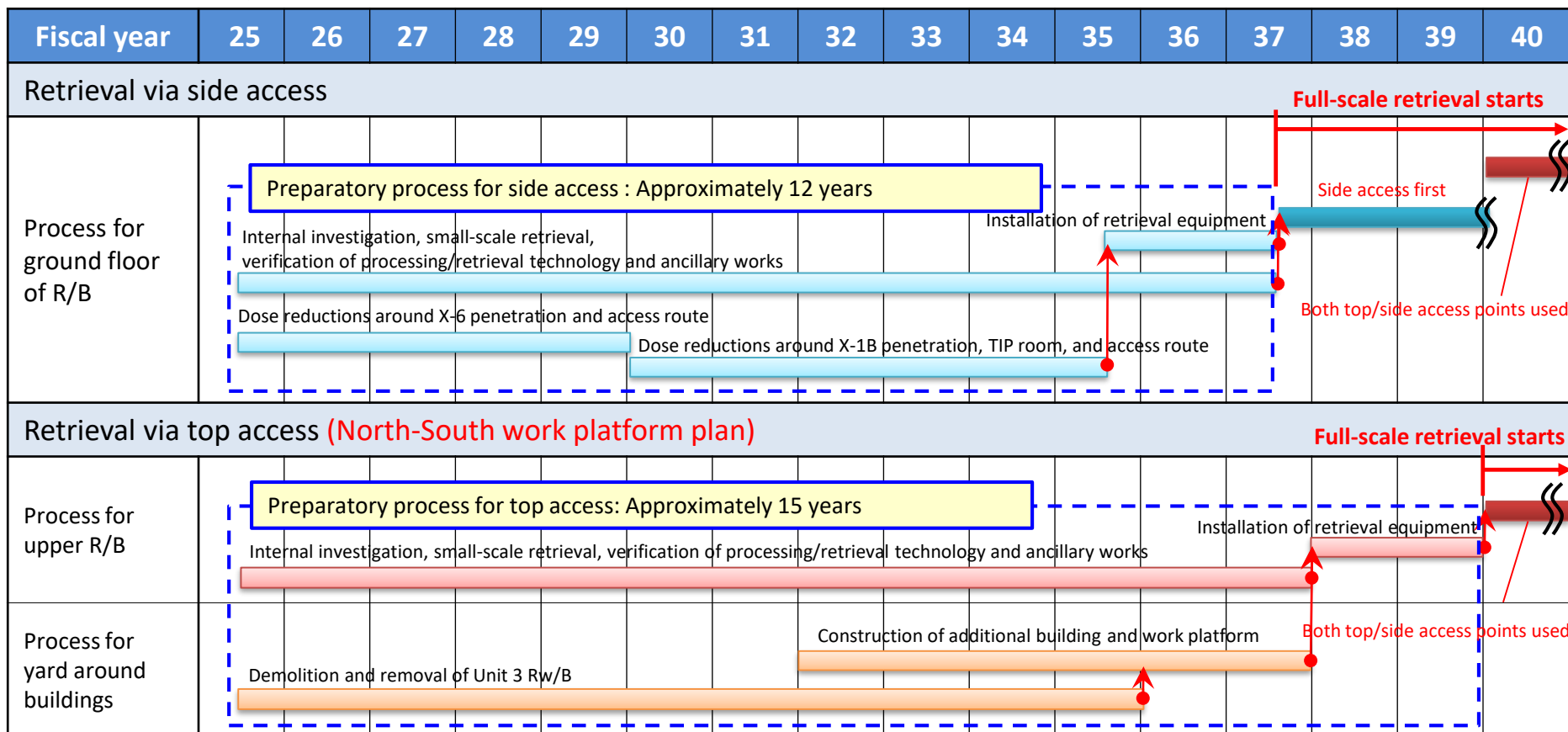
Stage	Internal investigation	Verification of processing/ retrieval technologies, etc.	Full-scale retrieval
Schematic diagram	 <p>Investigation head</p> <ul style="list-style-type: none"> <li>• Camera</li> <li>• Dosimeter</li> </ul>	 <ul style="list-style-type: none"> <li>• Trial processing head</li> <li>• Sampling equipment</li> </ul>	 <p>Both top/side access points used</p>
Purpose	<ul style="list-style-type: none"> <li>• To obtain information needed for full-scale retrieval</li> </ul>	<ul style="list-style-type: none"> <li>• To obtain information needed for full-scale retrieval</li> </ul>	<ul style="list-style-type: none"> <li>• To complete retrieval of fuel debris from inside the RPV</li> </ul>
Details	<ul style="list-style-type: none"> <li>• Check the condition of preexisting structures inside reactor</li> <li>• Construct access routes inside the RPV for investigation purposes</li> <li>• Obtain dose data</li> <li>• Acquire information on the distribution and quantity of fuel debris in the core and at the bottom of the reactor, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Collect particulate fuel debris</li> <li>• Trial process fuel debris</li> <li>• Review the impact of dust during fuel debris processing, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Construct access routes inside the RPV for retrieval</li> <li>• Secure a route for transporting fuel debris from the RPV</li> <li>• Full-scale processing of fuel debris</li> <li>• Fuel debris retrieval (side access), etc.</li> </ul>
Required environmental improvements	—	—	<ul style="list-style-type: none"> <li>• Remove structures that interfere with the installation of support structures for top access points</li> </ul>

## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.4 Schedule leading up to the start of full-scale retrieval (preparatory process)

- In this design deliberation, the process leading up to full-scale retrieval (preparatory process) was deliberated based on **certain assumptions**.
- The process following full-scale retrieval was not included in this deliberation because of the great degree of uncertainty.
- As shown on page 6, two options for the top access support structure, the north-south work platform and the east-west framework, were considered

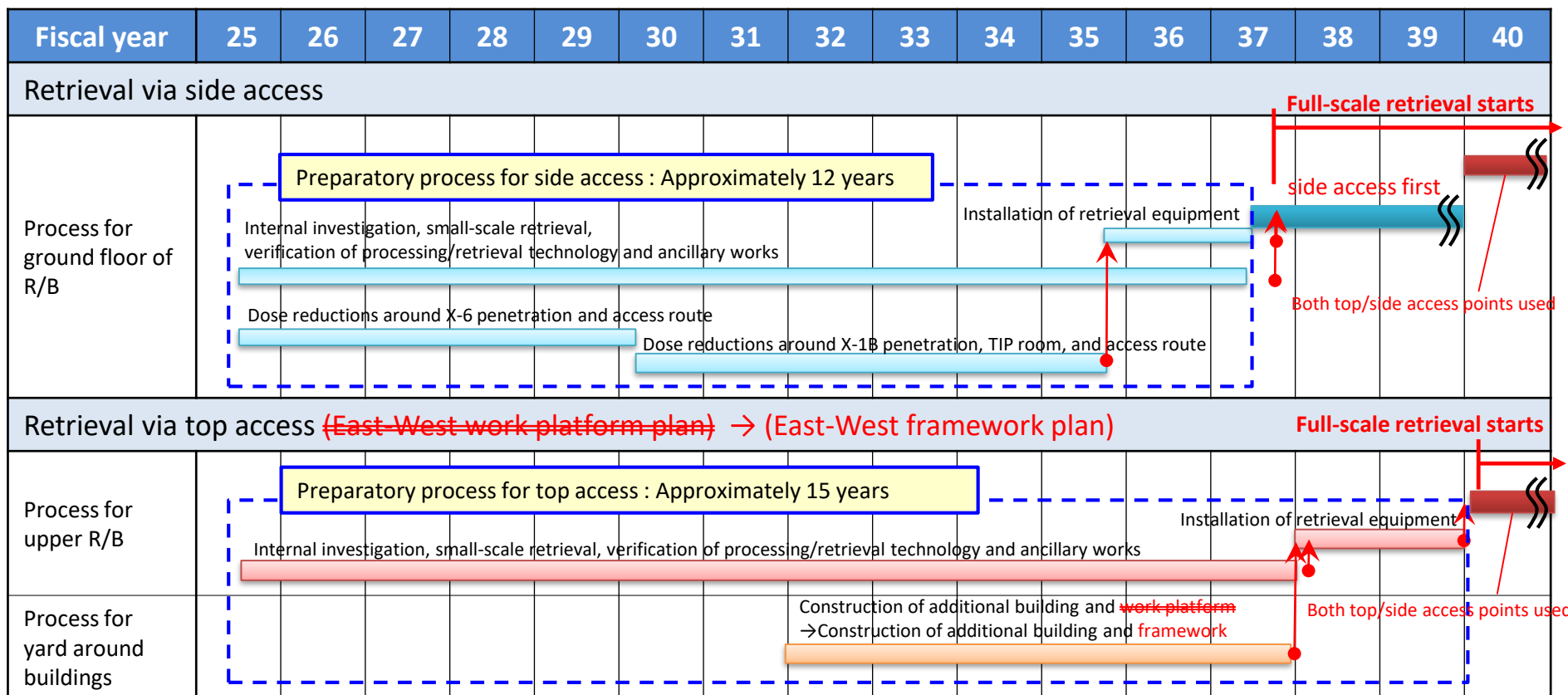
#### ■ Process if using the **North-South work platform plan**



## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.4 Schedule leading up to the start of full-scale retrieval (preparatory process)

#### ■ Process if using the **East-West framework plan**



**At present, it is estimated that approximately 12 to 15 years will be necessary to prepare the top and side access points regardless of which option (North-South work platform or the East-West framework) is employed.**

(However, the results of this deliberation are based on the assumption that progress will proceed as expected, even though there remain issues that require additional review)

**We will proceed with on-site verification/design deliberation of issues that require additional review over the next one to two years to reevaluate the feasibility.**

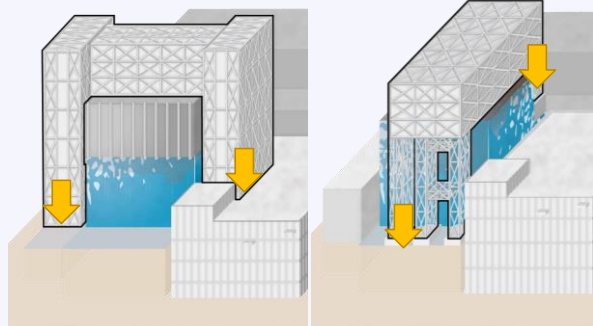
## 2. Overview of the fuel debris retrieval method design deliberation from Unit 3

### 2.5 Issues requiring additional review during the preparatory process

- Issues that require additional review (issues for which on-site information is insufficient, or issues that require further design evaluation, etc.) shall be verified on-site, and further design deliberation shall be conducted.
- The primary assumptions made and issues to be reviewed going forward are as follows:

#### Main assumption<sup>1</sup>

The load margins of the work platform/framework are sufficient for installing top access equipment

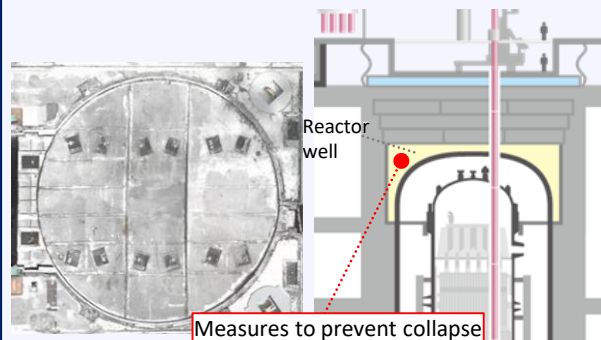


North-South work platform plan

East-West framework plan

#### Main assumption<sup>2</sup>

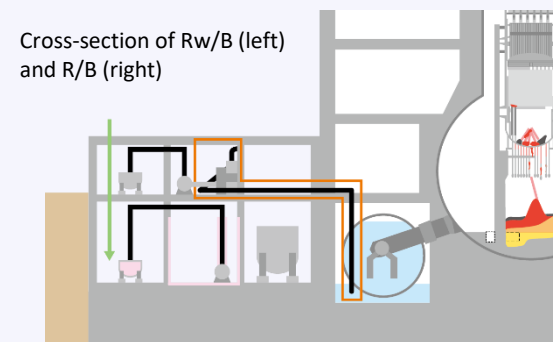
The shield plugs at the top of the PCV will not be removed during the preparatory stage



The shield plug at the top of the PCV is damaged, and measures to prevent collapse are necessary

#### Main assumption<sup>3</sup>

Other tasks can be performed during the demolition and removal of the Unit 3 Rw/B



It is necessary to remove equipment connected to the reactor building and recover highly radioactive waste.

#### ▼ Issues to be reviewed in the future ▼

[Design Verification]

Review of top access equipment

[On-site verification]

Survey of support structures for work platforms/framework (lower section and operating floor of the reactor building)

[On-site verification]

Survey of the scope of measures to prevent collapse (reactor well walls and spent fuel pool gates)

[On-site verification]

Examine how equipment to be removed interferes with other tasks, review subfloor doses, investigate the properties of highly radioactive resin\*

\*: Used to purify reactor coolant during reactor operation.



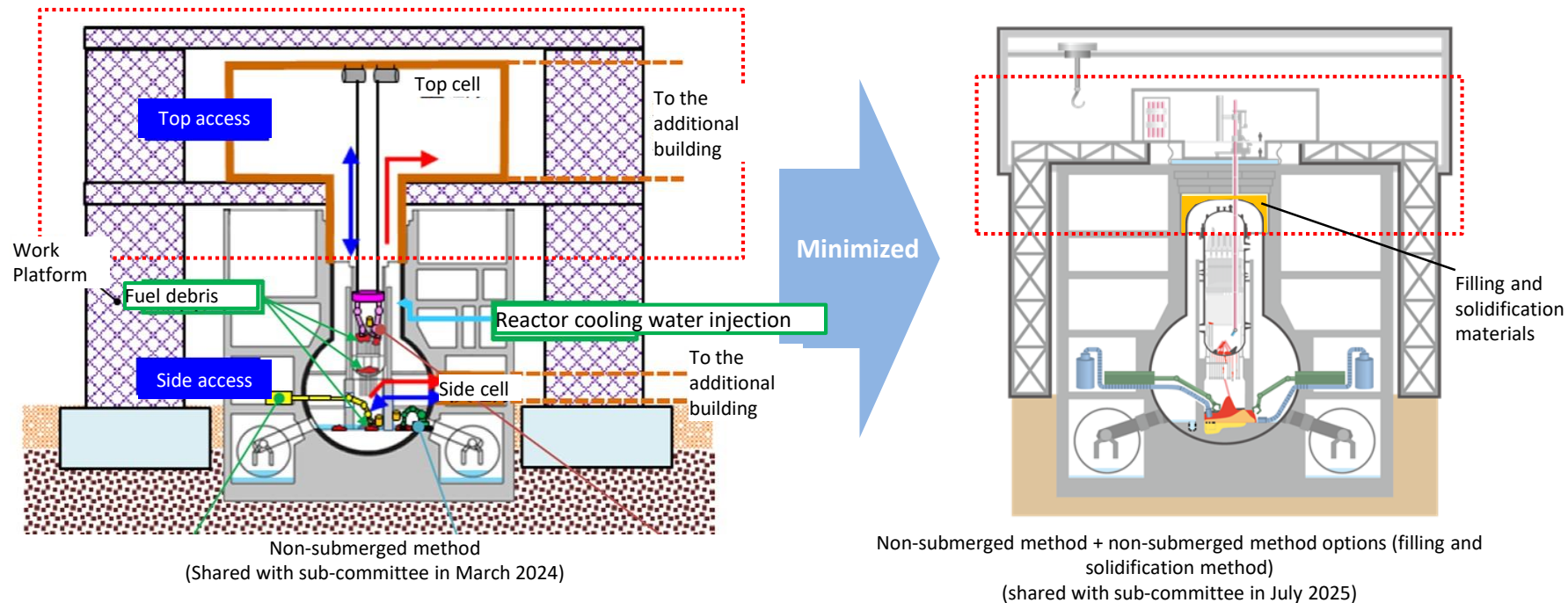
### 3. Summary

- We have conducted a design deliberation in accordance with the Sub-Committee report and summarized the preparations for full-scale retrieval based on certain assumptions.
- In regards to issues that require additional review, such as the demolition and removal of the Unit 3 Rw/B, and the two proposals for top access support structures (North-South work platform and East-West framework), we will proceed with on-site verification and design deliberation of issues that require additional review over the next one to two years to reevaluate the feasibility.
- At the same time, we will continue to exchange opinions with the Nuclear Regulation Authority on measures to ensure the safe fuel debris retrieval.

Appendix ①  
Large-Scale Fuel Debris Retrieval Method plan

- By switching from the non-submerged method used in March 2024 to the non-submerged method combined with partial submersion method options (filler material + solidification) it is possible to reduce the size of equipment and leverage the shielding effect of existing equipment.

Non-submerged method	Non-submerged method + non-submerged method options (filling and solidification method)
Access to the PCV through large opening	Access to the PCV through multiple small openings
Each of the various processing and retrieval methods requires separate development, design, and verification, and retrieval tasks place a heavy burden on operators.	Development, design, and verification can be minimized by standardizing and simplifying processing and retrieval methods, and the burden on operators during retrieval tasks is less.
Retrieve the fuel debris independently from the top and side.	Lower fuel debris inside the RPV from the top to the bottom and then retrieve it from the side (using top and side access points together).
-	Use filler and solidification materials as needed (Will be used at the reactor well)

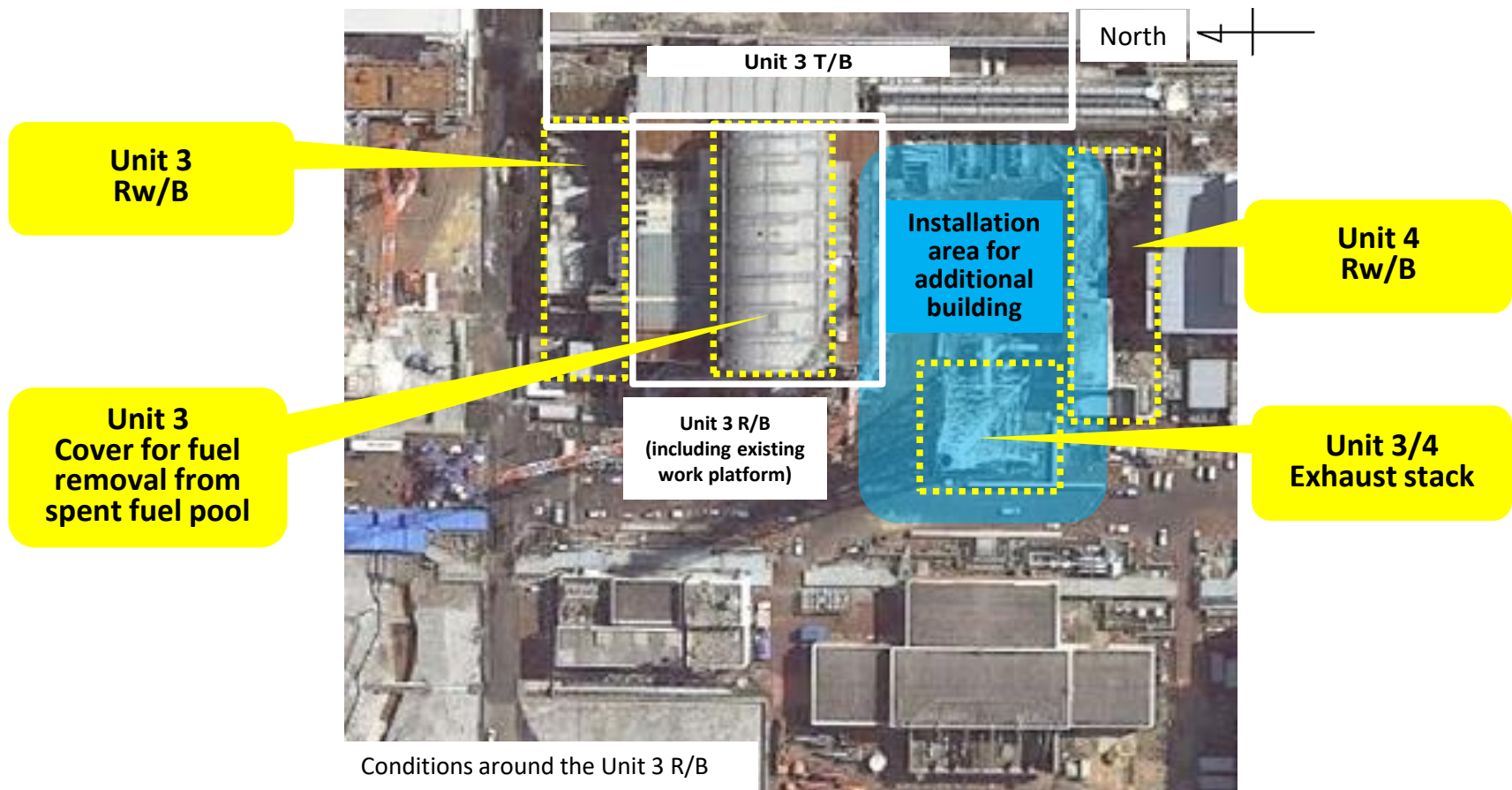


## Appendix ②

### Preparations around the Unit 3 reactor building

- Installation of the support structure for top access and the additional building\* will require the removal of obstructions (buildings, structures, etc.) around the Unit 3 reactor building. The main obstructions are shown in the diagram below.
- Although not explicitly shown in the diagram below, there are two plans for the top access support structure: North-South work platform and East-West framework, and the extent of the obstructions differs.

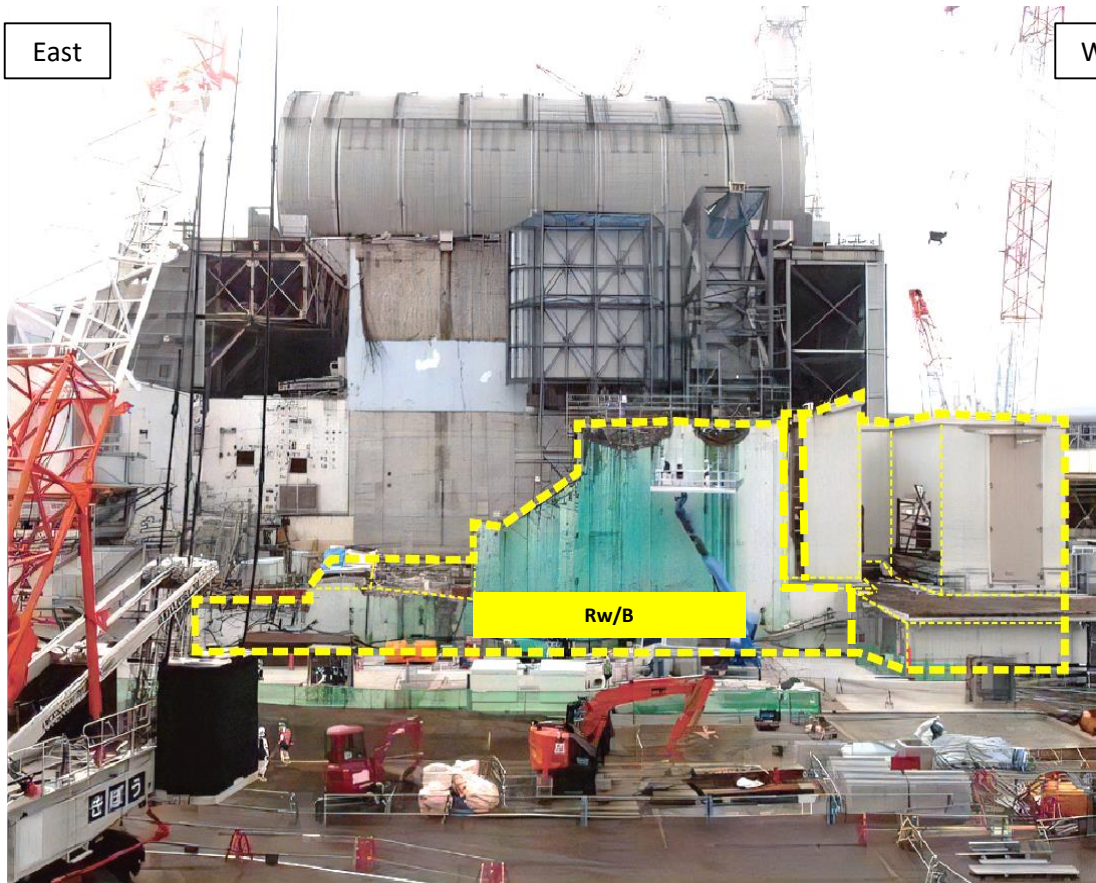
\*This will contain ancillary systems required for fuel debris retrieval (mainly facilities that reduce the amount of radioactive substances in gasses and liquids in PCV)



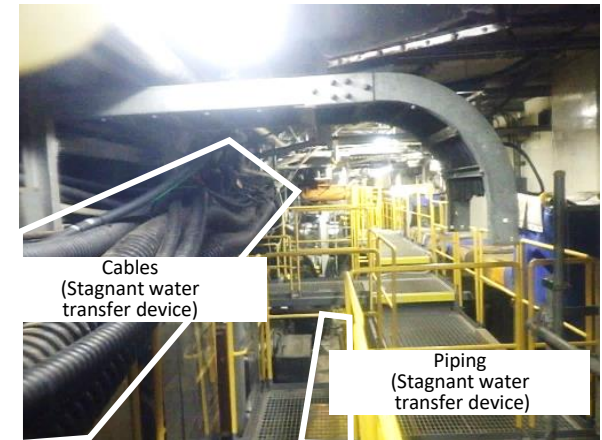


## Appendix ③ Overview of the Unit 3 Rw/B

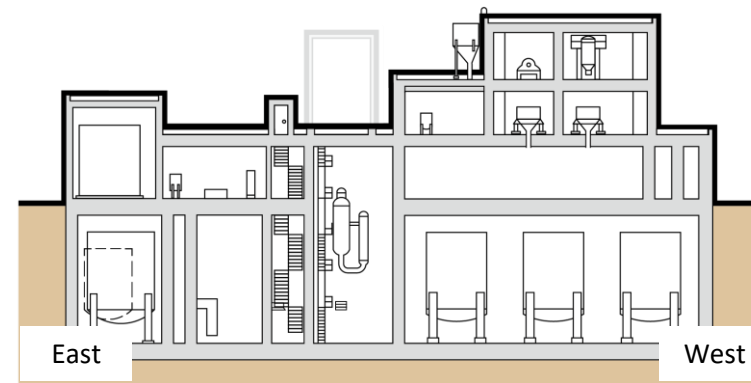
- The Unit 3 Rw/B is located on the north side of Unit 3 and used to treat radioactive waste liquids, gases, and solids from the reactor and turbine buildings. The building has tanks to store waste resin from the cleansing of reactor coolant during reactor operation.



Unit 3 Rw/B



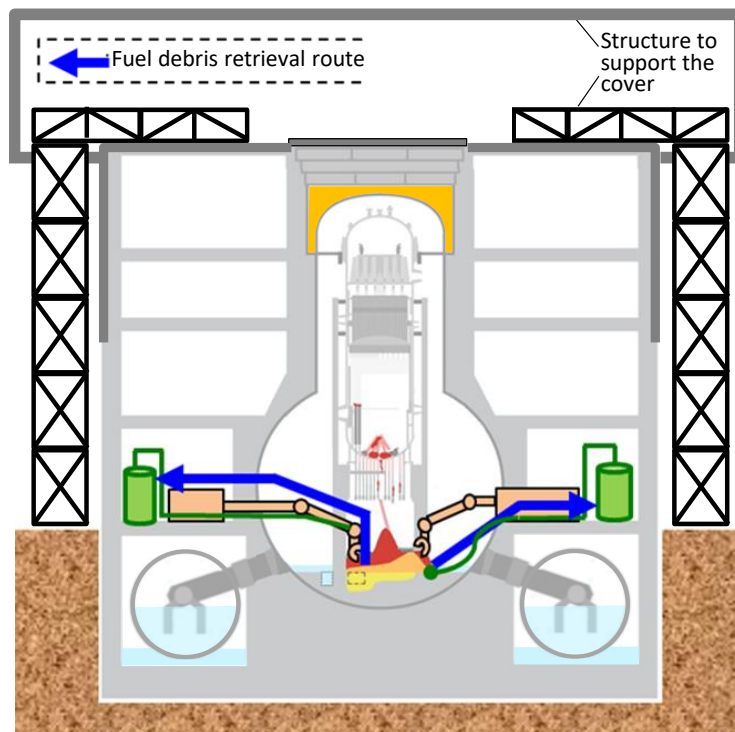
Inside the Unit Rw/B



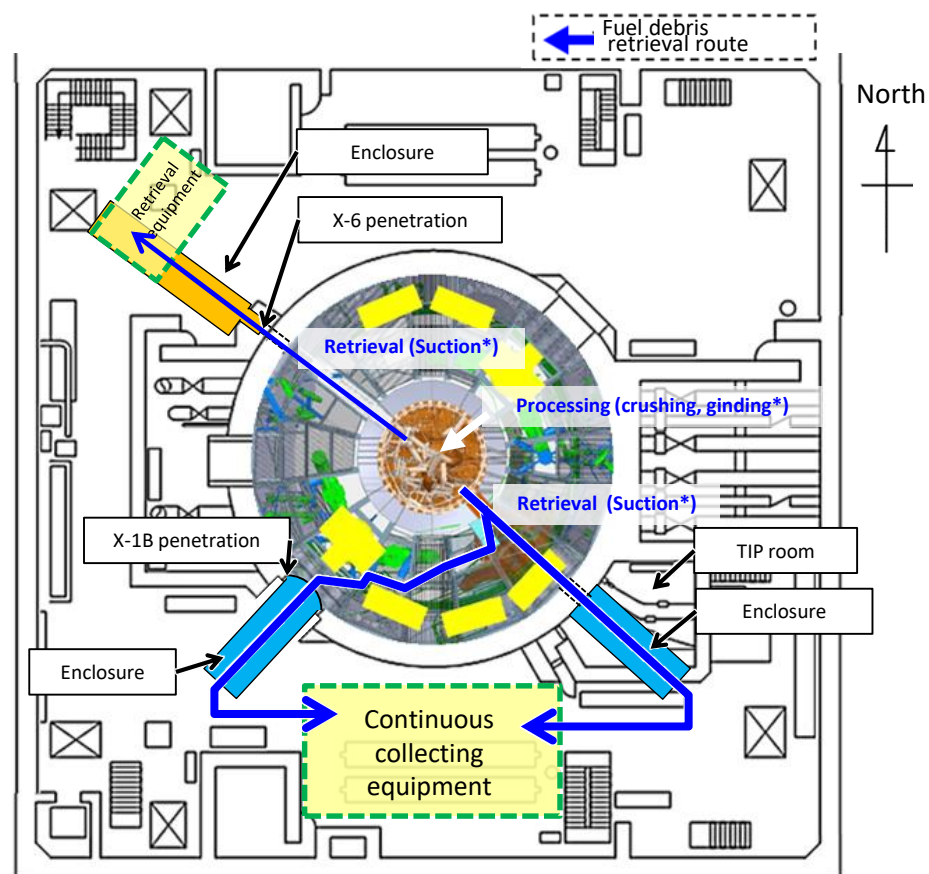
Cross section of Unit 3 Rw/B

## Appendix ④ Overview of Side Access Retrieval

- Primary containment vessel penetrations, such as X-6 penetrations on the first floor of reactor building, will be leveraged during side access point retrieval.
- Therefore, it is assumed that doses inside primarily the reactor building will be reduced during side access point preparations.



Cross section of reactor building



※Current assumptions. Decision is made based on “verification of processing and retrieval technologies”.

Bird's-eye view of the first floor of reactor building