Unit 3 Reactor Building Internal Investigation Results

June 27, 2024

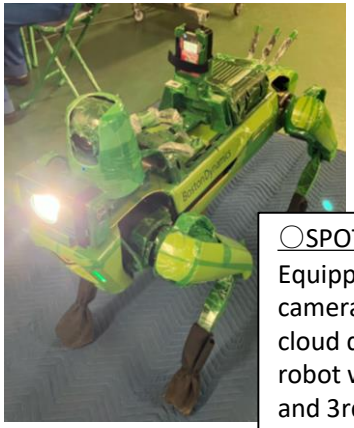
TEPCO

Tokyo Electric Power Company Holdings, Inc.

1. Overview

- We continues initiatives to shed light on how the accident unfolded in the form of “Evaluation of the situation of cores and containment vessels of Fukushima Daiichi Nuclear Power Station Unit 1 to 3 and examination into unsolved issues in the accident progression"
- In order to obtain information contributing to the planning of the investigation of the reactor building (R/B) in the future, as part of these initiatives, **we ascertained current conditions, such as dose rates and spatial information within the Unit 3 reactor building (for accessibility, etc.), within the scope possible**. (Investigation period: April 16~ June 14, 2024)
- **Elevated work platform trucks and four-legged robot (SPOT) that can be operated remotely were used to insert investigation instruments.**
- **γ imagers, three-dimensional laser scanners and dosimeters, etc. were used as investigation instruments.**
- The information obtained in this investigation will be utilized for the decommissioning work in the future.

○ Elevated work platform trucks
Equipped a platform to carry the γ imager/ FirstLook/ SPOT to each floor



○SPOT
Equipped with cameras/dosimeter/point cloud data gatherers, this robot was inserted on 2nd and 3rd floors to investigate

○ γ imager
Used to analyze γ ray distribution by combining hot spot identification functions with point cloud data acquisition functions

○ Platform for mounting FirstLook/ SPOT

○FirstLook
Equipped with cameras and radio relays

○Three-dimensional laser scanner
Laser scanner used to obtain precise point cloud data

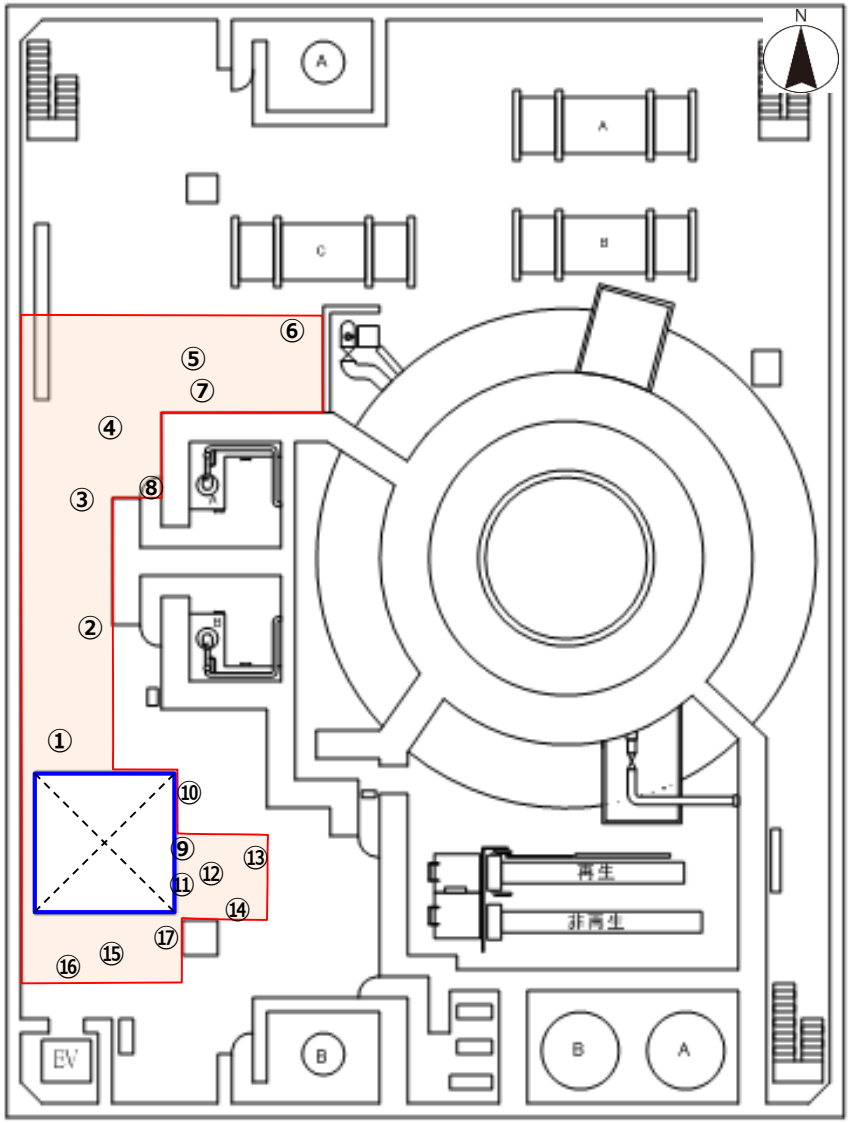
2. Unit 3 R/B 2nd floor investigation results (1/3)

■ Air dose rate inside the building

- Dose rates on the 2nd floor were confirmed to be between approx. 3~10mSv/h

Measurement location	Height of measurement ※Based on elevation of second floor (T.P.17264)	Dose rate [mSv/h]
①	Approx. 750mm	5.39
②		5.65
③		4.67
④		8.61
⑤		7.84
⑥		8.12
⑦		10.5
⑧		3.48
⑨	Approx. 850mm	4.64
⑩		4.75
⑪		4.60
⑫	Approx. 750mm	6.31
⑬		7.34
⑭		6.24
⑮	Approx. 850mm	7.67
⑯		7.93
⑰		7.20

Reported the reference materials announced on May 30, 2024



Unit 3 R/B 2nd Floor

□ : Equipment hatch position

□ : Travel range of remotely operated robot (result)

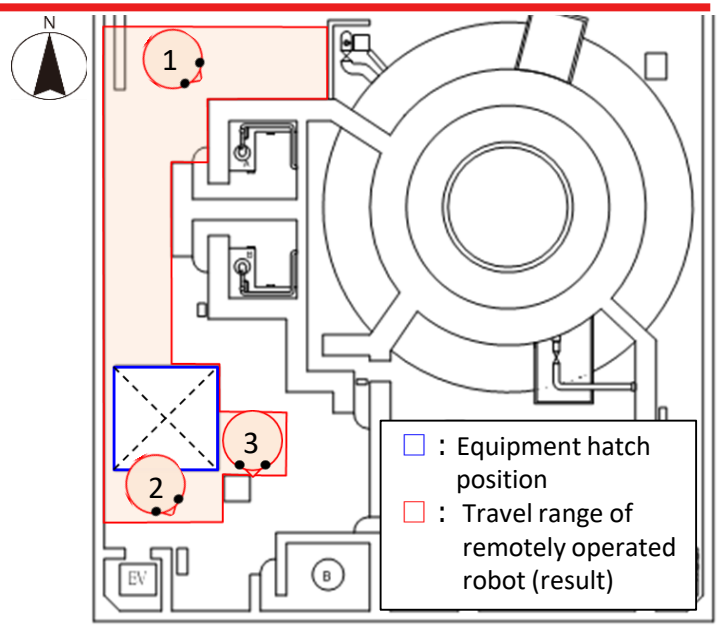
＜Measurement dates＞

- ①～⑧： June 6, 2024
- ⑨～⑪： May 13, 2024
- ⑫～⑭： June 13, 2024
- ⑮～⑰： May 29, 2024

2. Unit 3 R/B 2nd floor investigation results (2/3)

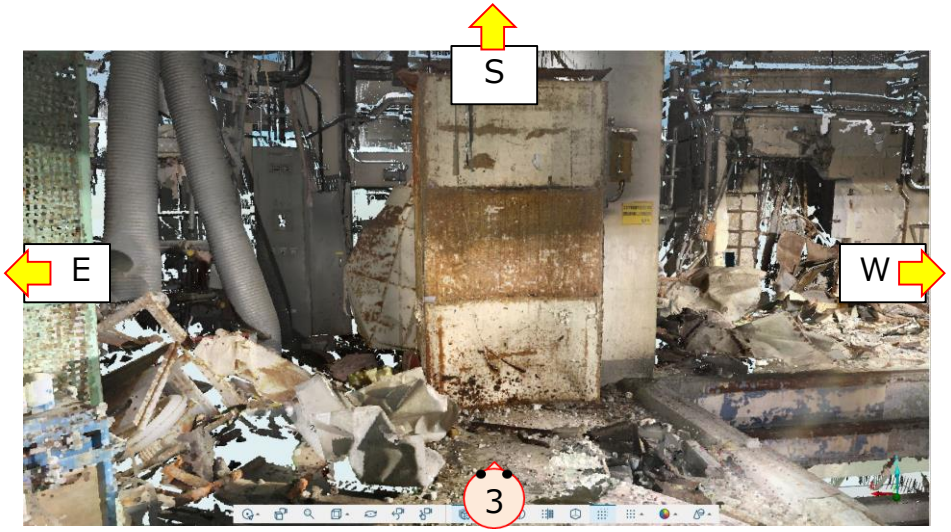
- Point cloud data
- Data obtained from multiple locations within investigation area

Arrow view 1: North side of 2nd floor (obtained on June 7, 2024)



Unit 3 R/B 2nd floor

Arrow view 2: South side of 2nd floor (obtained on May 30, 2024)



Arrow view 3: East side of 2nd floor (obtained on June 14, 2024)

2. Unit 3 R/B 2nd floor investigation results (3/3)

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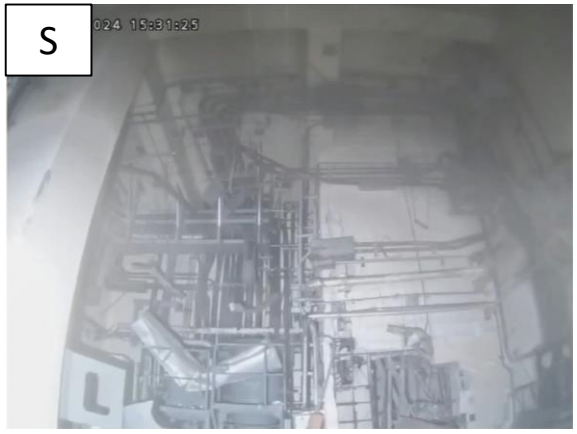
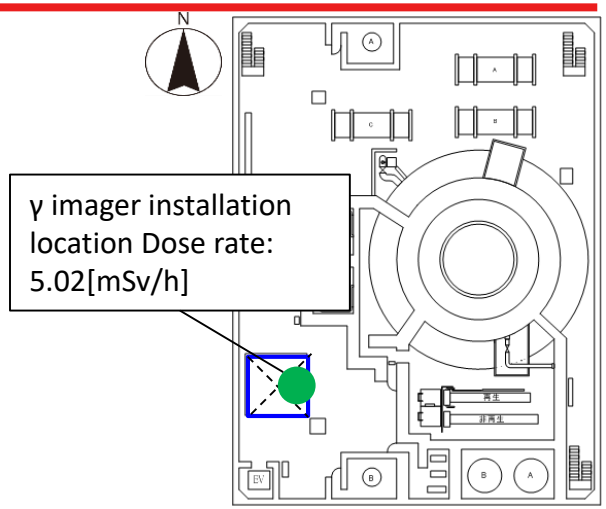
■ γ ray distribution by γ imager measurement

- On the 2nd floor, it was confirmed that the hot spot was around the rubble near the floor.

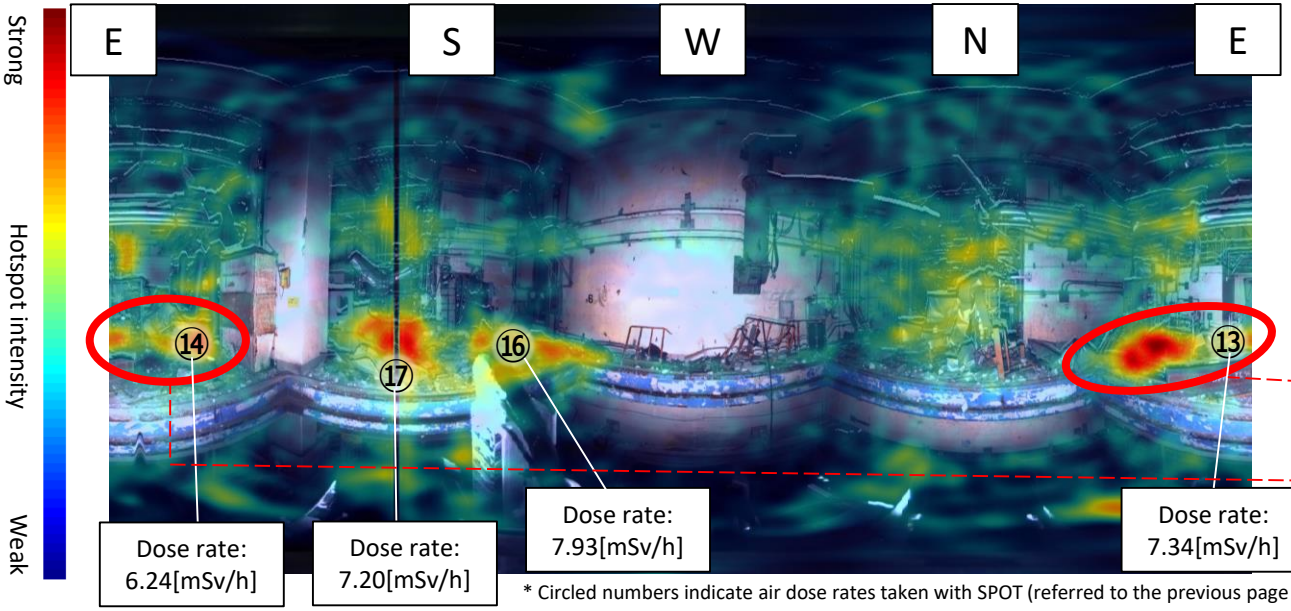




Unit 3 R/B 2nd floor,

□ : Equipment hatch position

● : γ imager installation location (Mounted on elevated work platform truck)



* Circled numbers indicate air dose rates taken with SPOT (referred to the previous page for details)

Photographed on April 16, 2024
γ imager measurement date: April 17, 2024

* Relative display of temperature distribution up to 10% of the maximum value (blue) based on the maximum value (red) of the radiation source intensity in the image

*Since this image combines a spherical image taken in the 360° direction onto a flat surface, distortion like a fisheye lens occurs in each direction

3. Unit 3 R/B 3rd floor investigation results (1/3)

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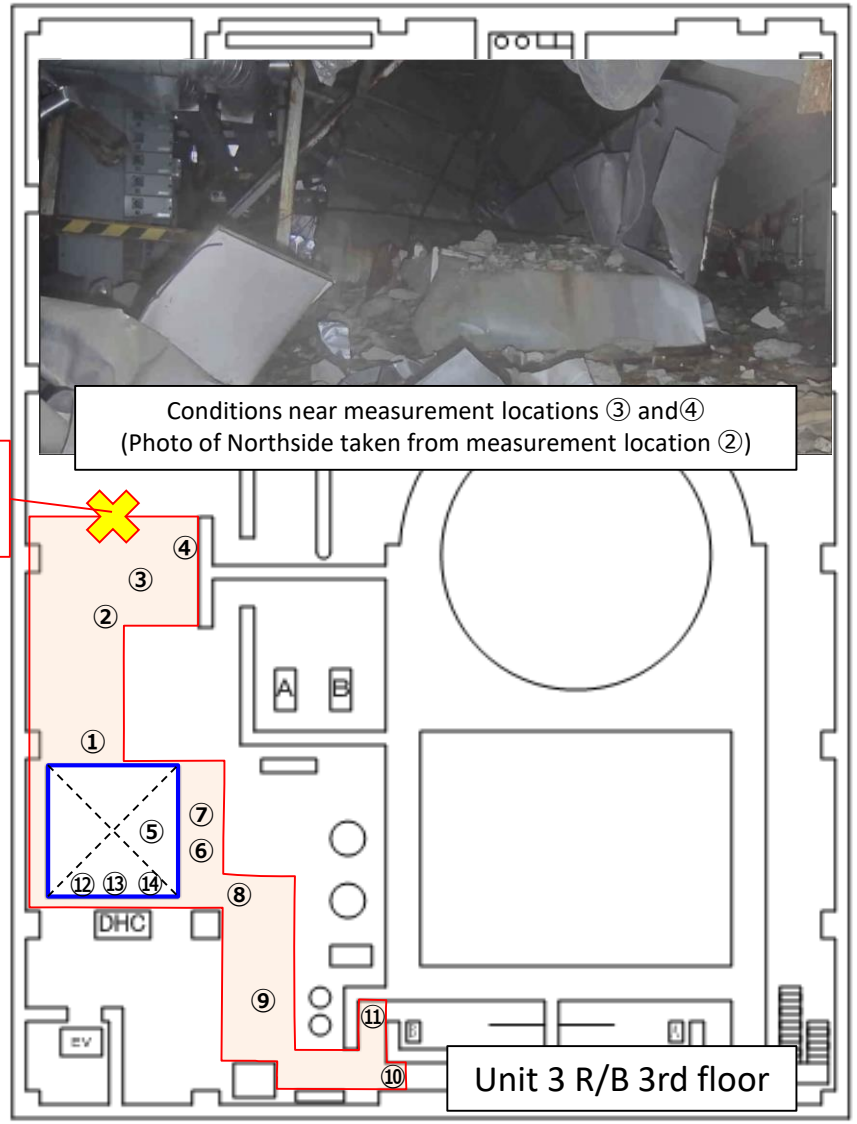
■ Air dose rate inside the building

- On the 3rd floor high-dose rates of over 20mSv/h were measured at measurement locations ②, ③, and ④

Measurement location	Height of measurement ※Based on elevation of third floor (T.P.25464)	Dose rate [mSv/h]
①	Approx. 750mm	15.6
②	Approx. 850mm	**21.1**
③		**28.4**
④		**28.2**
⑤	Approx. 650mm ※Above platform mounted to tracked bucket truck	8.21
⑥	Approx. 750mm	10.2
⑦		10.1
⑧		12.7
⑨		14.4
⑩		4.75
⑪		3.27
⑫	Approx. 1750mm ※Above platform mounted to tracked bucket truck	7.65
⑬		7.13
⑭		7.40

Reported the reference materials announced on May 30, 2024



□ : Equipment hatch position

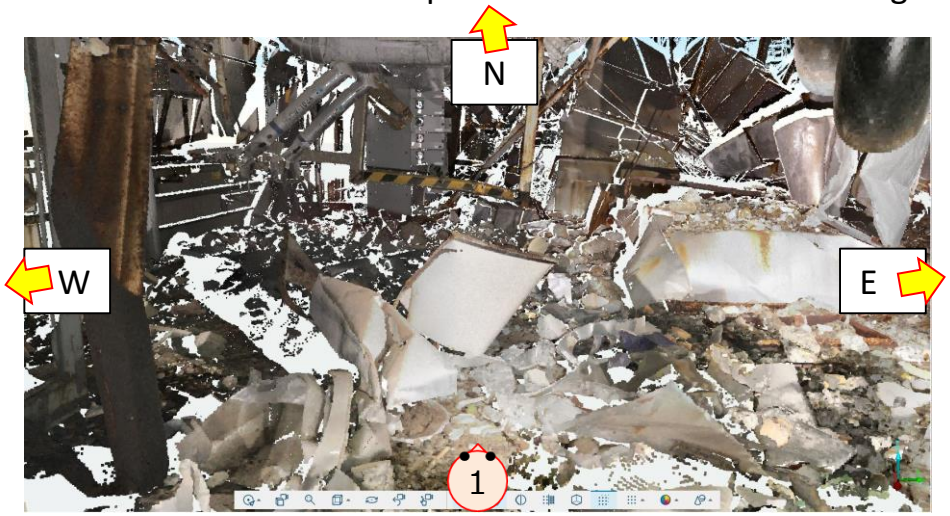
□ : Travel range of remotely operated robot (result)

<Measurement dates>

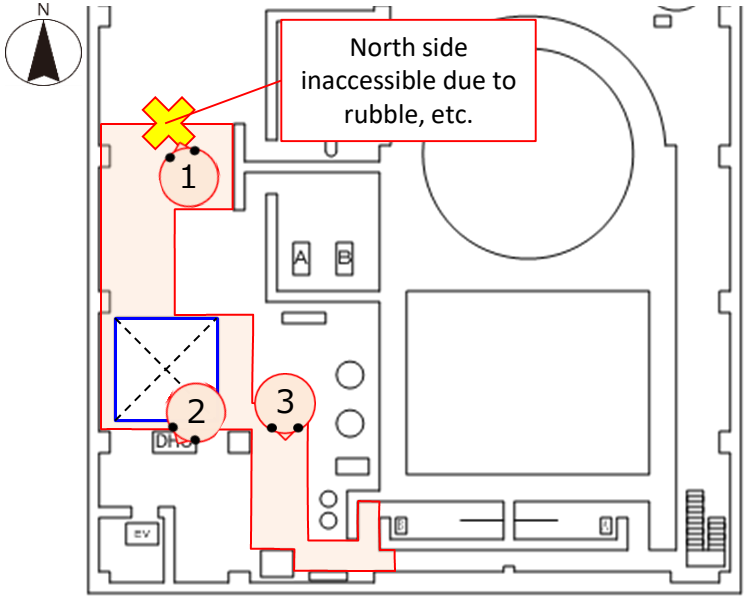
- ①～④ : June 11, 2024
- ⑤～⑪ : May 21, 2024
- ⑫～⑭ : June 3, 2024

3. Unit 3 R/B 3rd floor investigation results (2/3)

■ Point cloud data
- Data obtained at multiple locations within the investigation area

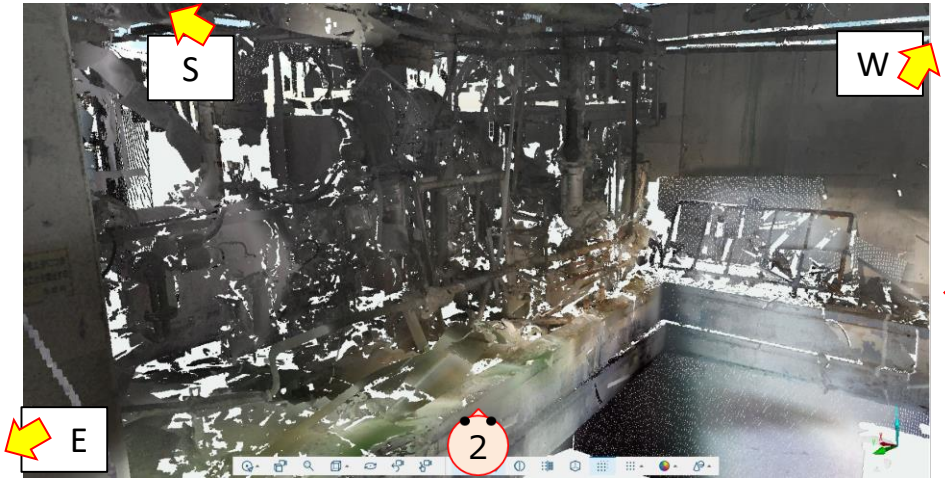


Arrow view 1: North side of 3rd floor (obtained on June 12, 2024)



Unit 3 R/B 3rd floor

□ : Equipment hatch position
□ : Travel range of remotely operated robot (result)



Arrow view 2: South side of 3rd floor (obtained on June 4, 2024)

Arrow view 3: East side of 3rd floor (obtained on May 22, 2024)

3. Unit 3 R/B 3rd floor Investigation results (3/3)

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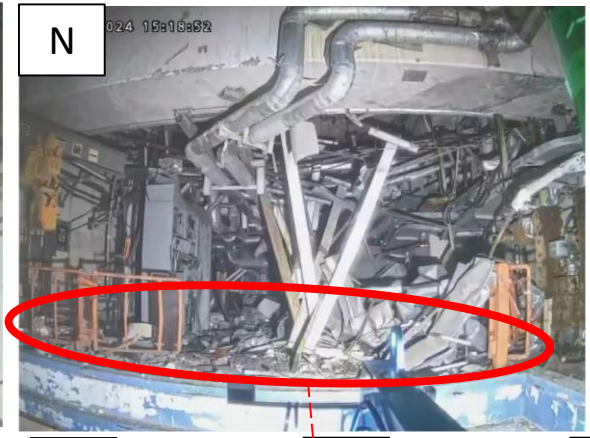
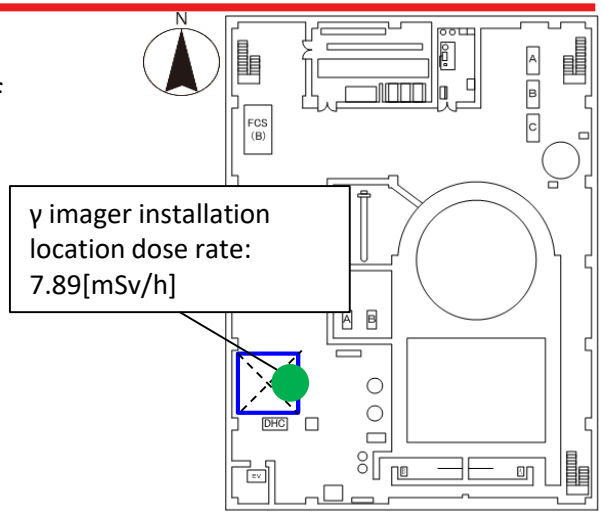
■ γ ray distribution by γ imager measurement

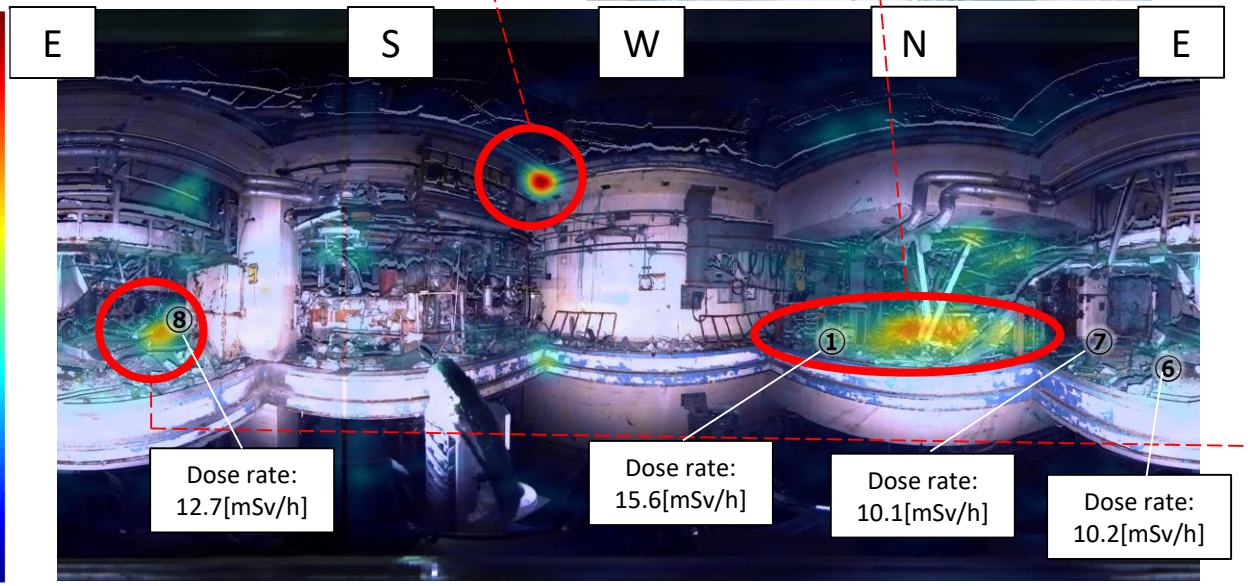
- On the 3rd floor, it was confirmed that the hot spot was around the edge of the top of the equipment hatch and around the rubble near the floor.

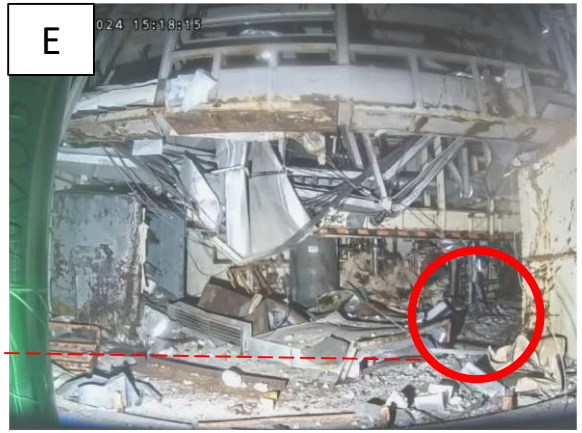




Unit 3 R/B 3rd fl.

□ : Equipment hatch position
● : γ imager installation location
(Mounted on elevated work platform truck)





Photographed on April 18, 2024
γ imager measurement date: April 18, 2024

* Circled numbers indicate air dose rates taken with SPOT (referred to the previous page for details)

* Relative display of temperature distribution up to 10% of the maximum value (blue) based on the maximum value (red) of the radiation source intensity in the image

*Since this image combines a spherical image taken in the 360° direction onto a flat surface, distortion like a fisheye lens occurs in each direction

4. Unit 3 R/B 4th floor Investigation results

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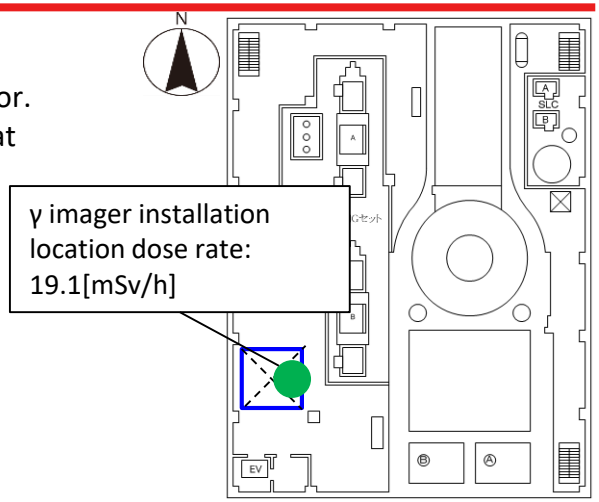
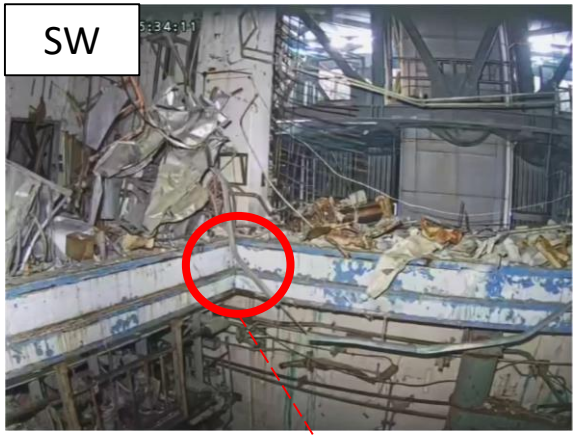
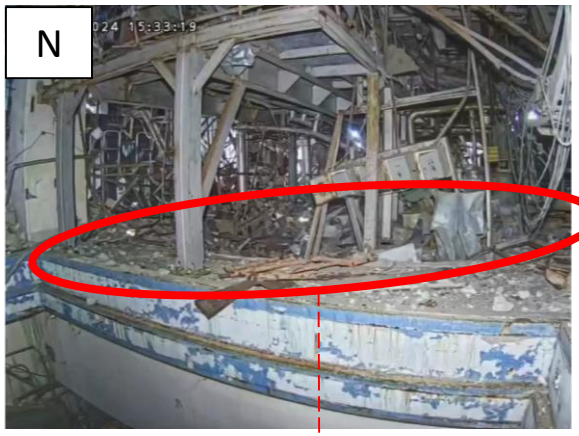
- γ ray distribution by γ imager measurement
- On the 4th floor, it was confirmed that the hot spot was around the rubble near the floor.
- Since the intensity of the hot spot on the 3rd floor are relatively weak, it is assumed that dose rates on the 4th floor are higher

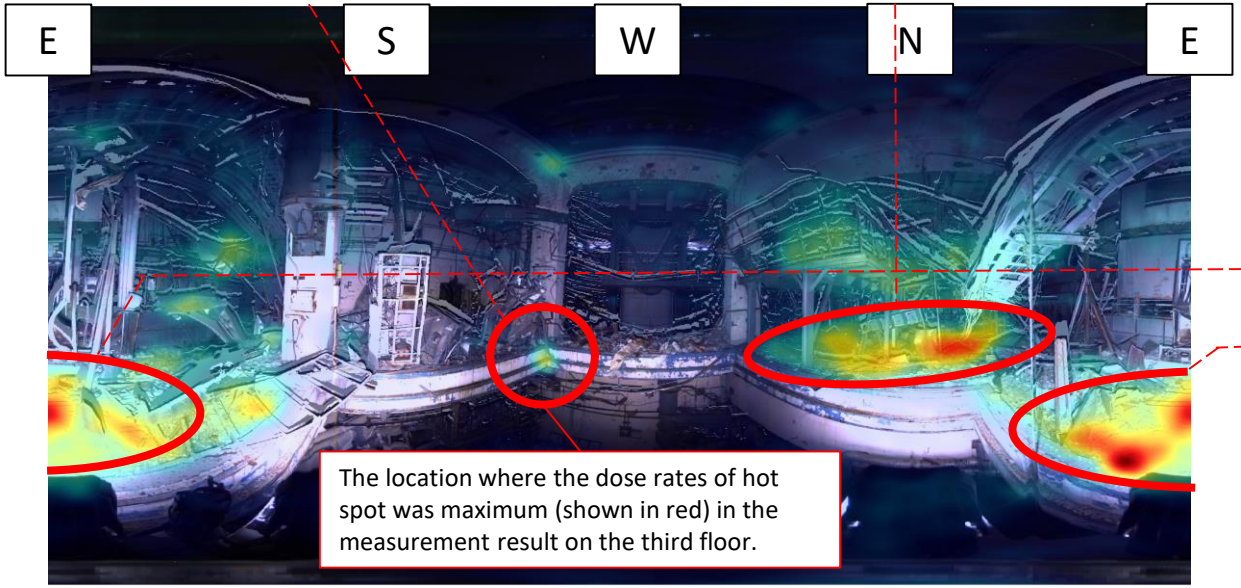


Unit 3 R/B 4th floor

□ : Equipment hatch position
● : γ imager installation location
(Mounted on elevated work platform truck)







The location where the dose rates of hot spot was maximum (shown in red) in the measurement result on the third floor.

Photographed on April 19, 2024
γ imager measurement date: April 19, 2024

* Relative display of temperature distribution up to 10% of the maximum value (blue) based on the maximum value (red) of the radiation source intensity in the image
* Since this image combines a spherical image taken in the 360° direction onto a flat surface, distortion like a fisheye lens occurs in each direction

5. Utilizing acquired data

- Video footage (used to ascertain accessible spaces, the position of rubble, and condition of damage)
  - Recording traces of the accident
  - Deliberating rubble removal and decommissioning task-related equipment installation, etc.
  - Drafting investigation plans for areas not yet investigated

- Point cloud data (used to quantitatively ascertain accessible spaces, the position of rubble, and condition of damage)
  - Recording traces of the accident
  - Deliberating rubble removal and decommissioning task-related equipment installation, etc.
  - Drafting investigation plans for areas not yet investigated

- Dose rate data (use to ascertain on-site air dose rates and high dose rate locations)
  - Deliberating exposure doses during future on-site work
  - Deliberating highly radioactive equipment and rubble removal for reducing dose rates on-site

- γ imager measurement results (Used to estimate hot spot intensity distribution)
  - Identify hot spot within the scope of measurement and estimate dose rate distribution
  - Assessment results used in the same manner as dose rate data

6. Estimate of dose rate distribution based on γ imager measurement results

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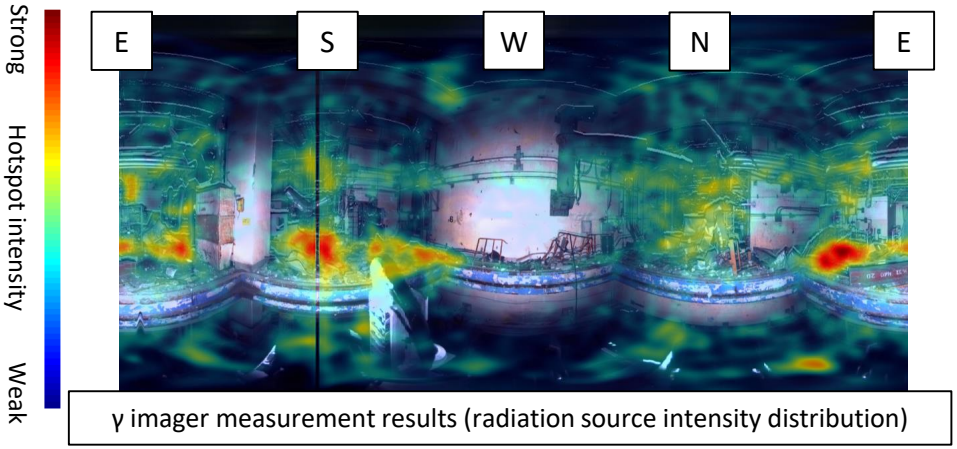
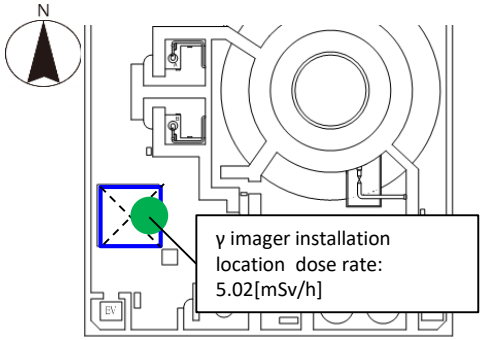
■ Dose rate distribution estimate for the 2nd floor of the Unit 3 R/B (provisional result)

• On the 2nd floor, dose rates were high around rubble on the east and south sides, and maximum dose rate at a height of 0.3m from the floor was estimated to be 10.8mSv/h



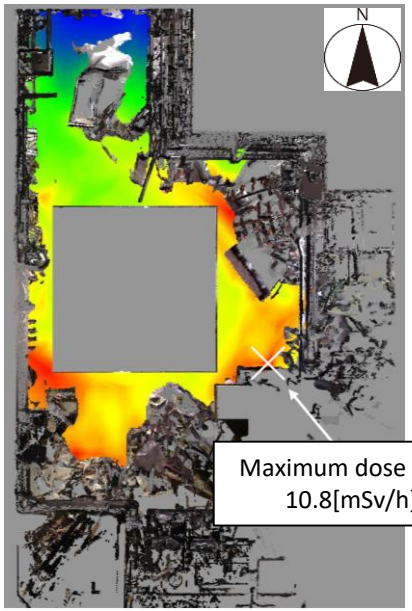
γ imager measurement results (radiation source intensity distribution)



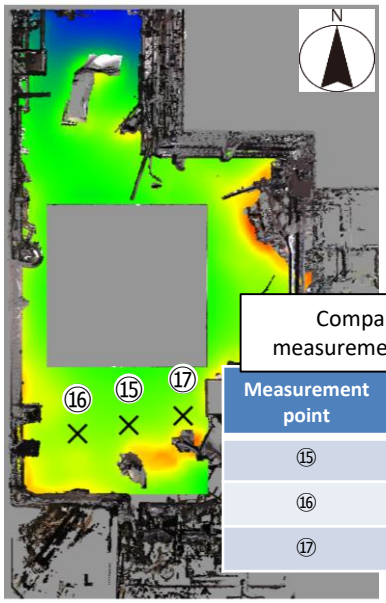
Unit 3 R/B 2nd floor

□ : Equipment hatch position

● : γ imager installation location (Mounted on elevated work platform truck)



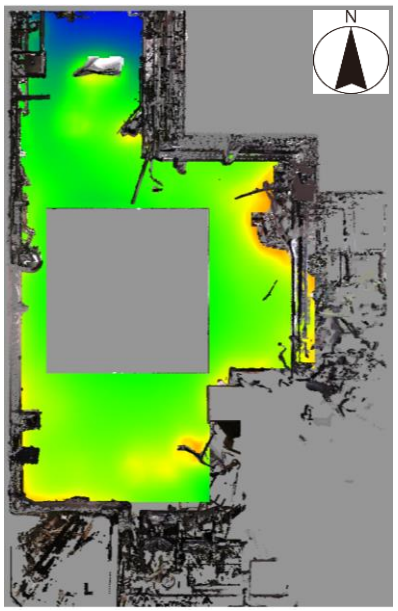
Dose rate distribution at a height of 0.3m from the floor (estimate)



Dose rate distribution at a height of 0.85m from the floor (estimate)

Comparison of actual measurements with estimates

Measurement point	Actual result	Estimate
⑮	7.67	7.40
⑯	7.93	7.64
⑰	7.20	7.29



Dose rate distribution at a height of 1.0m from the floor (estimate)

7. Conclusions of Unit 3 reactor building investigation

- A remotely operated robot was used in the southwest area of the Unit 3 R/B in order to obtain data (video footage, point cloud data and dose rate data) about traces of the accident left there.
- Conformed the main hot spot on 2nd~4th floors were around rubble near the floor.
- The obtained data will be used to identify hot spot in the aforementioned area and estimate dose rate distribution.
- The information acquired during this investigation will also be used for future decommissioning works (to deliberate dose reduction measures through rubble removal and the installation of decommissioning task-related equipment, etc.) and to draft investigation plans for areas not yet investigated.

[Reference] Investigation overview

■ Investigation method

- Cameras, dosimeters, γ imagers, and point cloud data acquisition equipment used to acquire information about open spaces inside the R/B (ability, etc.), and dose rate data.
- Investigation was carried out by installing an investigation instrument on a remotely operated robot.
- A tracked bucket truck was used to insert investigation equipment onto each floor through equipment hatches on the southwest side of the R/B.

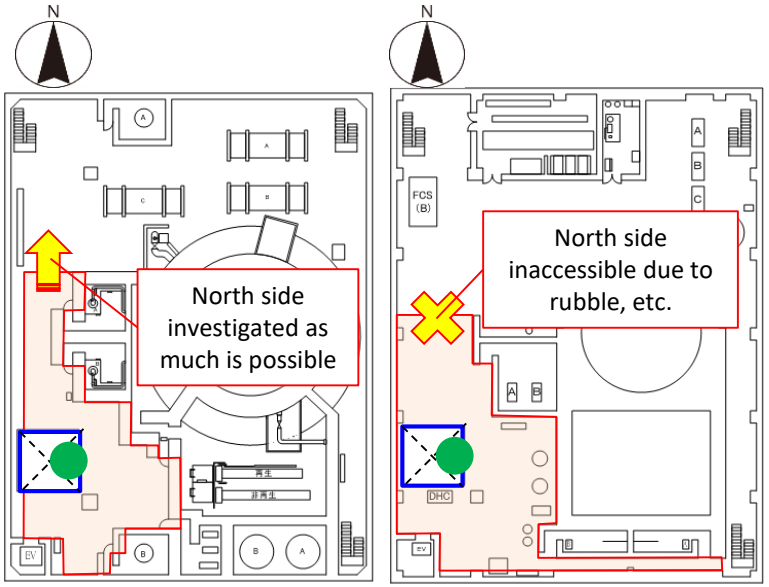
■ Investigation scope

- The investigation focused on the areas around the equipment hatches on the south side of 2nd~4th floors (refer to the maps on the right).
- Only γ imager measurements were taken on the 4th floor (The arm extension limitations of the tracked bucket truck made it difficult to insert the robot on the fourth floor).
- Main points of the investigation show below.

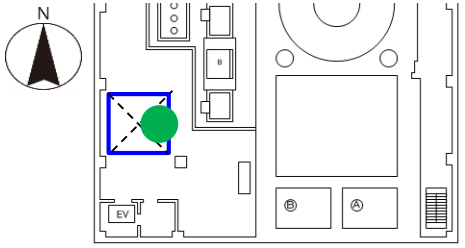
Main points \ Investigation method	Video footage	Dose rate measurements	γ imager measurements	Point cloud data
Accessibility of each floor	○			○
Rubble conditions	○			○
Building damage	○			○
Dose rate distribution		○	○	
Hot spot conditions	○	○	○	○

■ Investigation period (tentative)

- April-June 2024



2nd floor　　3rd floor



4th floor (only γ imager measurements ware taken)

□ : Equipment hatch position
□ : Scope of remotely operated robot investigation
(Varies depending on the Rubble conditions and real communication conditions)
● : γ imager installation location (mounted on elevated work platform truck)

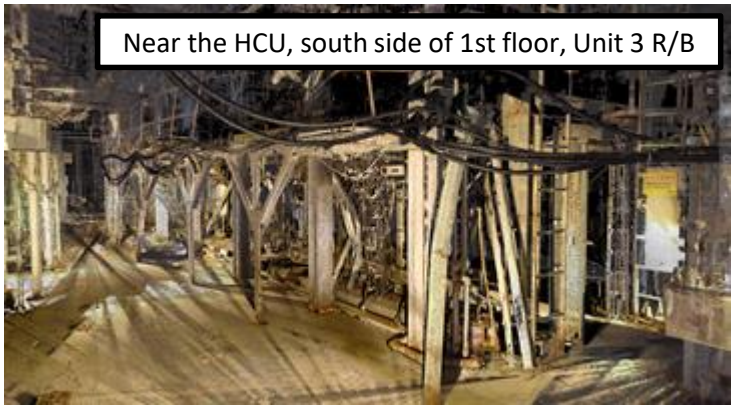
Scope of investigation inside the Unit 3 R/B (Overview)

[Reference] Status of initiatives to acquire point cloud data inside the Unit 1-3 reactor buildings

- Point cloud data is being acquired inside the Unit 1-3 R/Bs to deliberate decommissioning works that need to be performed inside the R/B in preparation for fuel debris retrieval.
  - In addition to being littered with rubble, etc., the areas inside the Unit 1~3 R/Bs are high-dose environments. Point cloud data in high-dose areas, with the exception of areas littered with rubble, etc., is being acquired using a remotely operated devices (four-legged robots). (Data being acquired from each unit in the order of Unit 1 → Unit 3 → Unit 2)
  - Acquiring point cloud data will enable field conditions to be ascertained without the need to enter the R/B, which contributes to the reduction of the exposure associated with the accessing these areas.

- Future initiatives
  - Littered rubble, obstructions, and restricted signal ranges, etc. inside the R/B limit the range within which the four-legged robot can acquire point cloud data, so we are deliberating using drones (proposed) in order to fill out to the point cloud data.
  - Data will be acquired when possible (updated/added) as field conditions inside the reactor building change in conjunction with decommissioning work progress.

Four-legged robot



Near the HCU, south side of 1st floor, Unit 3 R/B

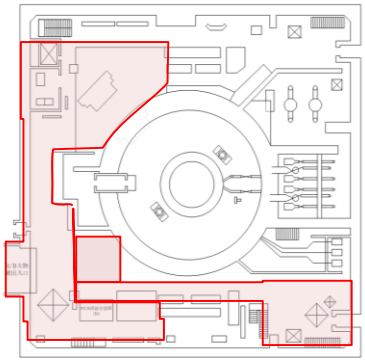
Near the RCW surge tank, 4th floor, Unit 1 R/B

[Note] The four-legged robot cannot operate in cramped locations or areas where there is scattered rubble, etc.

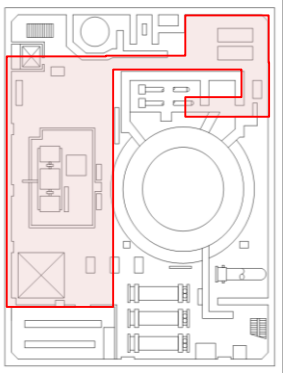
[Reference] Scope of point cloud data acquisition inside the Unit 1-3 reactor buildings (as of June 2024)

【Unit 1】

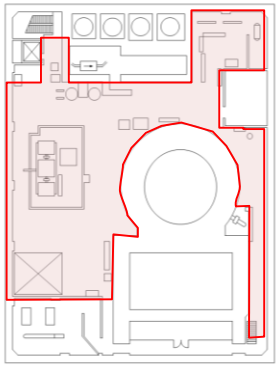
R/B 1st fl.



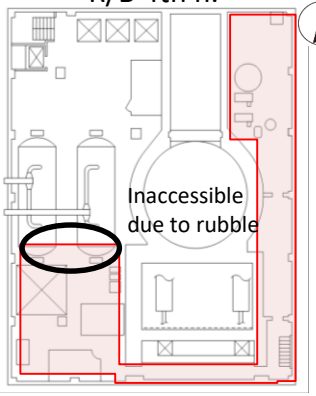
R/B 2nd fl.



R/B 3rd fl.



R/B 4th fl.



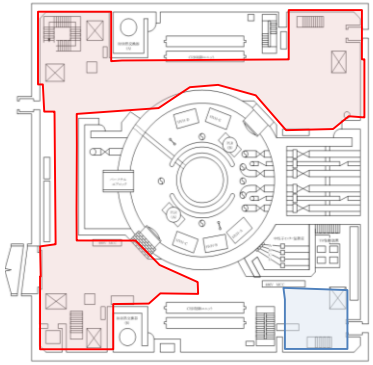
○Acquisition period
- November 2021
- September 2023 – January 2024

○Acquisition method
Point cloud data acquisition system equipped on Four-legged Robot
※Some equipment was inserted by workers

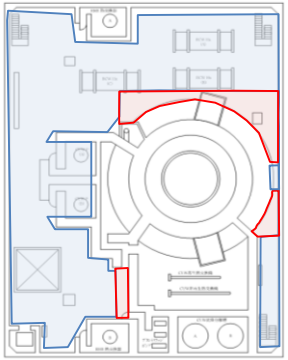
Acquired

【Unit 2】

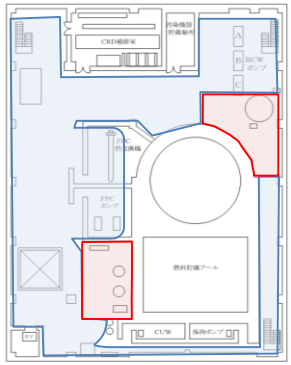
R/B 1st fl.



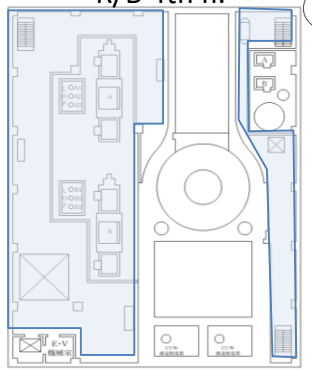
R/B 2nd fl.



R/B 3rd fl.



R/B 4th fl.



○Acquisition period
- November – December 2021
- April - May 2023

○Planned acquisition period
Planned for June – September 2024

○Acquisition method
Same as above

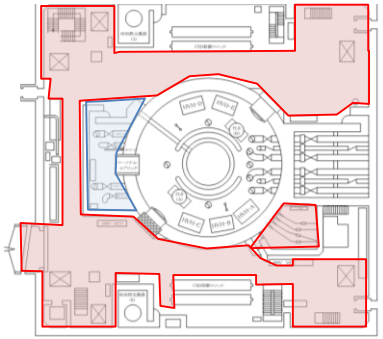
Acquired

To be acquired

May change due to rubble/stairs/transmission conditions

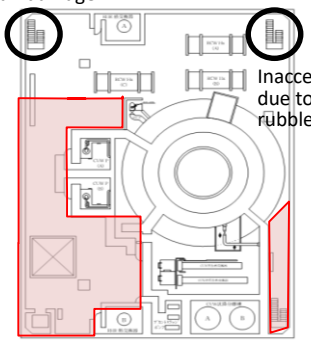
【Unit 3】

R/B 1st fl.



Inaccessible due to stair damage

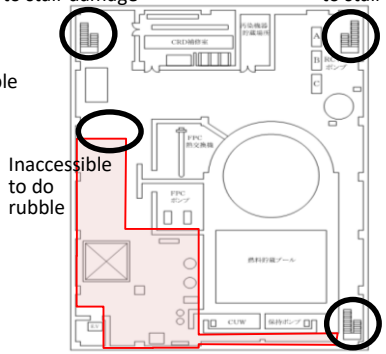
R/B 2nd fl.



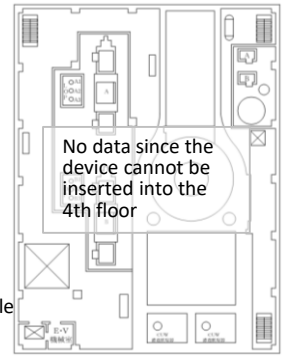
Inaccessible due to stair damage

R/B 3rd fl.

Inaccessible due to stair damage



R/B 4th fl.



○Acquisition period
May 2023 - June 2024

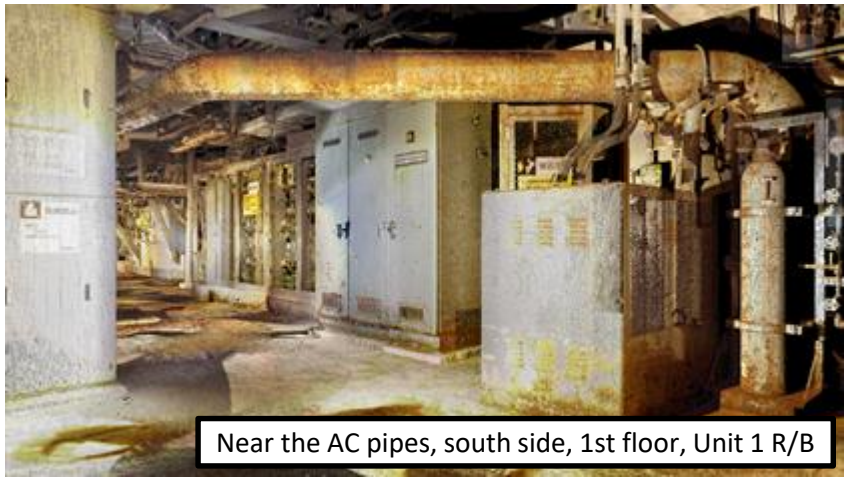
○Planned acquisition period
Planned for the second half of FY2024

○Acquisition method
Same as above

Acquired

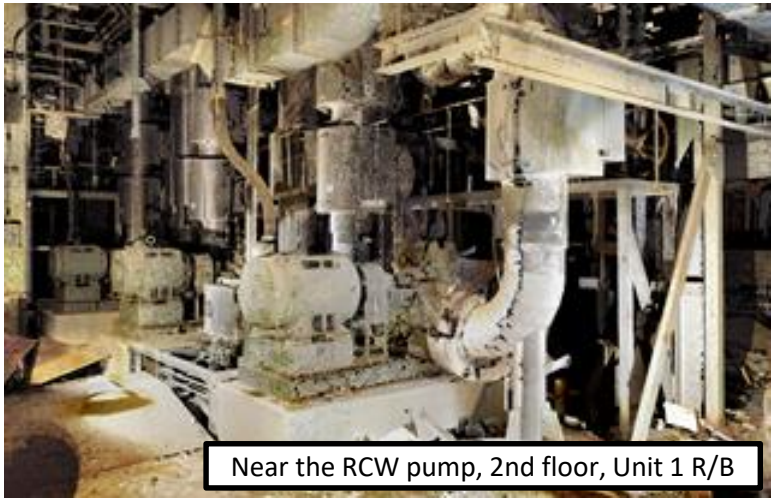
To be acquired

[Reference] Status of point cloud data acquisition inside the Unit 1 R/B



Near the AC pipes, south side, 1st floor, Unit 1 R/B

Near the X-6 penetration, south side, 1st floor, Unit 1 R/B



Near the RCW pump, 2nd floor, Unit 1 R/B

Near the X-25 penetration, 3rd floor, Unit 1 R/B

Note: Point cloud data acquisition was performed while a light attached to the Four-legged Robot turned on.