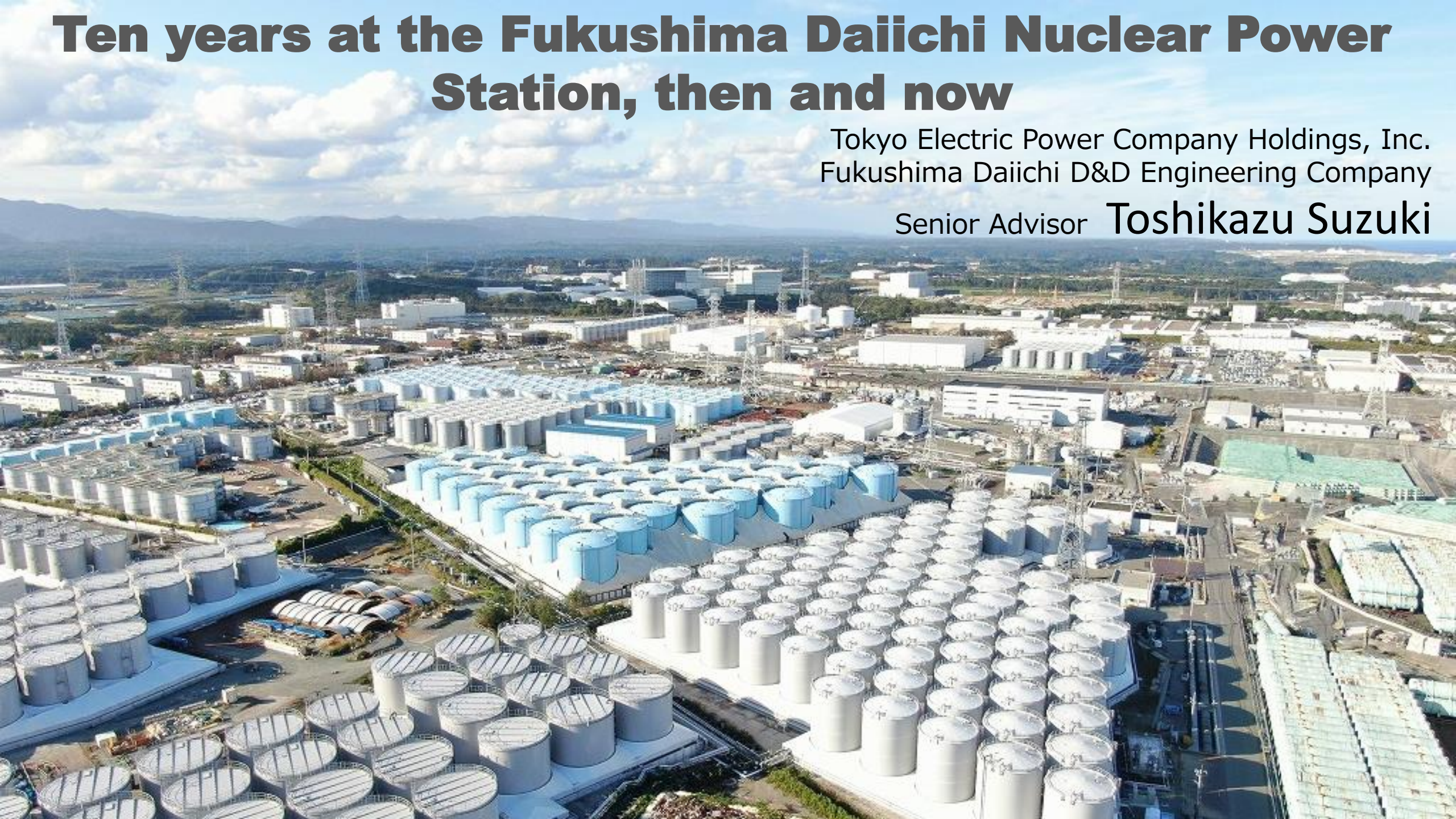
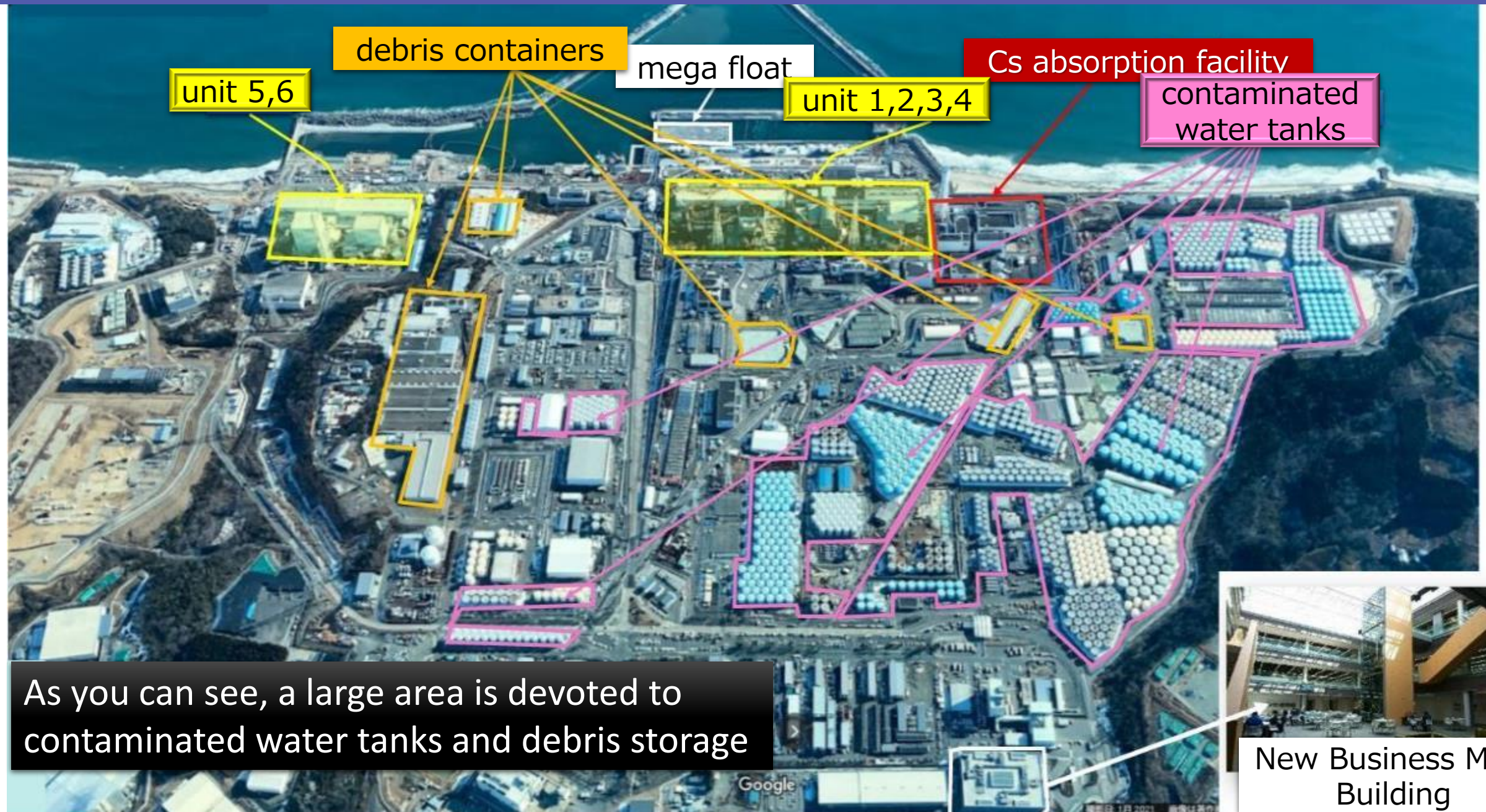
Ten years at the Fukushima Daiichi Nuclear Power Station, then and now

Tokyo Electric Power Company Holdings, Inc.
Fukushima Daiichi D&D Engineering Company
Senior Advisor Toshikazu Suzuki



Current situation at FDNPS

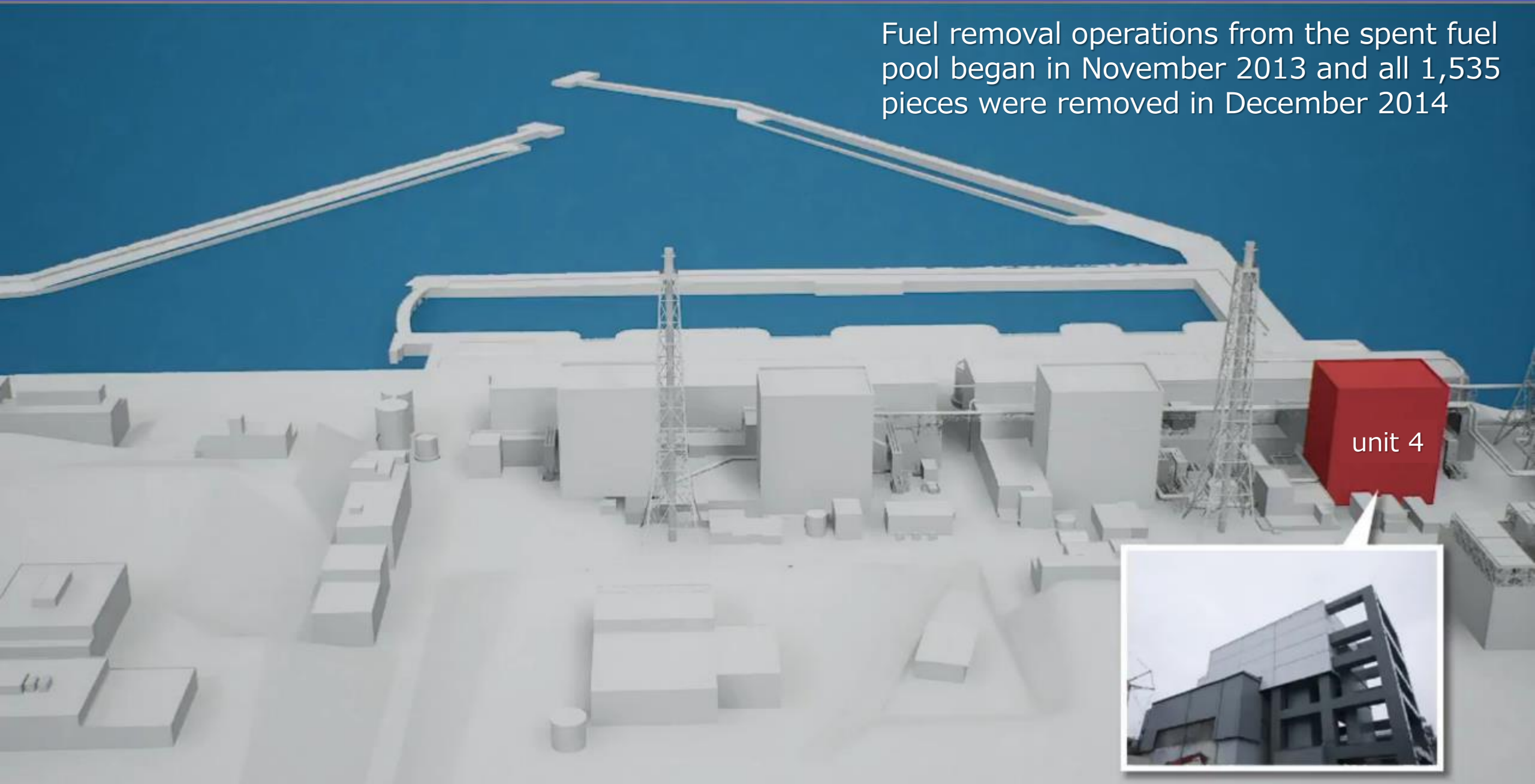


As you can see, a large area is devoted to contaminated water tanks and debris storage

New Business Main Building

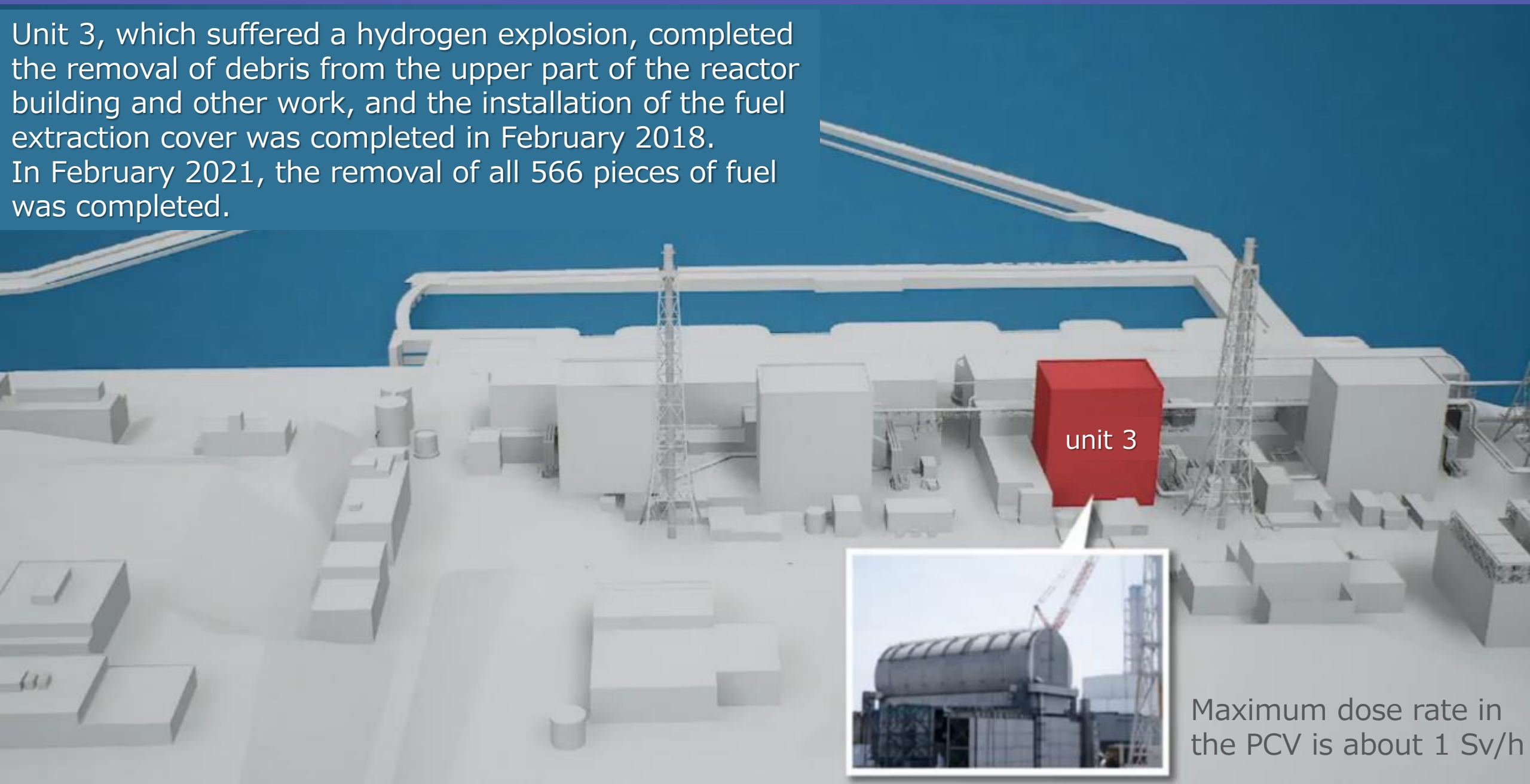
Unit 4 … Completion of nuclear fuel removal

Fuel removal operations from the spent fuel pool began in November 2013 and all 1,535 pieces were removed in December 2014



Unit 3 ･･･ Completion of nuclear fuel removal

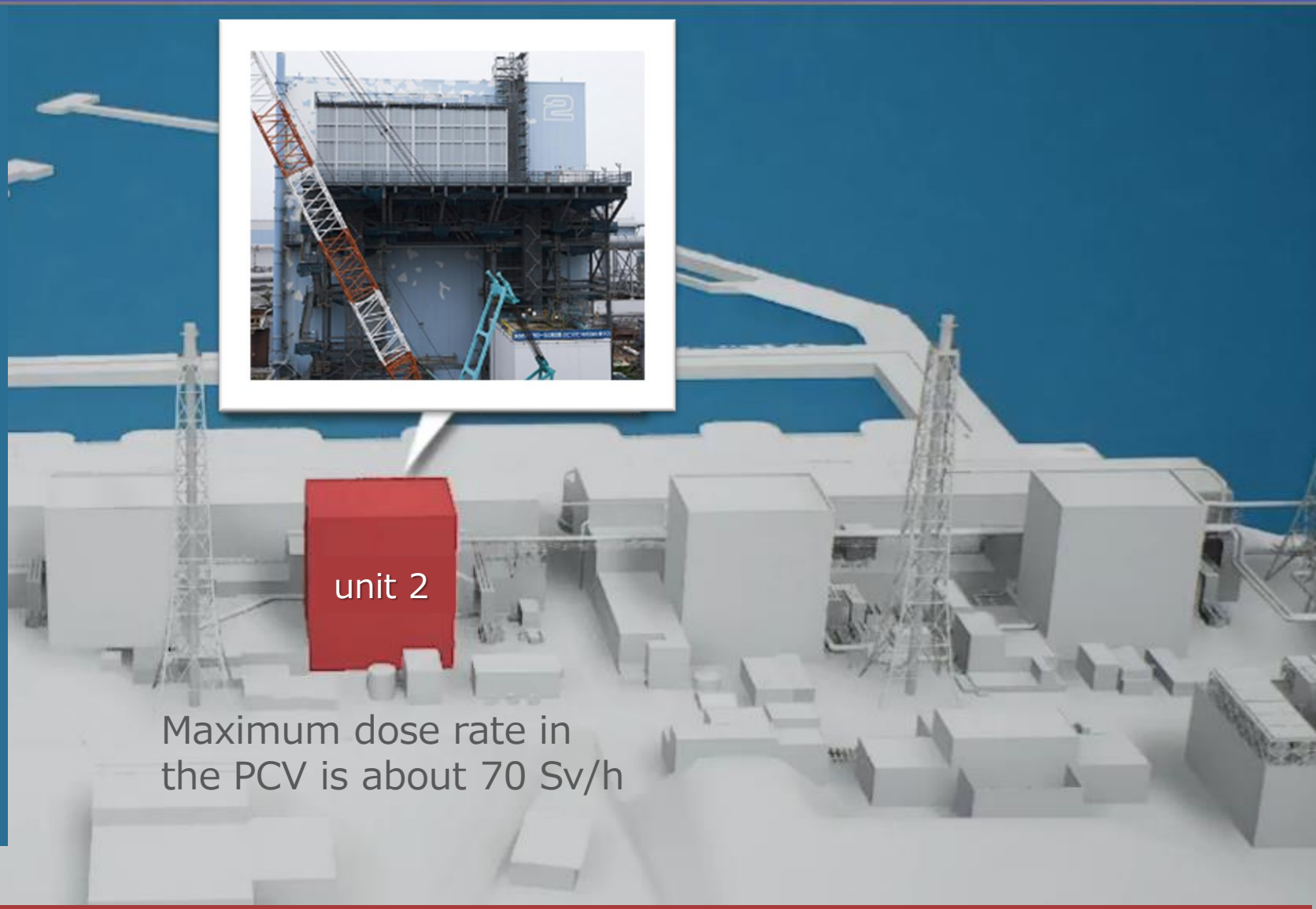
Unit 3, which suffered a hydrogen explosion, completed the removal of debris from the upper part of the reactor building and other work, and the installation of the fuel extraction cover was completed in February 2018.
In February 2021, the removal of all 566 pieces of fuel was completed.



Maximum dose rate in the PCV is about 1 Sv/h

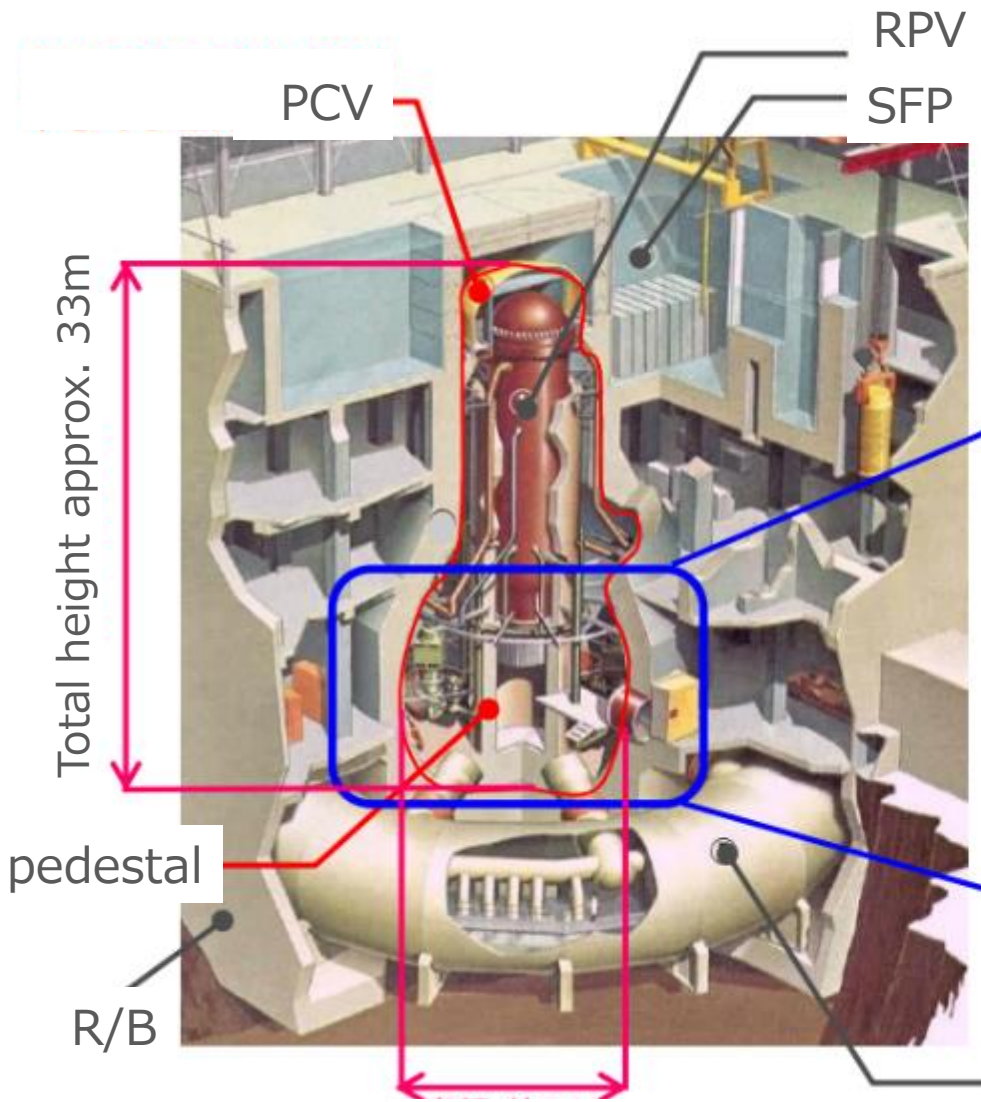
Unit 2 ･･･ Under construction of a take-out bunker

Unit 2 did not result in an explosion of the reactor building due to a partial opening of the wall and release of hydrogen. The plan for removing the fuel from the spent fuel pool was reviewed, with the safety of the surrounding area as the first priority, and the upper part of the building dismantled.
After the review, a 'fuel removal yard (yard and front room)' will be constructed on the south side of the building for removing the fuel, and the fuel removal equipment will be connected to the building and put into the operating floor, where the fuel will be removed by remote control.

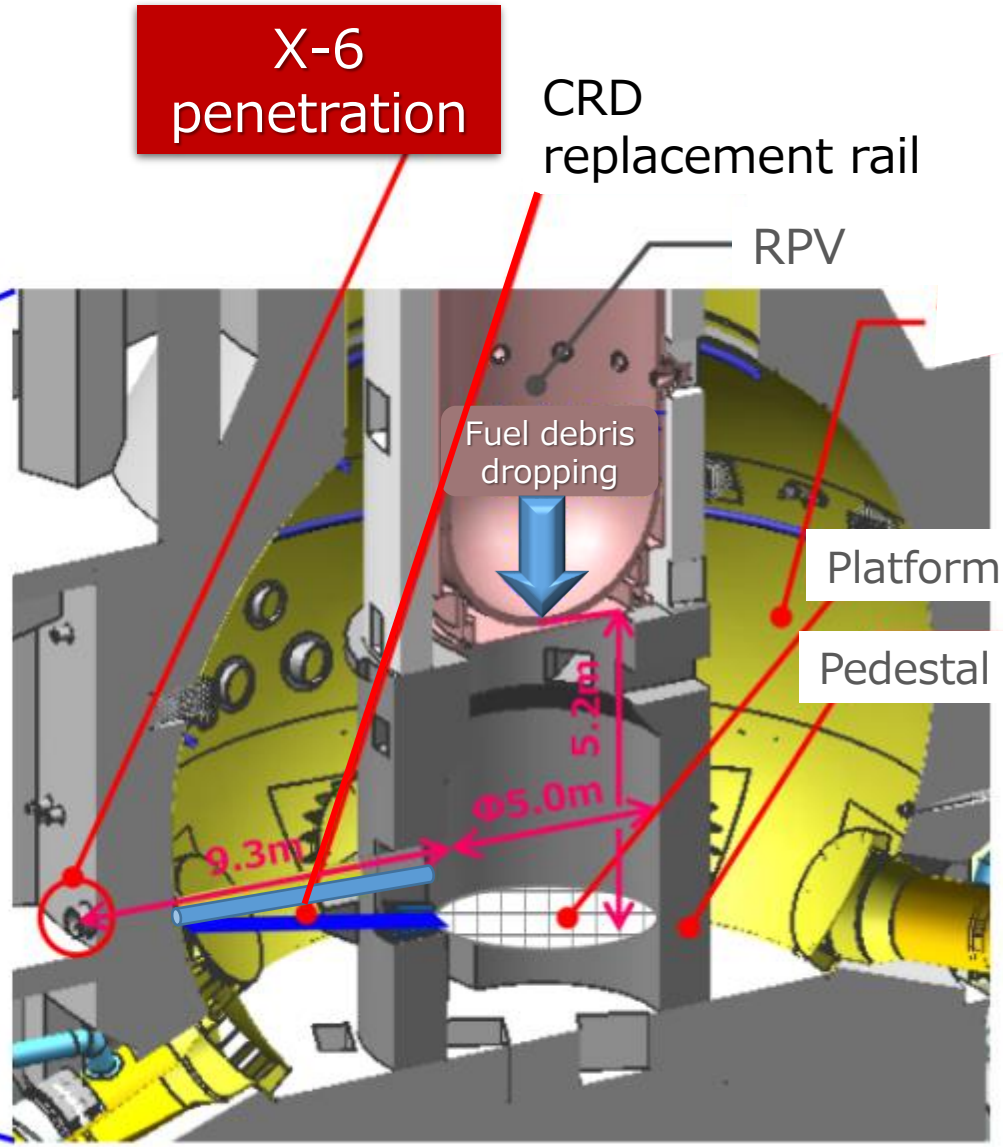


Fuel debris extraction is planned to be carried out in stages, starting with Unit 2

Unit 2 Investigation of deposits inside the reactor containment vessel

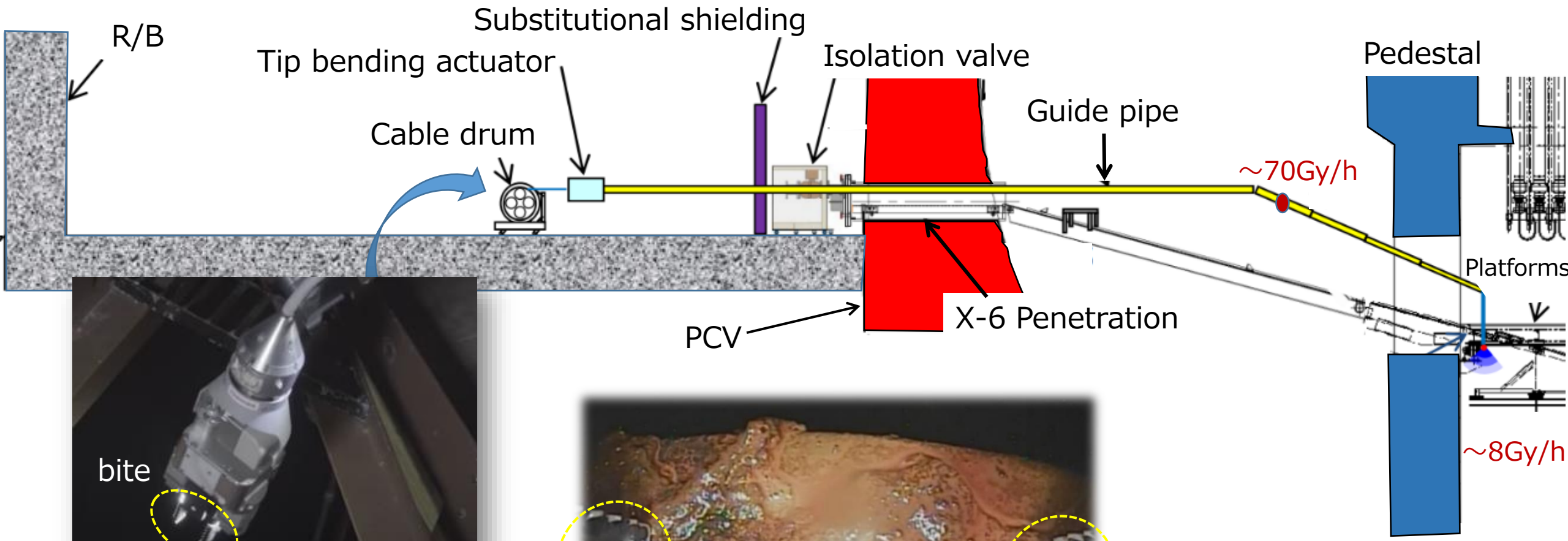


Enlargement

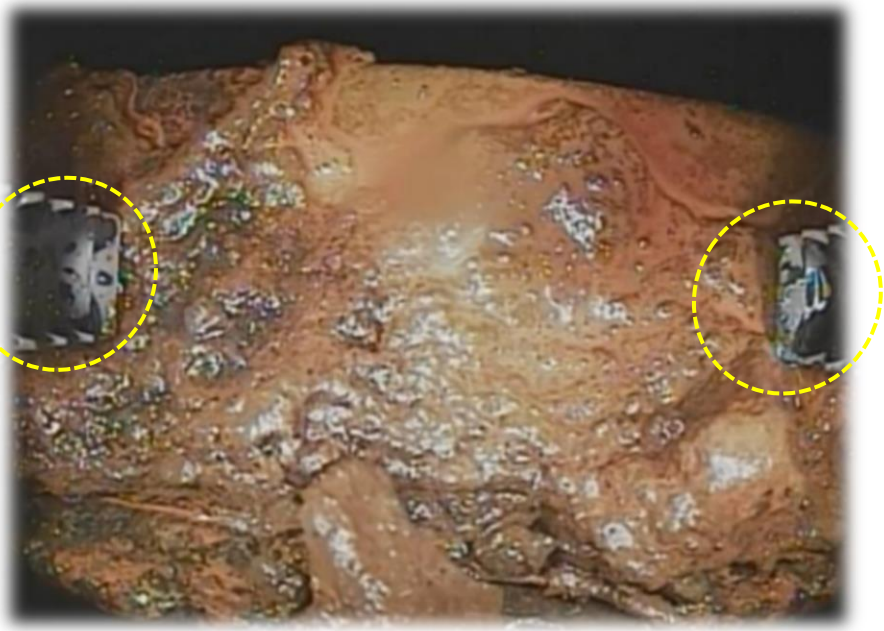


PCV lower section

Unit 2 Investigation of deposits inside the reactor containment vessel



Equipment for investigating deposits inside the PCV



The contact survey confirmed that pebble- and structure-like sediments can be grasped and moved, and that hard rocky sediments that cannot be grasped may be present

Unit 1 … Under construction to install a large cover

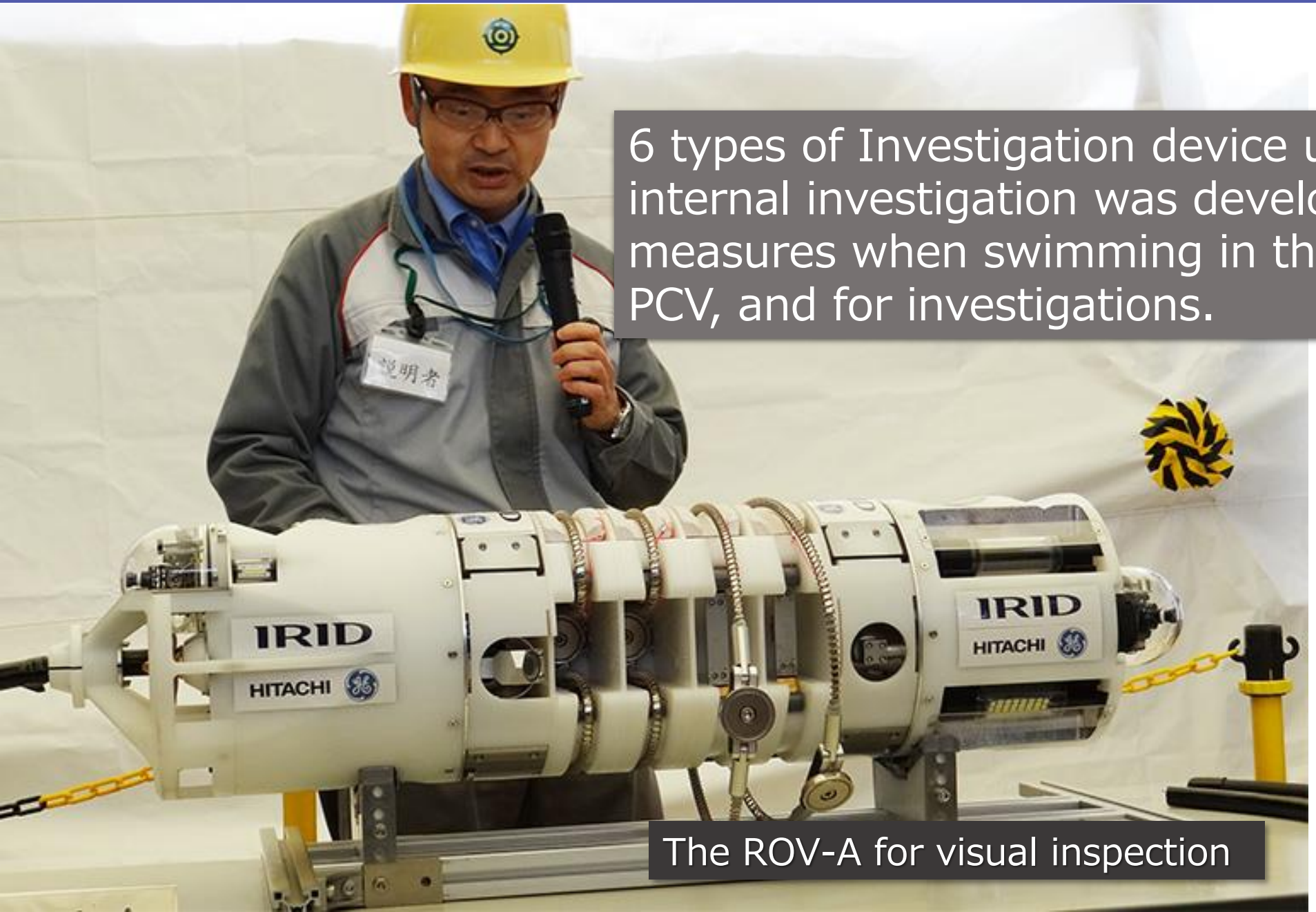
The plan is to cover the entire building with a large cover and remove debris remotely using an overhead crane for debris removal and demolition heavy equipment inside the cover.
After debris removal, the operating floor will be decontaminated and shielded, and equipment for removing fuel (fuel handling machines and cranes) will be installed.

unit 1

The dose rate in the PCV ranges from 4.1 to 9.7 Sv/h

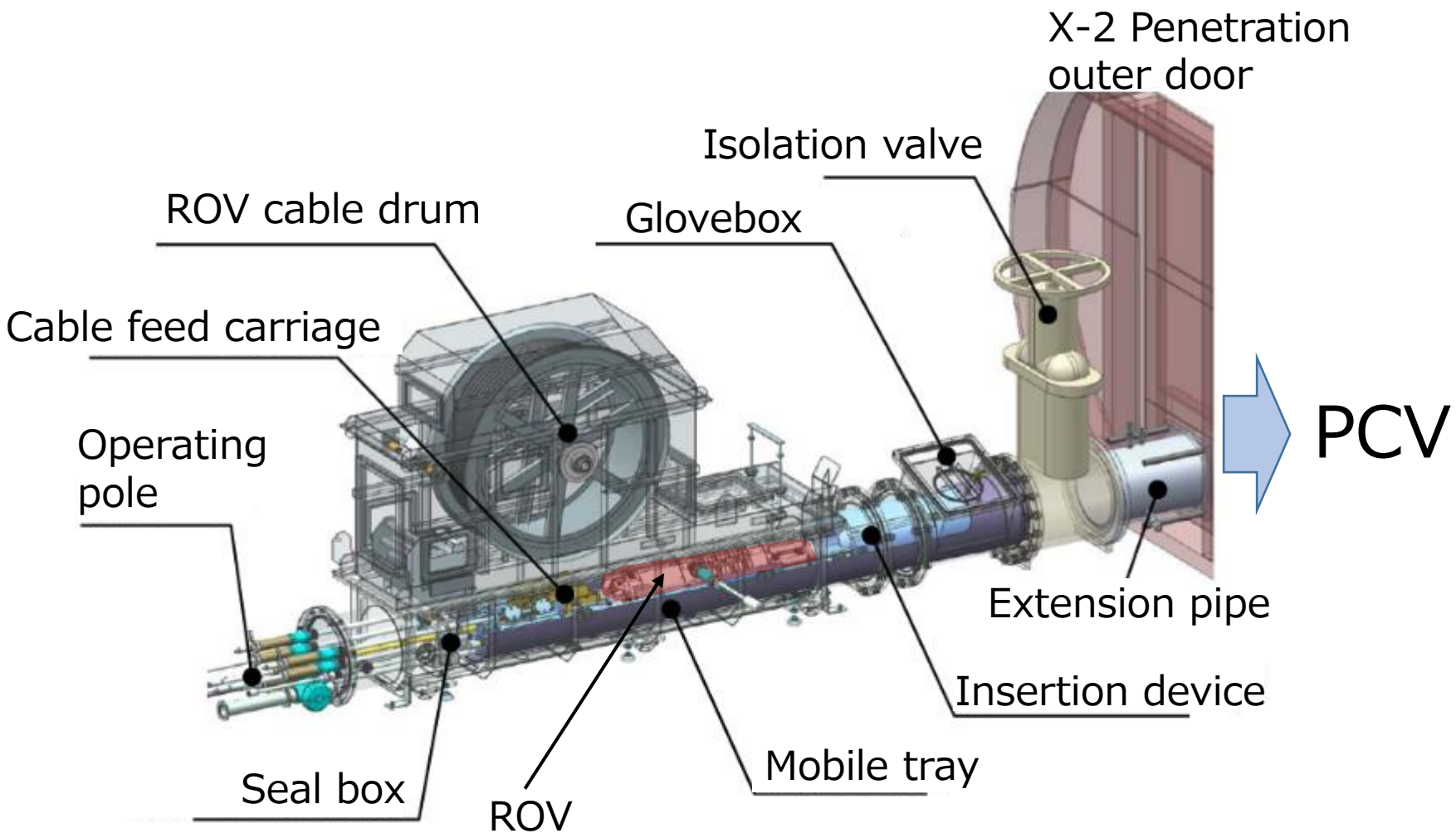
Unit 1 Remotely Operated Vehicles for PCV investigation

6 types of Investigation device used for PCV internal investigation was developed for preliminary measures when swimming in the water inside the PCV, and for investigations.



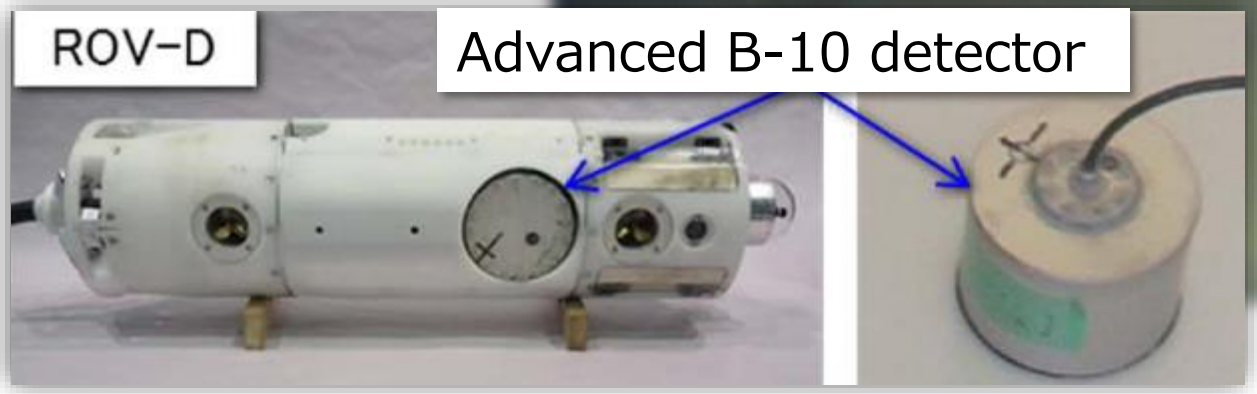
The ROV-A for visual inspection

Unit 1 PCV boundary in combination with ROV cable drum



Unit 1 Nuclear fuel debris was confirmed

Thermal neutron flux was observed near the pedestal opening at all measurement points (48.0, 29.1, 50.2, 5.8/cm^2/sec each).
This result confirms for the first time that the deposit is nuclear fuel debris.



The ROV-D was used for fuel debris detection.
It detects the fuel components contained in the deposits by CZT and B10 counter

Debris/solid waste containers

・Waste with a surface dose rate of less than 30 mSv/h will be collected outdoors (including in tents)

・Wastes with a surface dose exceeding 30 mSv/h are to be stored in containers and then in solid waste storage.

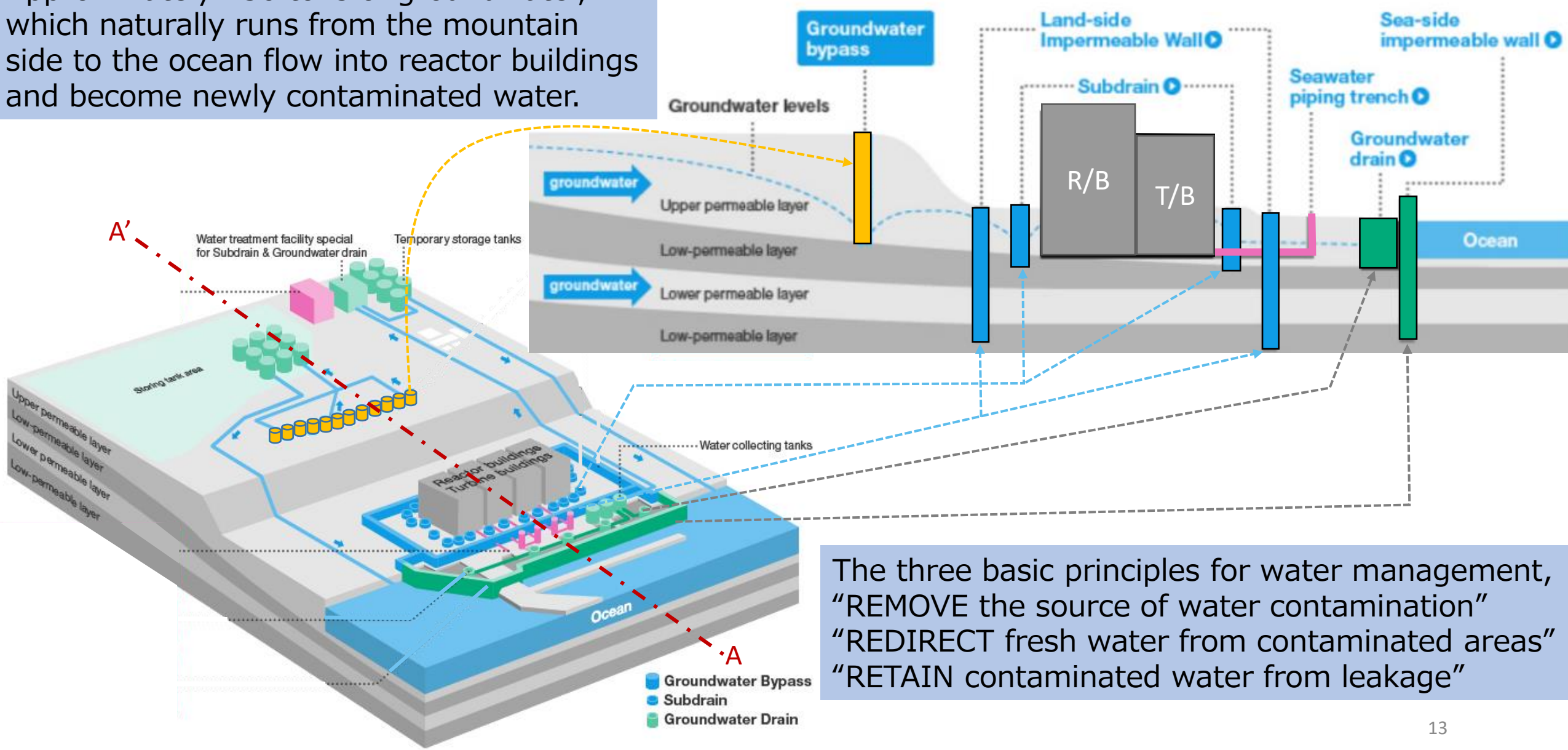
The number of containers stored in the storage area is about 85,000, with about 54,000 debris (about 47,000 combustible and 7,000 non-combustible) and about 31,000 used protective clothing, etc

Volume reduction processing

It is extremely difficult to grasp all the contents of the containers because some of them have been there since immediately after the accident

Groundwater Water Management

Approximately 150 tons of groundwater, which naturally runs from the mountain side to the ocean flow into reactor buildings and become newly contaminated water.



The three basic principles for water management,
"REMOVE the source of water contamination"
"REDIRECT fresh water from contaminated areas"
"RETAIN contaminated water from leakage"

Contaminated water tanks

- As of April 2021, the number of contaminated water tanks is 1047
- Volume of water stored in the tanks is approx. 1.25 million m^3,mainly tritiated water (HTO)
- Tritium average concentration in the water is approx. 620kBq/L
- Total amount of the tritium is approx. 780 TBq

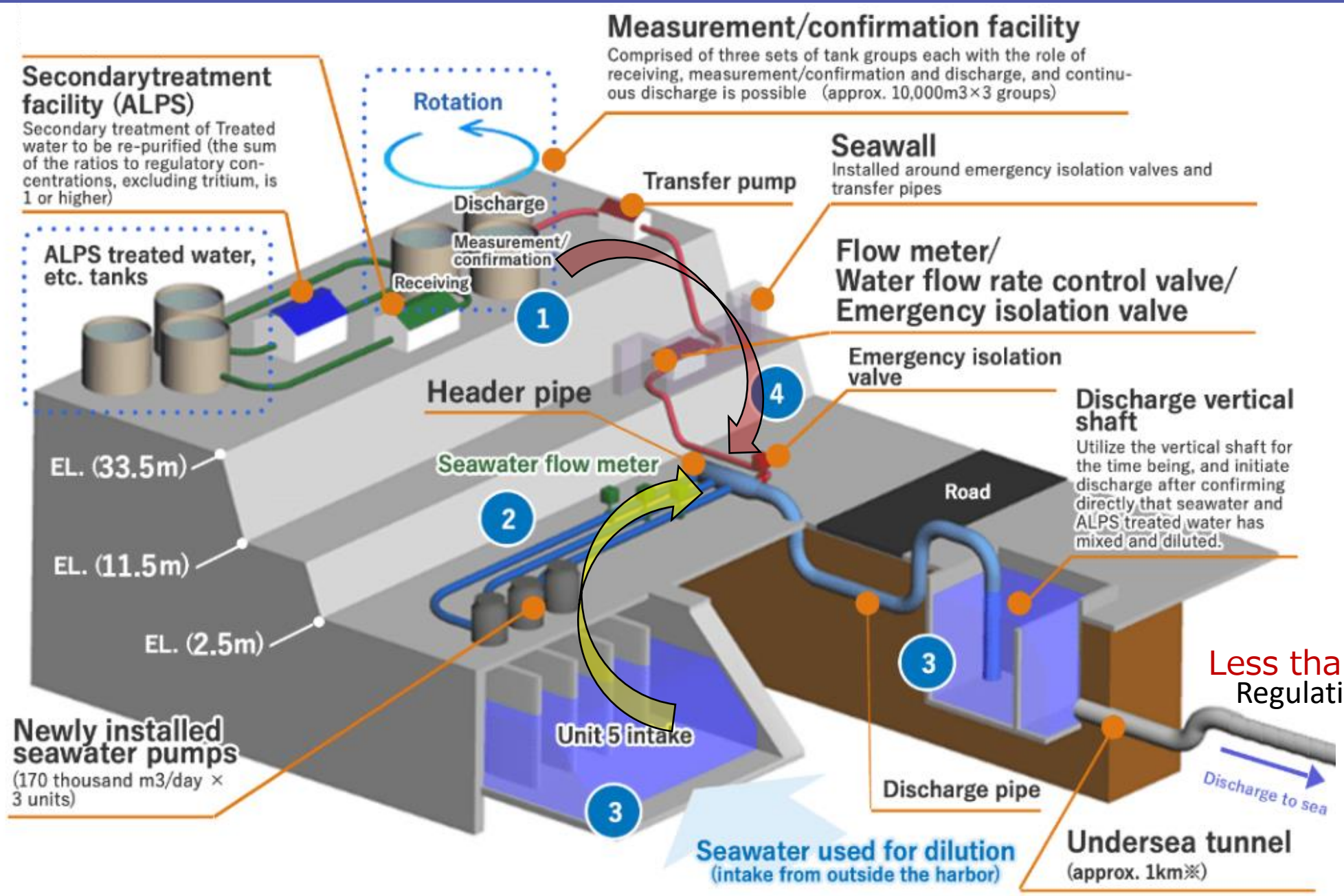
In case of marine discharge

- The tritium concentration at the time of discharge into the sea will be determined on the basis of the operational standard for the “groundwater bypass” and the “sub-drain”

Operational standard:1,500 Bq/L

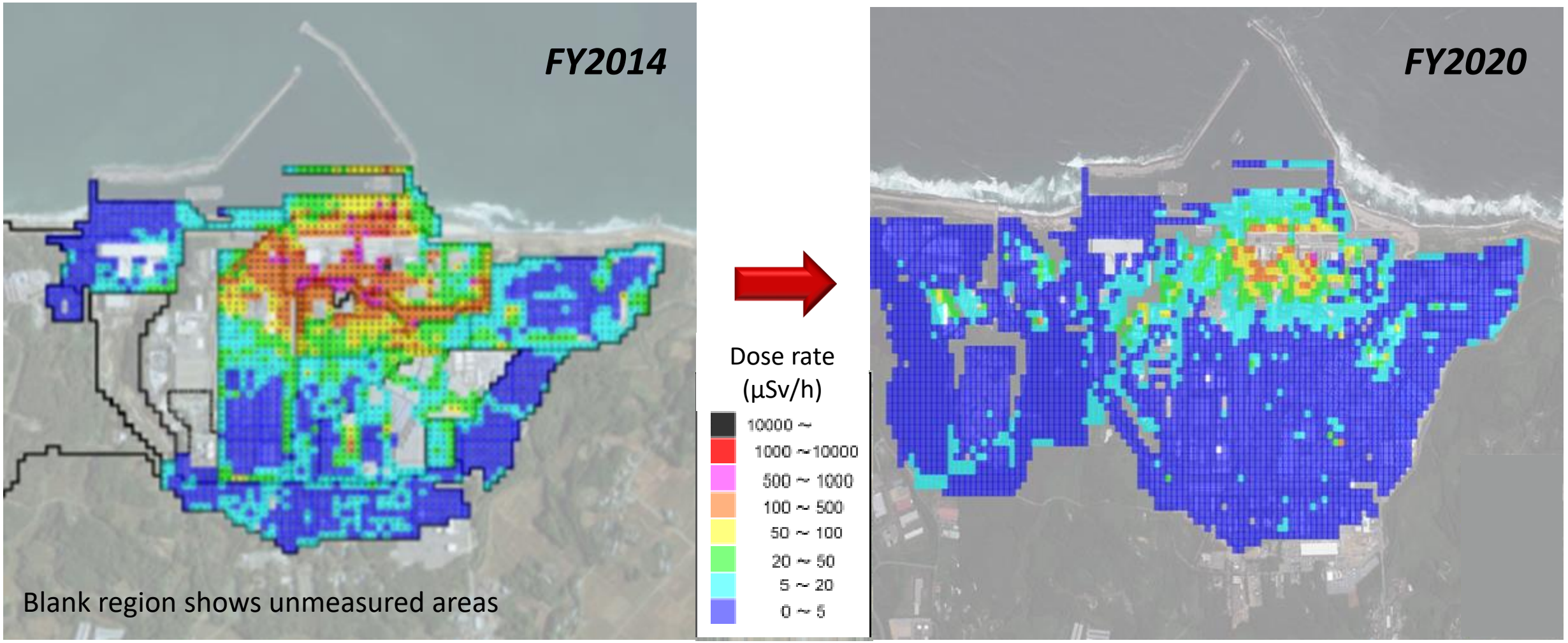
Regulation:60,000Bq/L

Dilute release of tritiated water



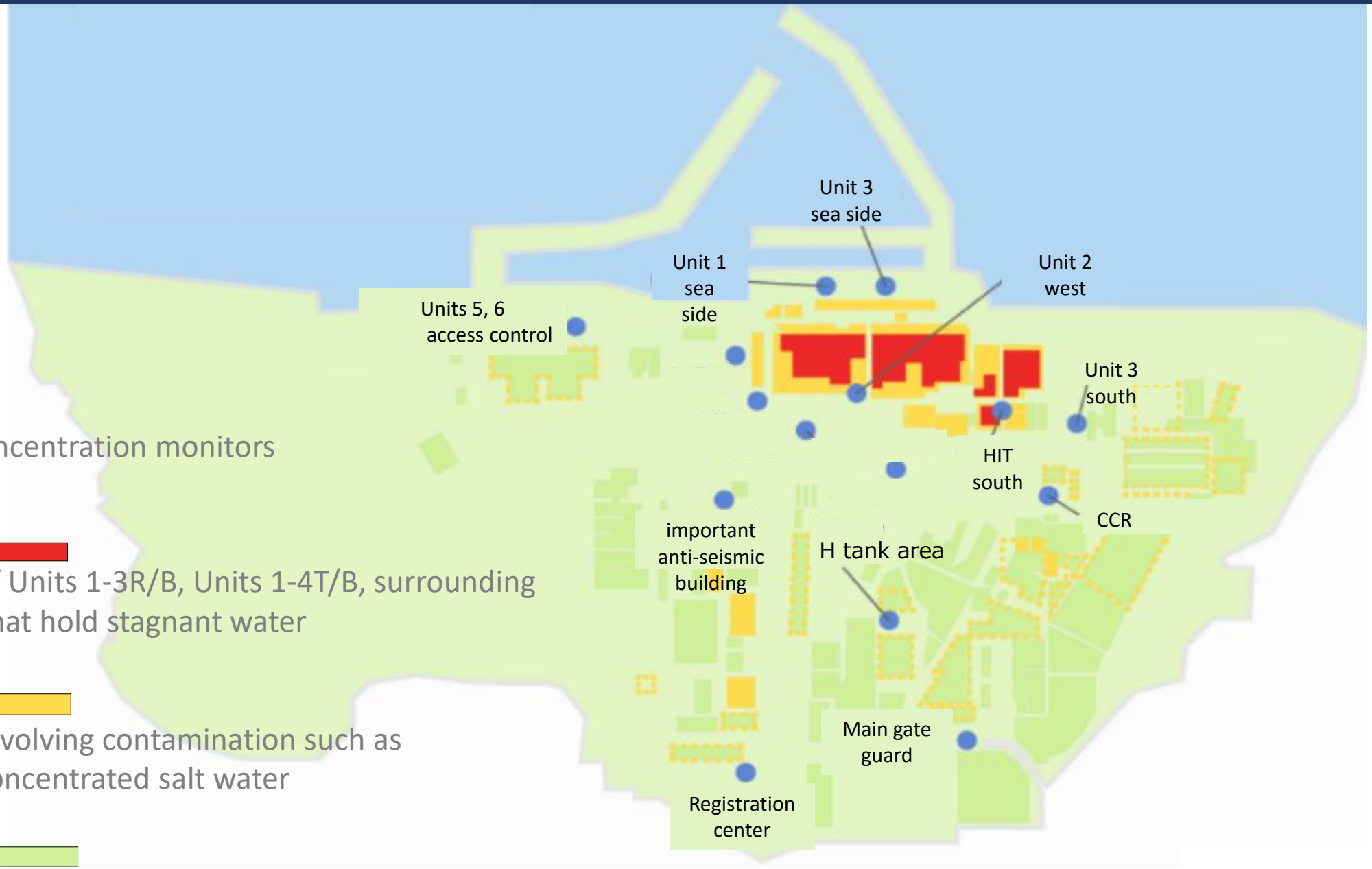
Less than 1500 Bq/ℓ
Regulation:60,000Bq/ℓ

Decrease in air dose rates



Environmental improvements (facings, decontamination, removal of contaminated materials) have reduced air dose rates throughout the premises.
By FY2020, 96% of the premises will no longer require full face mask.

Layout of control zones



Air concentration monitors

R zone

The area of Units 1-3R/B, Units 1-4T/B, surrounding buildings that hold stagnant water

Y zone

For work involving contamination such as handling concentrated salt water

G zone

Radiation protection equipment by category

R zone

Full face mask

Sequentially replaced by full-face masks with positive-pressure electric fans to reduce wearing load and prevent leakage from glasses

Anorak over coverall

Y zone

Full or half face mask

Coverall

G zone

Disposable dust mask

the concentration of radioactive dust

$< 2 \times 10^{-4}[Bq/cm^3]$

General Operating Wear

Exit flow with awareness of internal intake

G ⇔ Y equipment exchange

R/B: R zone

R ⇔ Y equipment exchange

Around R/B:
Y zone, partially R zone

Units 1-4 access control station
-surface contamination inspection-

primary

1回目

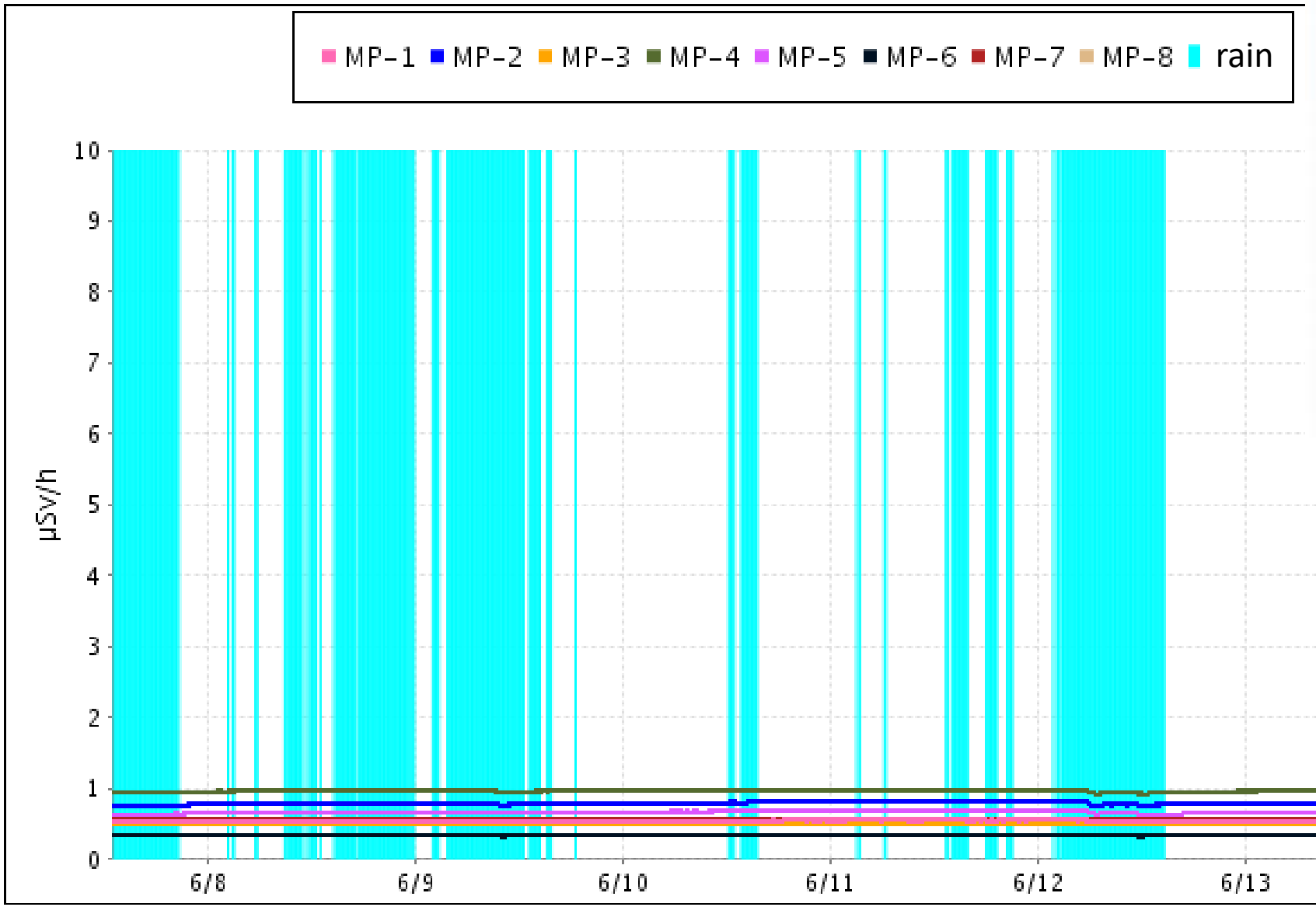
Worker exit flow

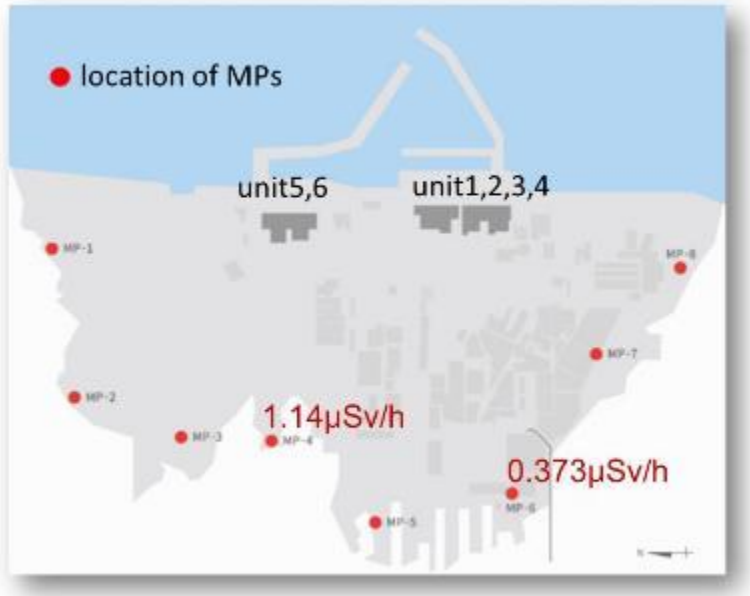
New administrative main building (WBC)

secondary

Access control building
-surface contamination inspection-

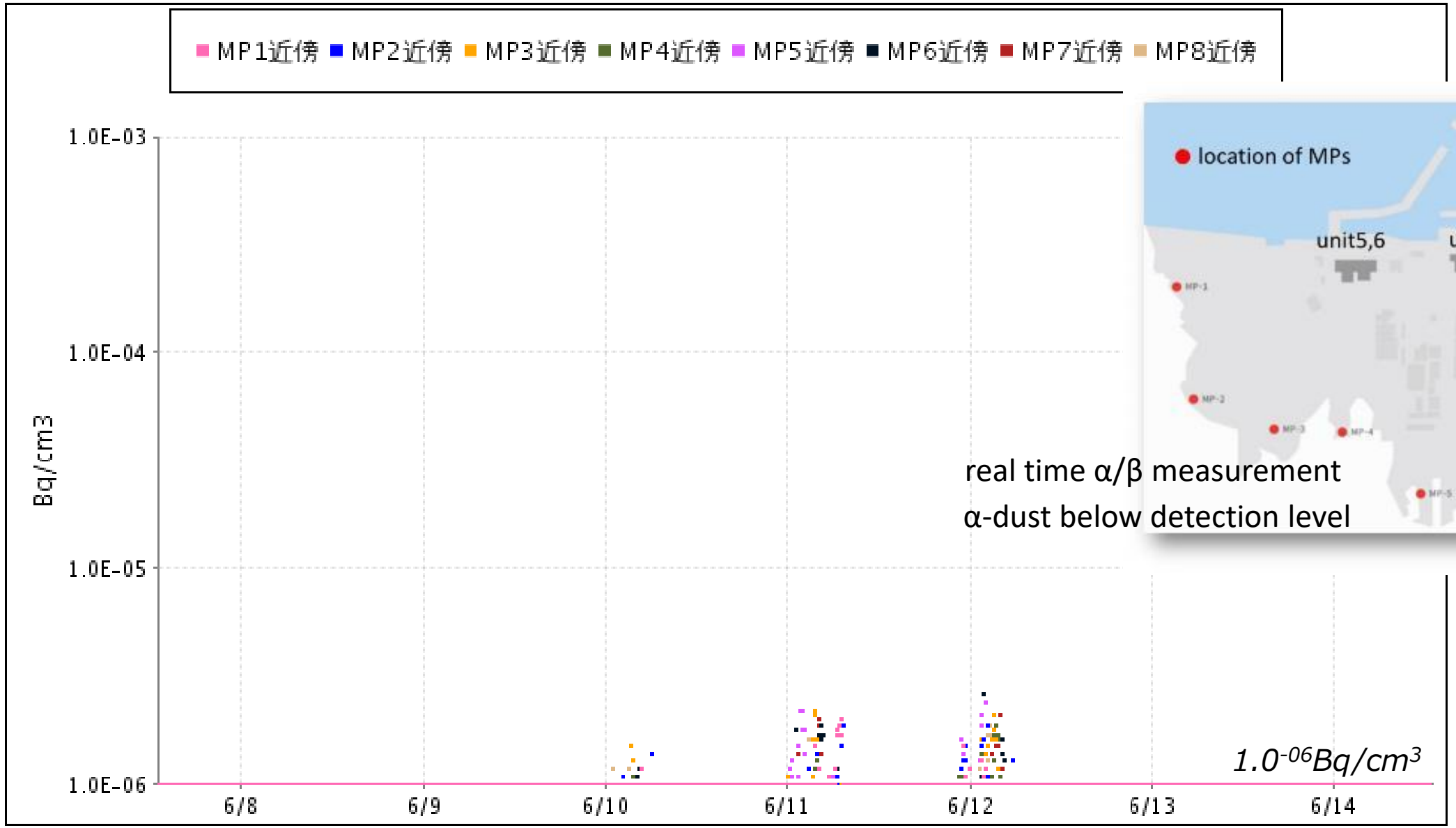
Air dose rates measured at the site boundary monitoring posts





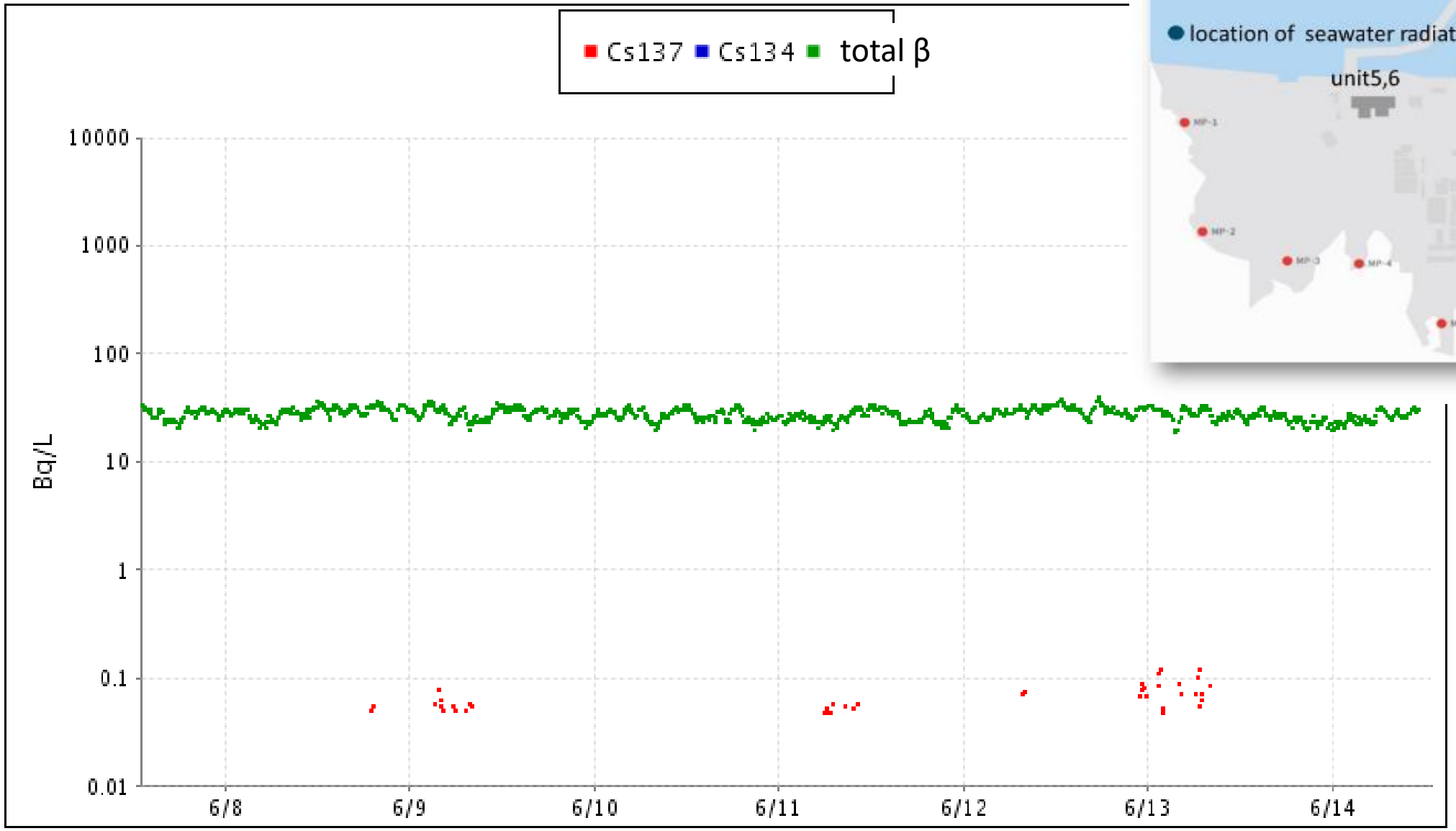
FY2022

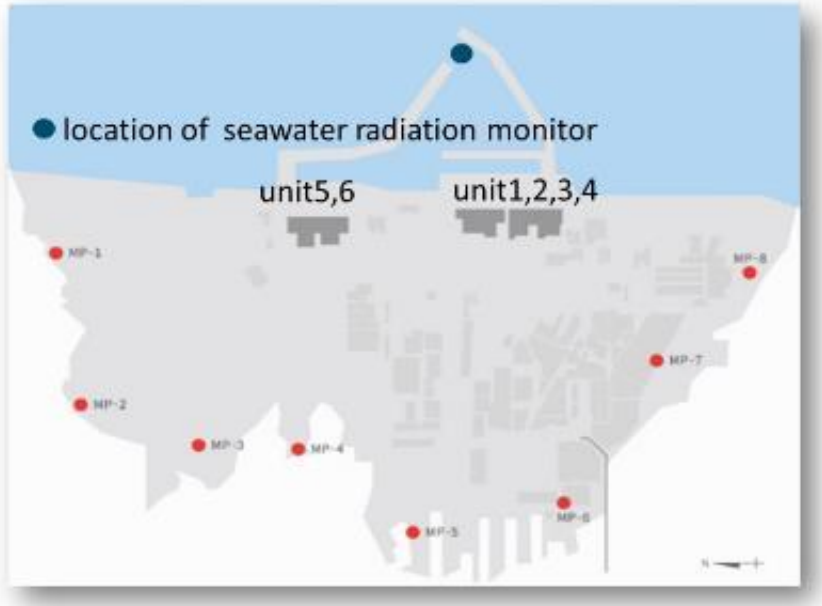
Air concentration measured at the site boundary monitoring posts



FY2022

Concentration of radioactivity in seawater by seawater radiation monitor

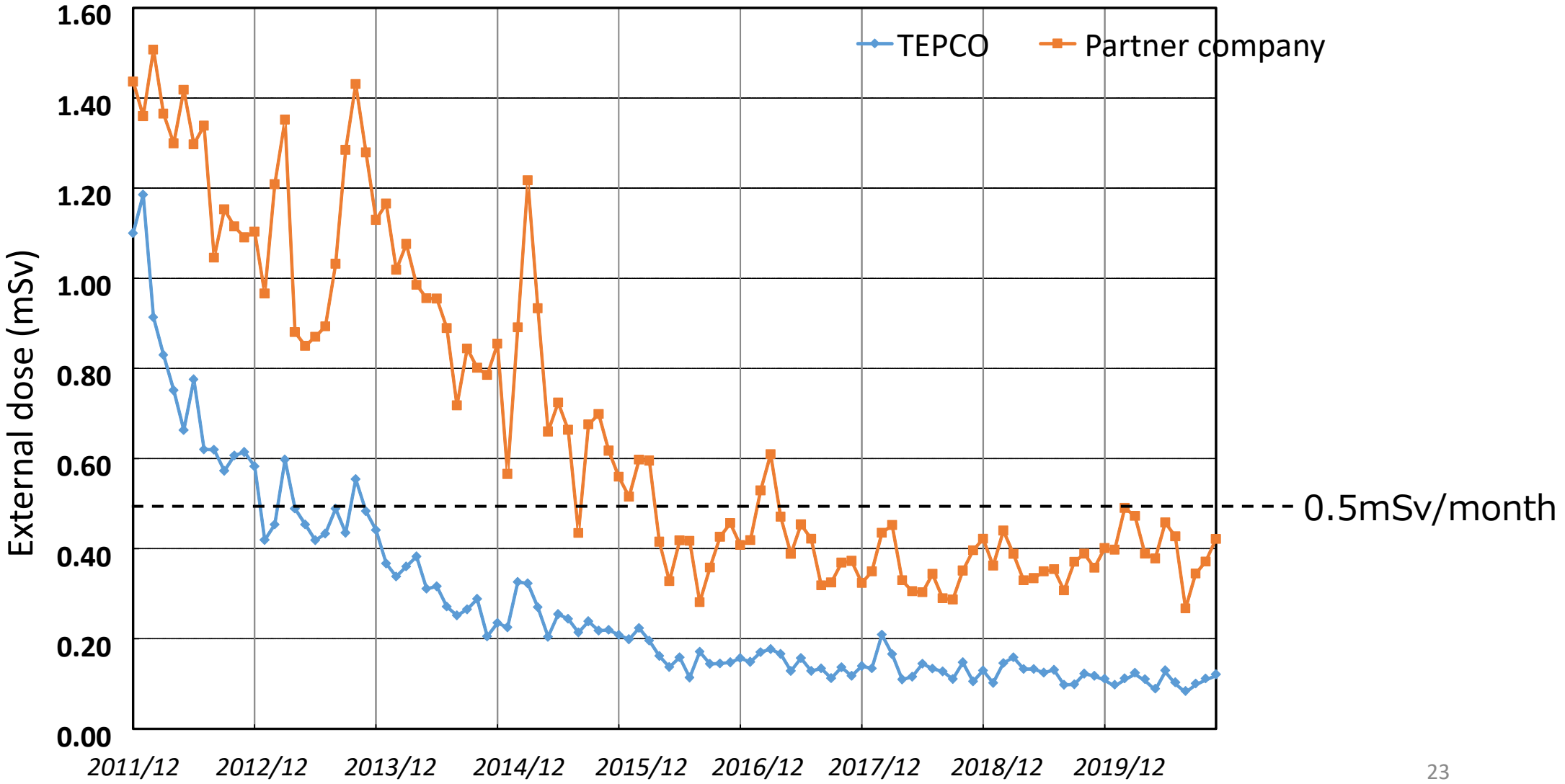




FY2022

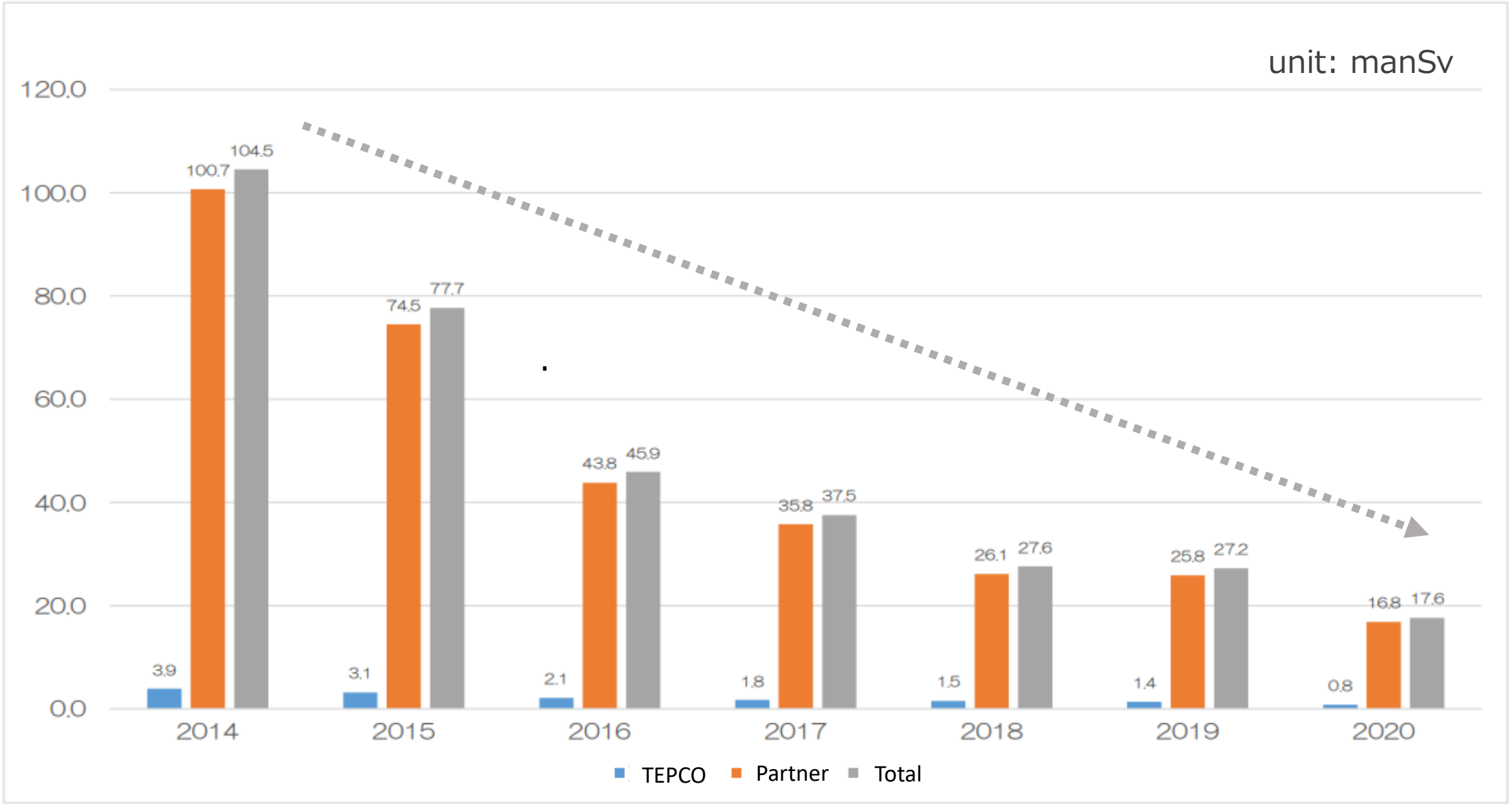
Changes in external radiation dose

since December 2011 -*monthly average dose*-

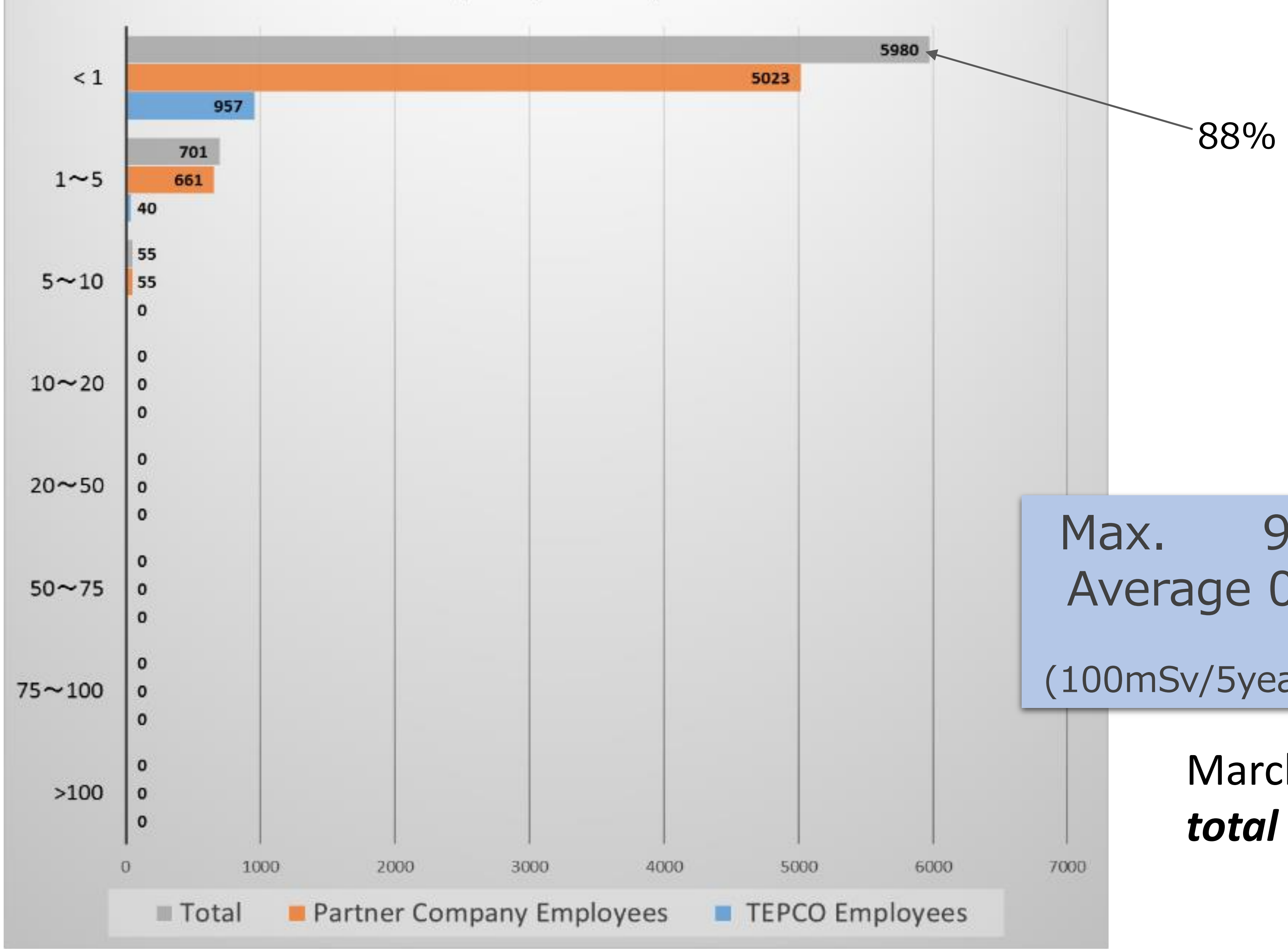


Average number of workers per day

Collective effective dose



External radiation dose distribution for workers



Max.　　9.47 mSv/month
Average 0.39mSv/month

(100mSv/5years=1.67mSv/month)

March 2021
total 6736 workers

Internal exposure

No significant internal exposure (above 2mSv) has been observed since October 2011

toshikazu.suzuki@gmail.com
toshikazu.suzuki@tepco.co.jp