FPCJ Briefing

Fukushima Daiichi Decontamination and Decommissioning
-Current Status and Challenges-

March 4, 2021

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Agenda

1. Water Management
2. Fuel Removal from Spent Fuel Pools
3. Work toward Fuel Debris Retrieval
4. Improved Work Environment
5. Striking a Balance between Reconstruction & Decommissioning

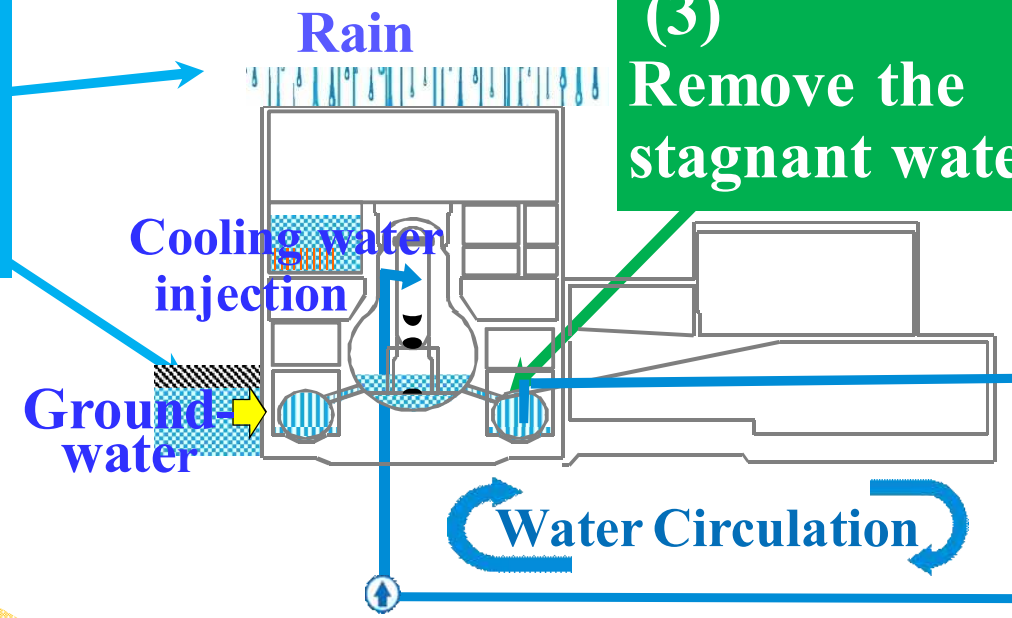
1. Water Management

Major issues surrounding water stored at Fukushima Daiichi

(1) Curb the inflow of ground water & rainy water

(2) Handle the ALPS-treated water

(3) Remove the stagnant water



Reducing cesium & strontium

Desalination

ALPS

Capable of removing 62 kinds of nuclides, other than tritium

Strontium-reduced water (Cesium & Strontium reduced)

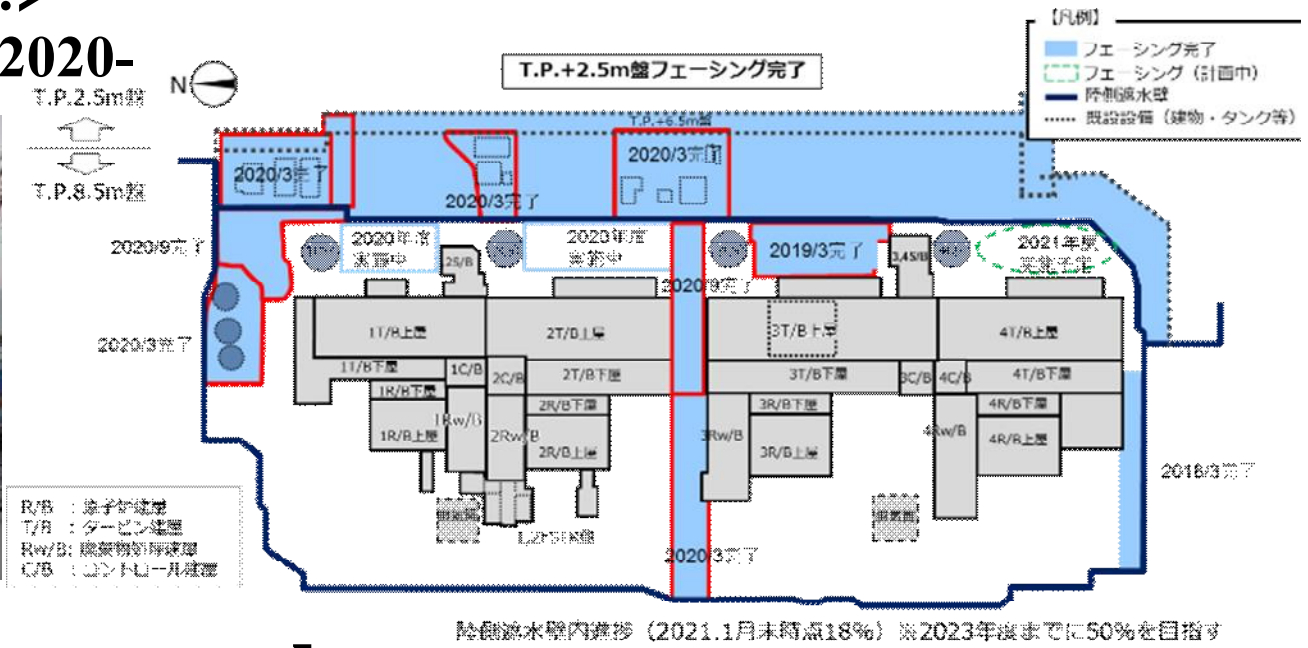
ALPS-treated water

Decrease in the generation of contaminated water

- As a result of measures such as roof covers and pavements around buildings in addition to the Ice Wall and sub-drain well system etc. , contaminated water generation decreased to 140m^3/day in 2020.
- The milestone set in the Mid-and-Long-Term Roadmap (150m^3/day) has been achieved.

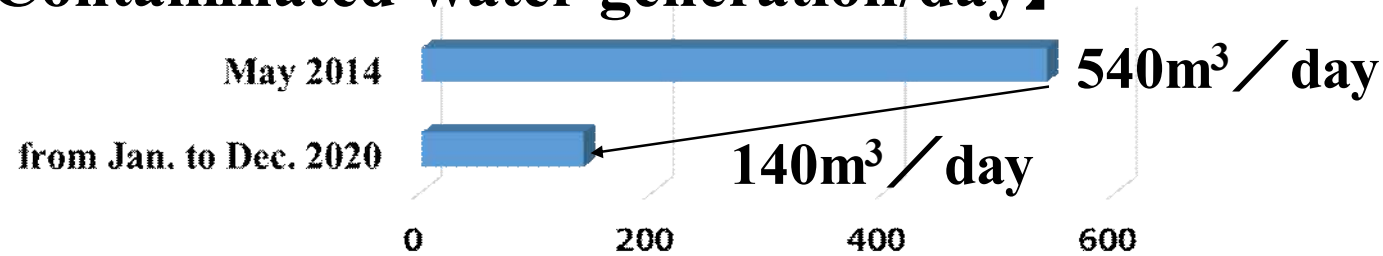
<Countermeasure against rainwater inflow at Unit 3 turbine bldg.>
-Roof cover completed in Aug. 2020-

<Pavement around Units 1 to 4>



陸側遮水壁内凍結（2021.1月末時点18%）※2023年度までに50%を目指す

【Contaminated water generation/day】



Removal (Drying up) of stagnant water in the buildings

<Reactor & Turbine Buildings>

<Centralized Radiation Waste Treatment Facility >

Water injection

To be decreased by half around FY2022 to 2024

Removal Completed in 2020

Process main bldg. (PMB)/ High temperature incinerator bldg. (HTI)

Countermeasure being studied

SARRY/KURIO (Reduce Cs & Sr)

Desalination apparatus

Water Circulation

Cooling water tank

ALPS

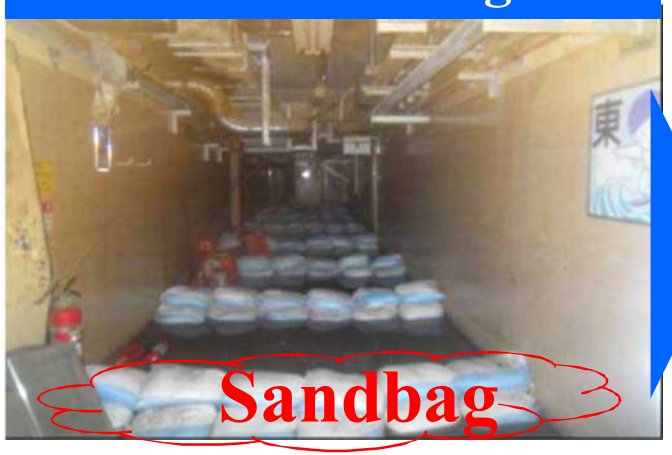
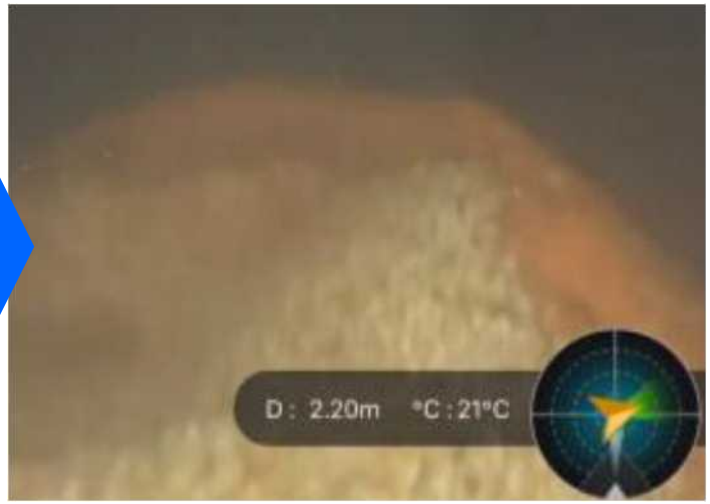
Remove 62 nuclides other than tritium

Sr-reduced water (Cs & Sr reduced)

ALPS-treated water

The high dose detected from zeolite sandbags at the basements of Process main bldg. (PMB) & High temperature incinerator bldg. (HTI)

- In 2018, we investigated the basements of the two buildings and detected high dose rates.
- In 2019, we reinvestigated using an underwater ROV, and the highest measurement from the sandbags in each basement was 3,000 and 4,400 mSv/h.
- A method for collecting the sandbags before drying up is being studied.

	After the accident; Placed sandbags	Current situation; breached sandbags
PMB		
HTI		

Grain from the zeolite bag in PMB (Feb. 2020)

Nuclide	Radioactive concentration [Bq/g]
Cs134	8.0E+06
Cs137	1.3E+08

Handling of the remaining sludge on the floors after drying up

- At the buildings which underwent drying up, there remains sludge on the floors (The amount of radioactive materials is estimated to be 19trilion Bq)
- We are studying a method for its collection, referring to the achievement at the Unit 1 turbine building.

The amount of radioactive materials※1

Remaining sludge after drying up※2		1.9 E13 Bq (=19trillion Bq)
Reference	Stagnant water (Units 1-3 Reactor Bldgs, PMB, HTI)	5.5 E14 Bq
	Zeolite sand bags	3.6 E15 Bq
	Sludge from decontamination apparatus	2.0 E17 Bq

※1 May change depending on the increased sample data
※2 Estimate for the buildings which underwent drying up

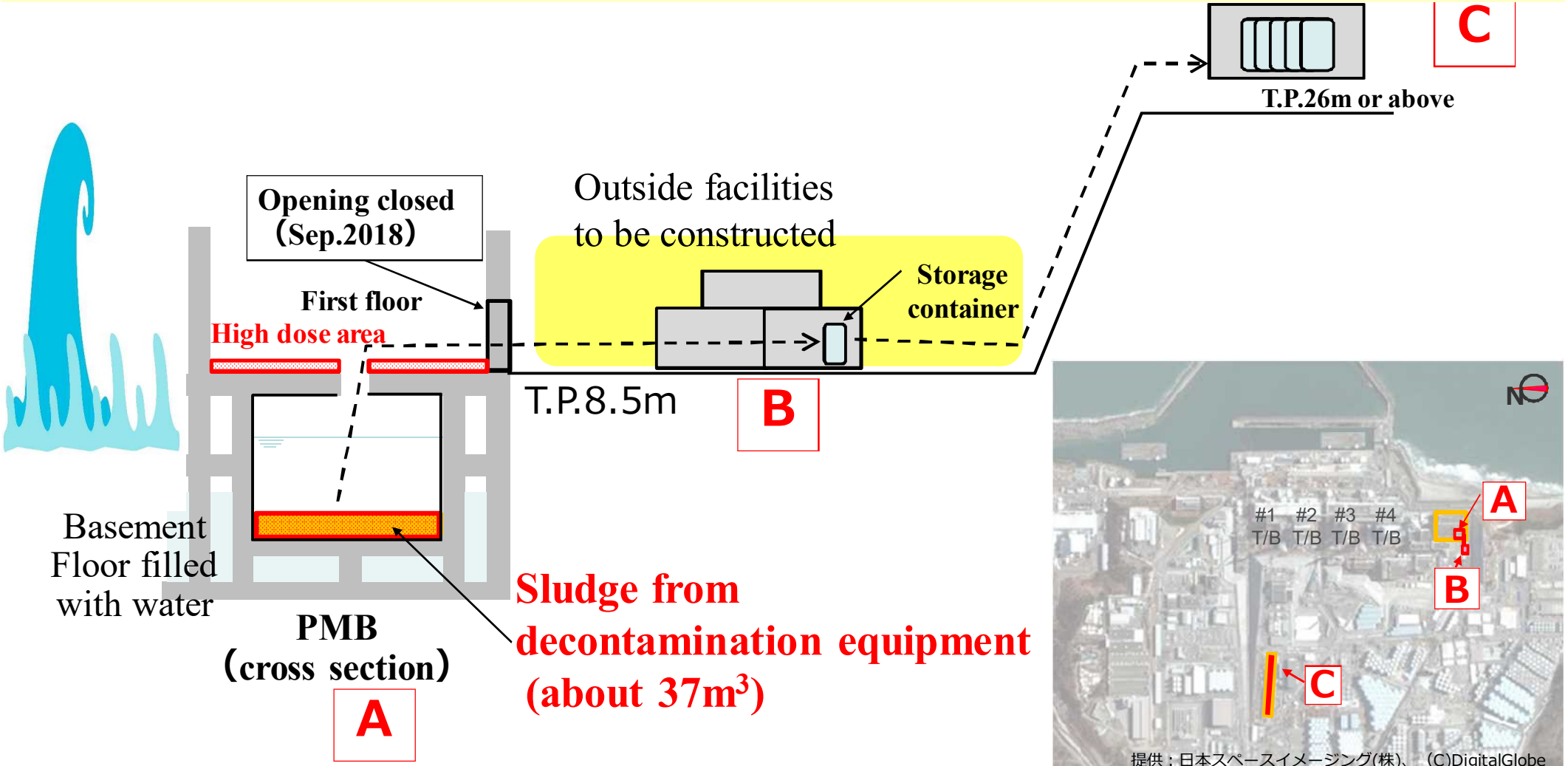
Example at a mezzanine floor above the basement of Unit 1 turbine bldg.

Sludge collection by using a ROV & manual labor

<Air dose rate>
~8.5mSv/h ~1.1mSv/h

Transportation plan of sludge generated from decontamination apparatus

- The sludge from a decontamination apparatus (AREVA) which was operated temporally after the accident, is stored in D tank at PMB.
- As a precaution against a tsunami which might surpass the largest recorded one, the transportation of the sludge to a high place is being planned.
- Now that the design is finished, the extraction will be carried out in FY2023.



2. Fuel Removal from Spent Fuel Pools

Overview of tasks toward fuel removal

Units 1 & 2 | Unit 3 | Unit 4

Removal of rubble & Decontamination etc.	Installation of fuel removal facility	Fuel removal	Storage & Transportation

Unit 1
(Removal to start in FY2027 to 2028)

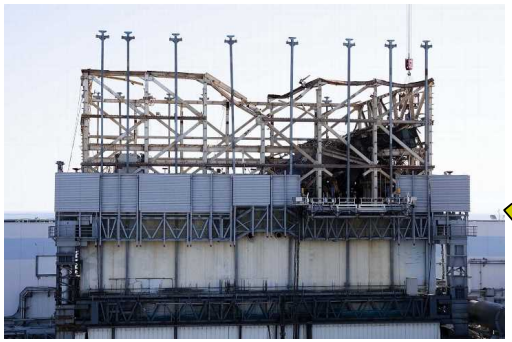
Unit 2
(Removal to start in FY2024 to 2026)

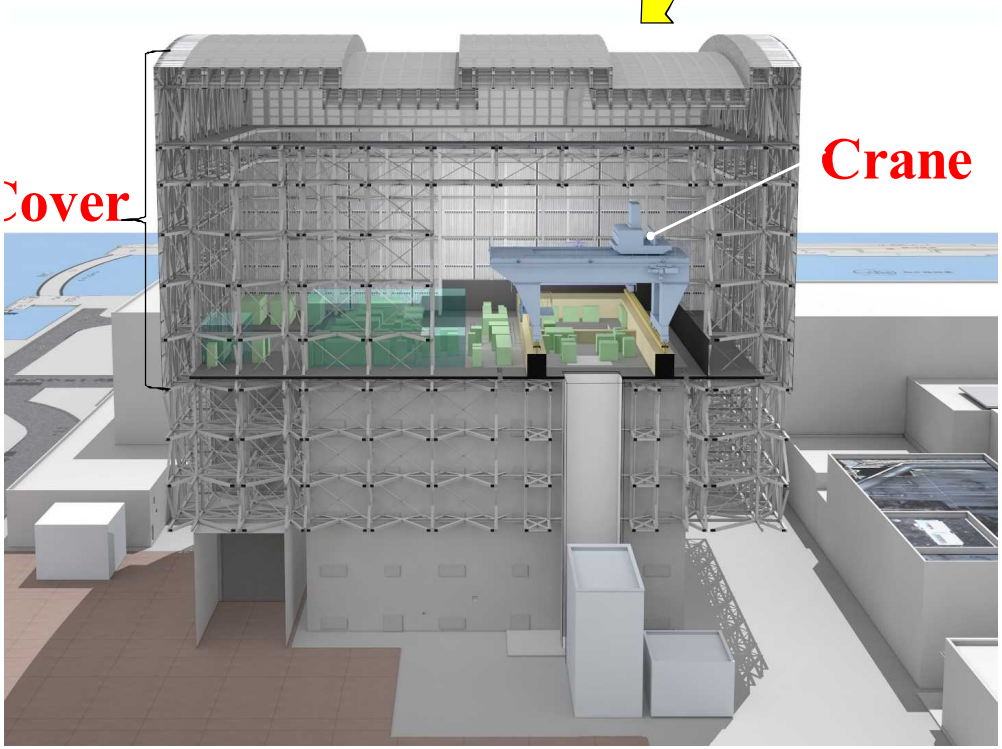
Unit 3
(Removal completed on Feb. 28)

Method of fuel removal at Units 1 & 2

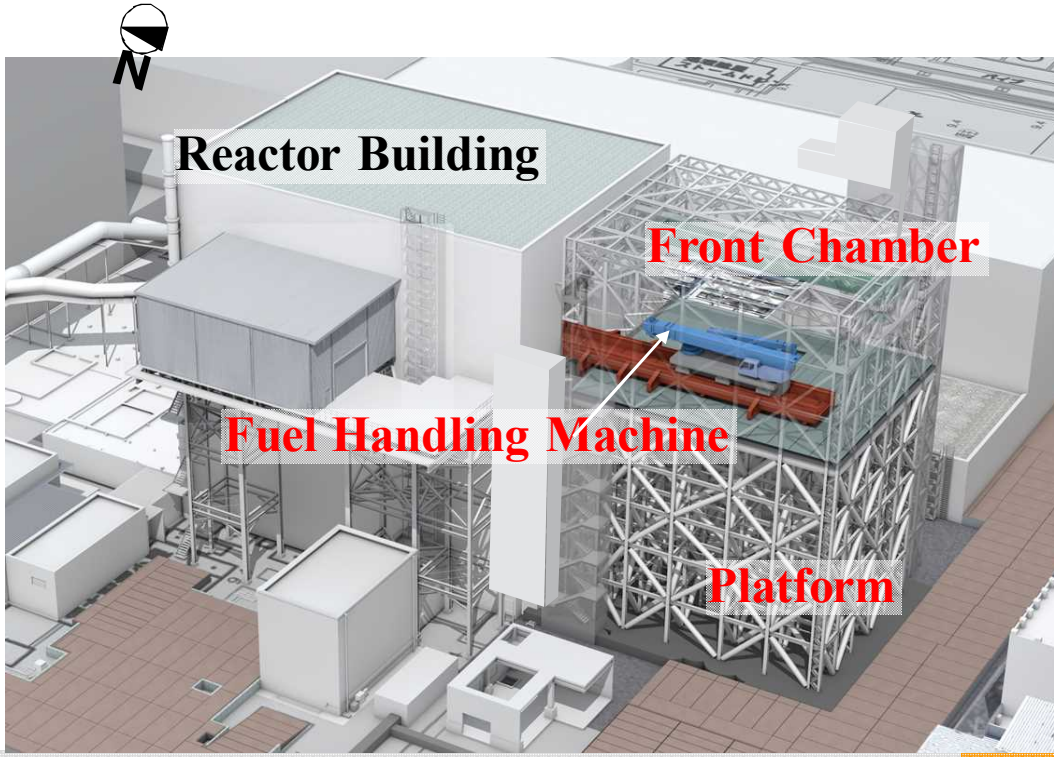
- As the return of local residents and reconstruction efforts make progress, we put premium on their safety and peace of mind by preventing radioactive dust from scattering.

<Unit 1>





<Unit 2>



Rubble accumulated over the spent fuel pool at Unit 1

- **Removing layers of rubble over the spent fuel pool in the south side is a big challenge.**

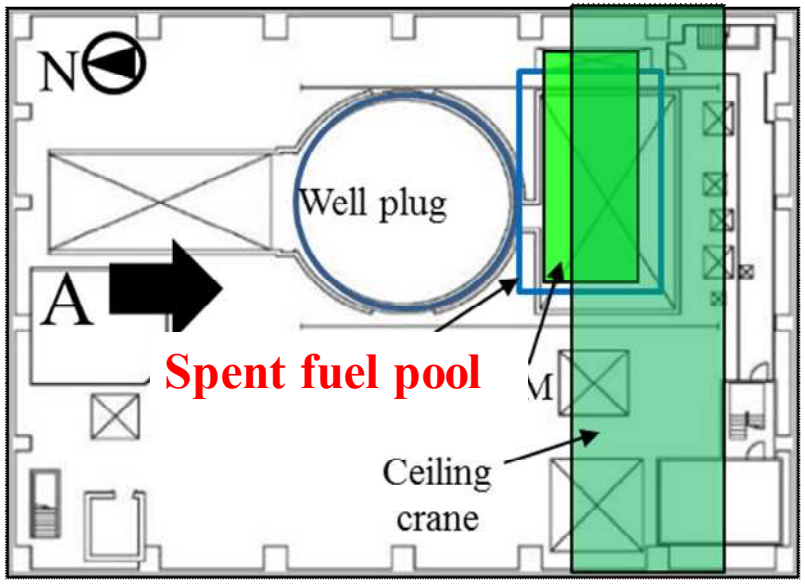


Figure 1 Refueling floor layout plan

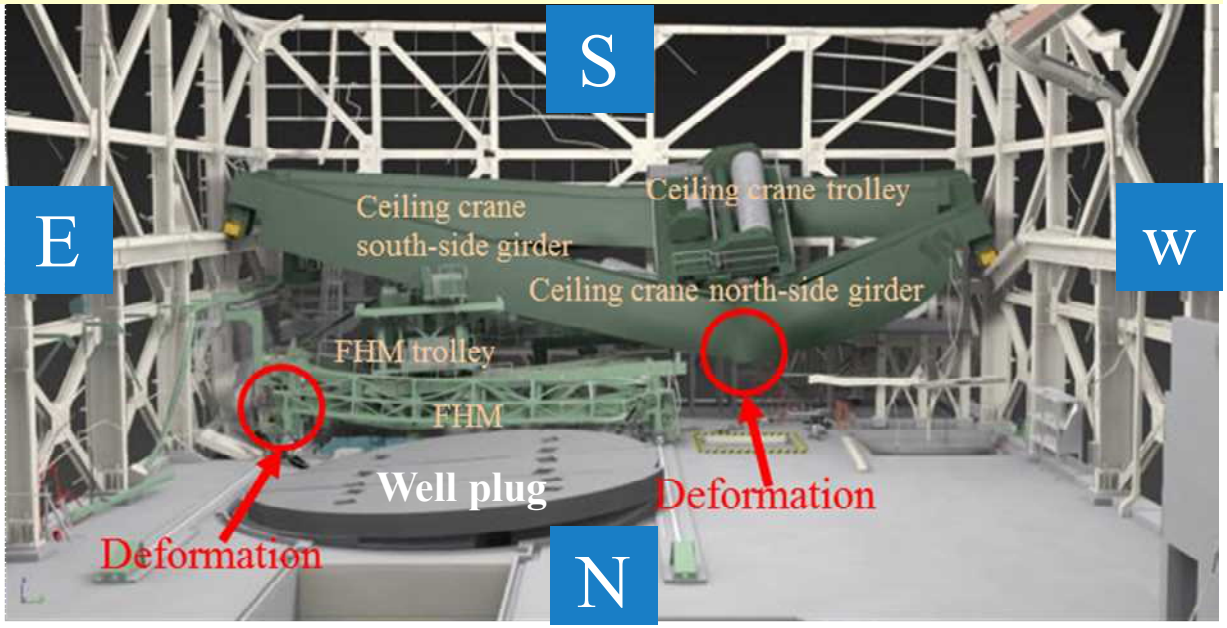
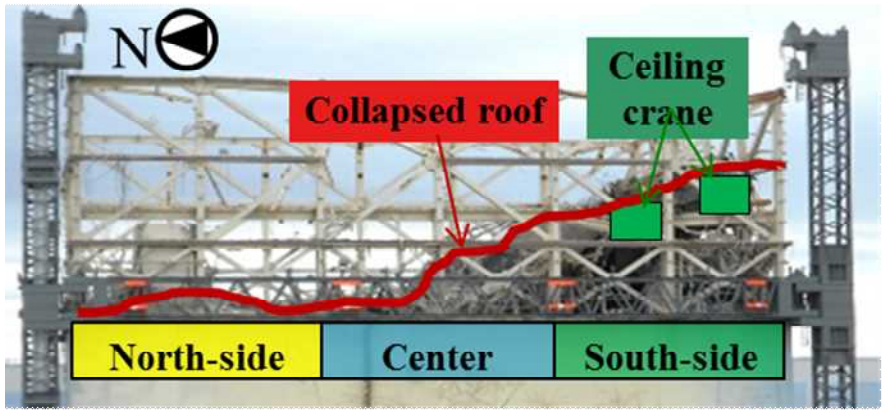


Illustration of the ceiling crane & fuel handling machine (view from A)



Condition of the collapsed roof

South-side collapsed roof (A)

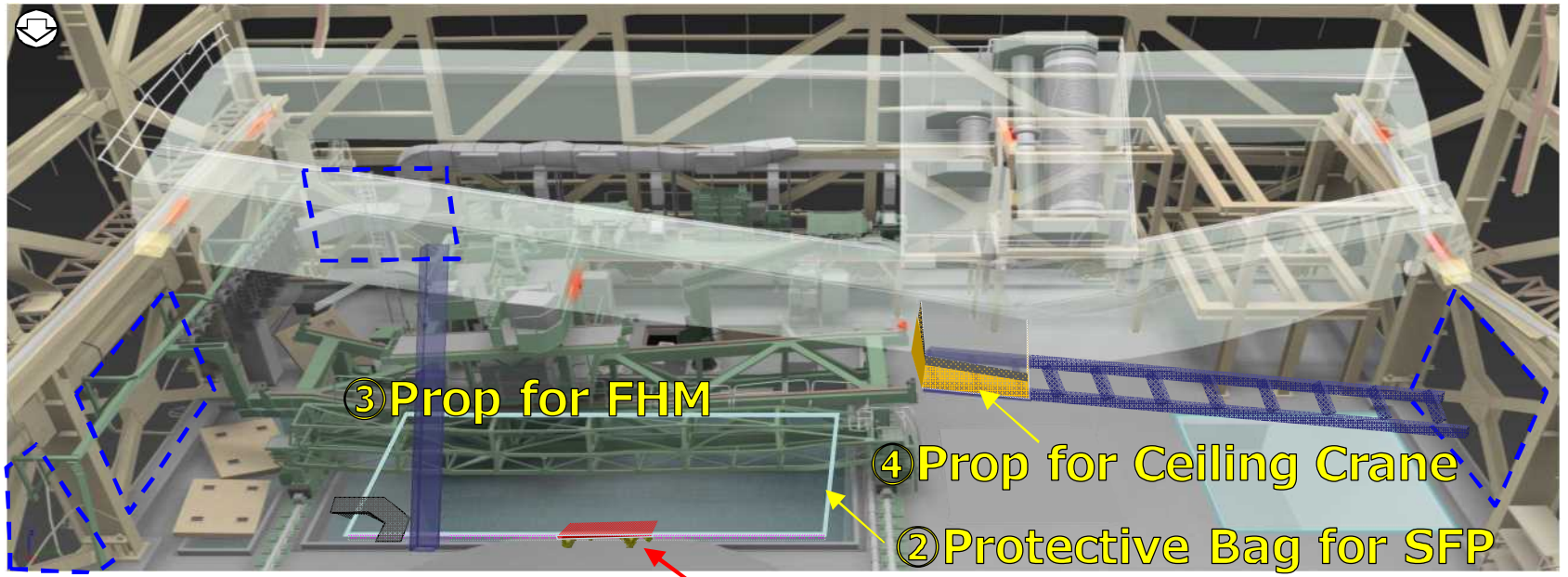
Measures to reduce the risk of rubble falling at Unit 1

■In the lead-up to the rubble removal on the south side, measures have been taken to reduce the risks of possible rubble falling into the spent fuel pool (SFP) area.

① Installation of SFP gate cover (Mar. 2020)
Reducing the risks of water loss due to the damage to the SFP gate caused by falling roof frames and other rubble.

② Installation of protective bag on SFP (Jun. 2020)
Reducing the impact on the fuel assemblies in the pool caused by falling frames and other rubble.

③ Installation of prop for FHM (Oct. 2020), ④ Installation of prop for crane (Nov. 2020)
Reducing the risk of dust scattering and impact on fuel assemblies caused by falling roof frames.



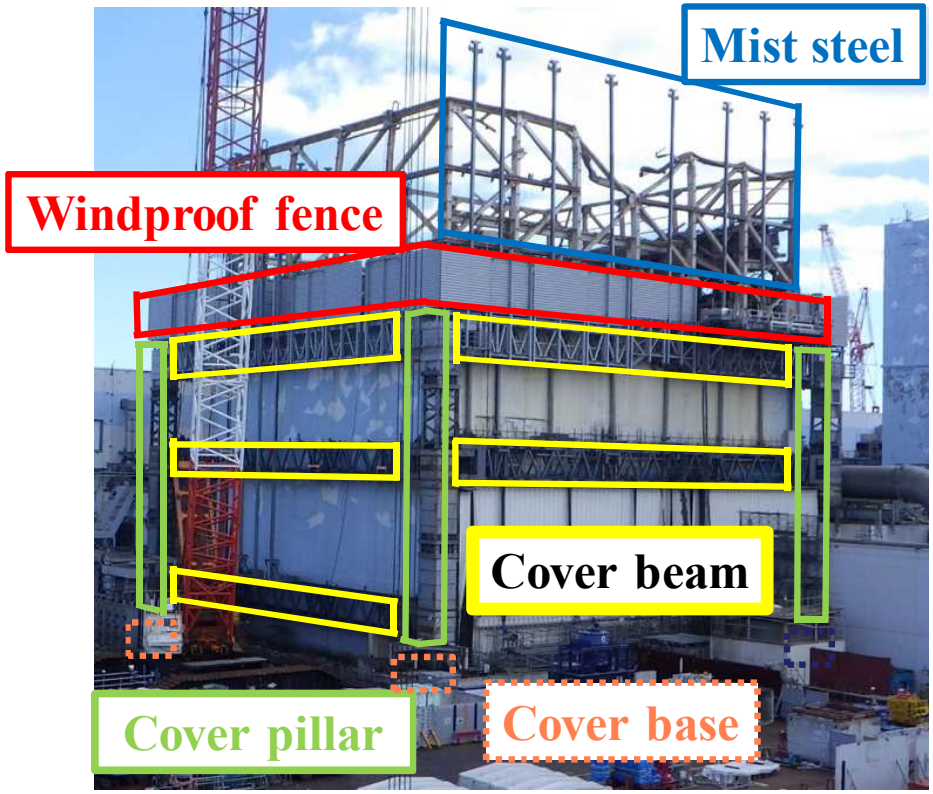
: X Brace removed

Toward the installation of the large cover at Unit 1

- Prior to installation of the large cover, work to dismantle the previous, remaining part of the cover commenced in December 2020.
- The installation of the large cover will start in the first half of FY2021.

Current Status

Dismantlement of windproof fence & mist steel → Dismantlement of cover beam & pillar → Dismantlement of Cover base → Dismantlement completed



Full view (as of Mar. 2020)

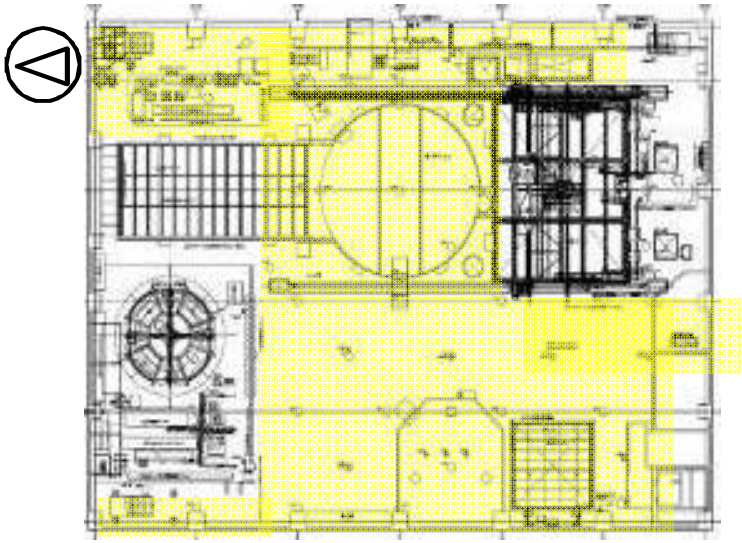
Dismantlement of windproof fence (as of Dec. 19, 2020)

Investigations inside Unit 2 reactor building

- In June 2020, the inside of the Unit 2 spent fuel pool was investigated for the first time since the accident. No obstacle to hinder the upcoming removal was detected
- Dose measurement on the refueling floor commenced this Feb.

Investigation inside the spent fuel pool (Jun. 2020)

Dose measurement on the refueling floor (from Feb. 2021)

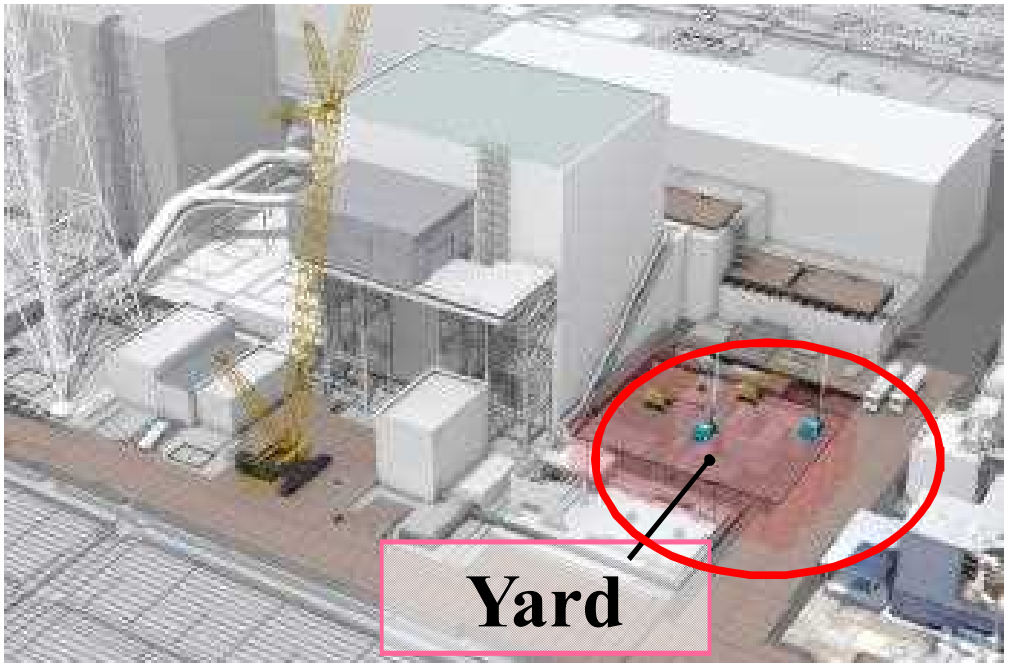


Measurement area

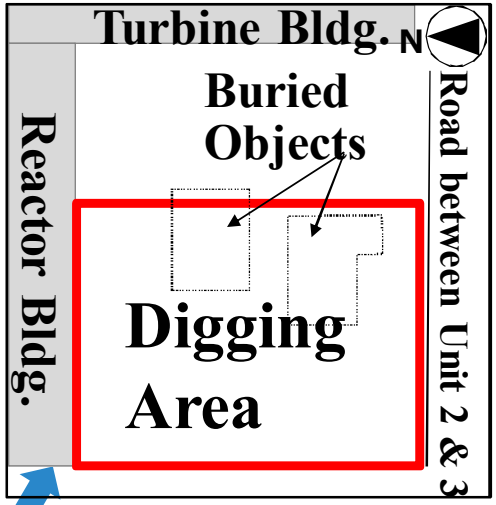
ROVs for investigation			
ROV	 BROKK400D	 Kobra	 Packbot
Task	・Measurement via γ camera	・Measurement of air dose rate & surface contamination ・Measurement assistance	

Yard arrangement for the installation of the platform at Unit 2

- Yard arrangement and dose measurement are underway
- After the installation of the platform, an opening will be created on the south wall to be used for the fuel removal



Removal of buried objects underway (Digging & Removal)



Completion of fuel removal at Unit 3 (Feb. 28)

- We overcame the issue of deformed handles and hindrance by rubble etc.
- We succeeded in removing 566 fuel assemblies in all ahead of scheduled.

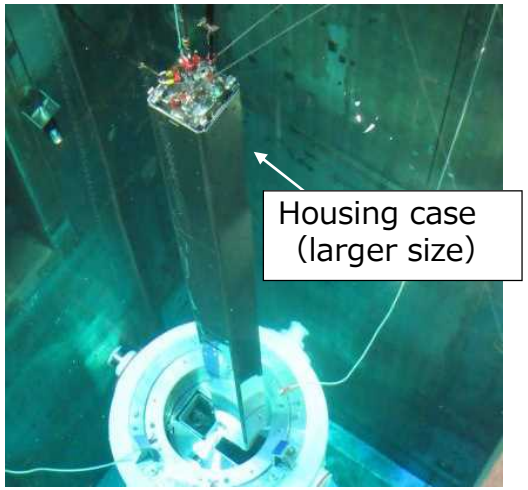
Removal of fuel with a deformed handle (from Feb. 3)

Spent fuel pool at Unit3

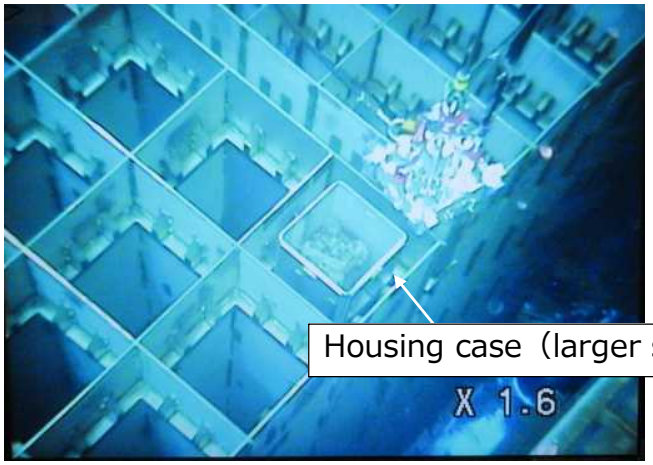
Hoisting

Loading into transportation canister

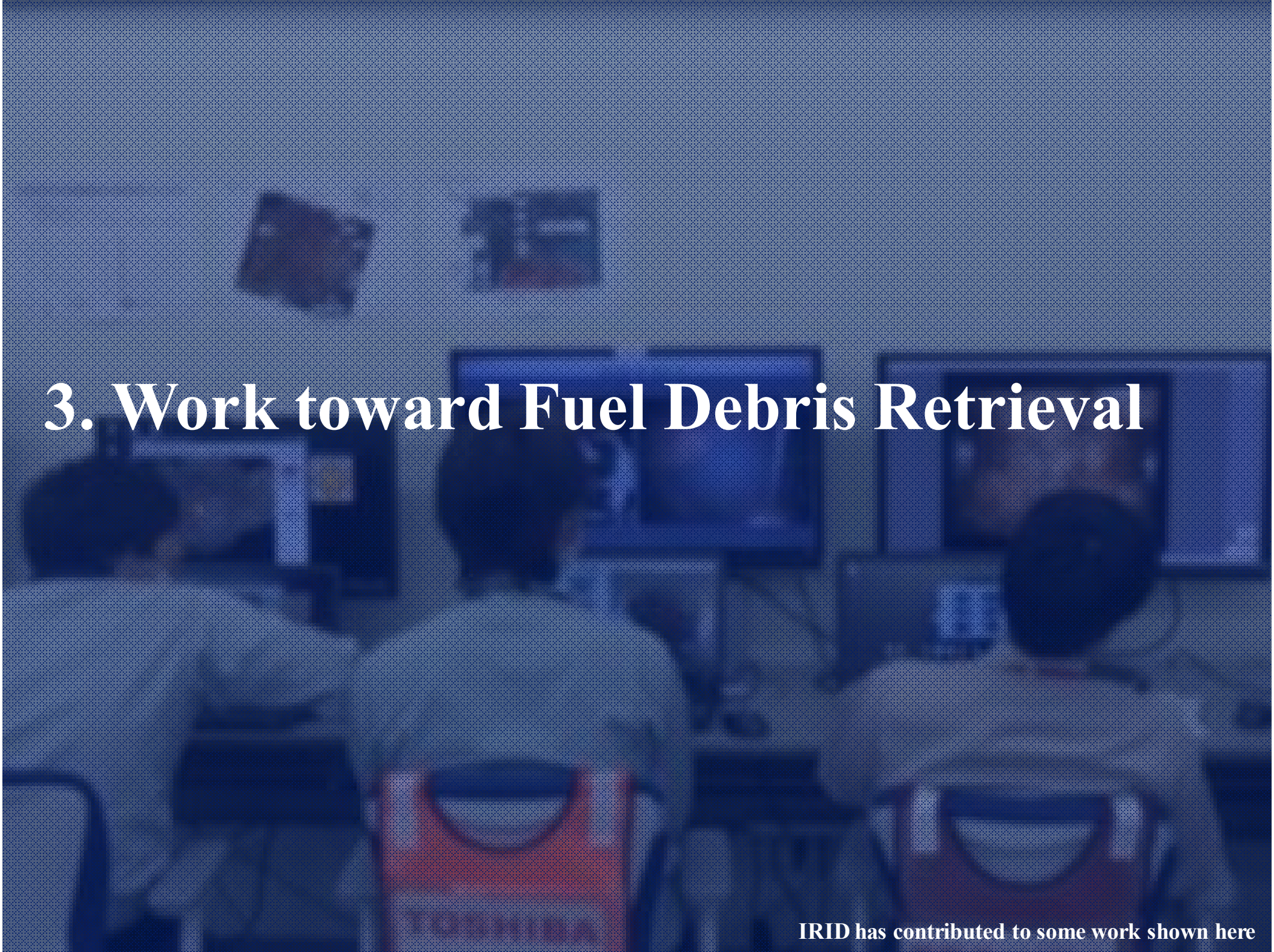
Common pool



Hoisting a housing case (larger size)



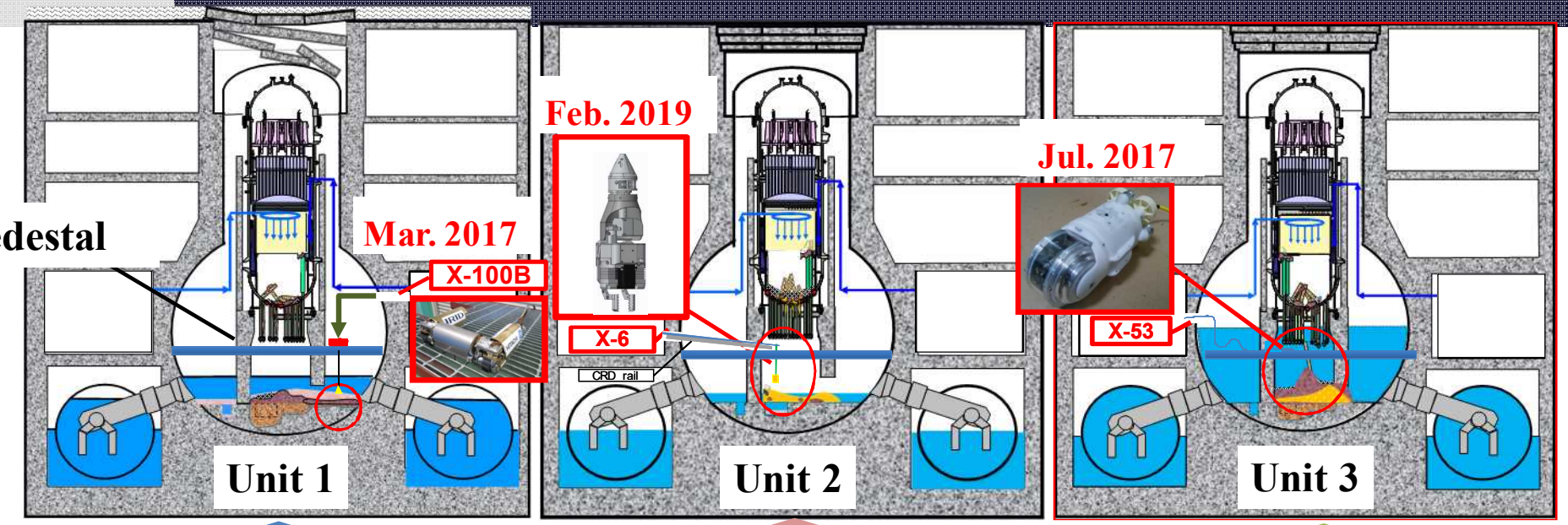
Loading into fuel rack



3. Work toward Fuel Debris Retrieval

IRID has contributed to some work shown here

Assumed distribution of fuel debris



Time	Investigation
Feb. to May. 2015	Investigation of reactor core using muon analysis method
Apr. 2015	Investigation on the 1st floor grating using shape-changing robots (outside pedestal)
Mar. 2017	Investigation of the lower part of PCV by hanging sensor equipment from the 1st floor grating (outside pedestal)

Time	Investigation
Mar. to Jul. 2016	Investigation of RPV using muon analysis method
Jan. to Feb. 2017	Distortion of the grating found by investigation using a telescopic guide pipe
Jan. 2018	Shooting the deposits at the bottom, using a camera attached to the tip of the modified telescopic guide pipe
Feb. 2019	Contacting and shooting the deposits using a finger-like device attached to the tip of the telescopic guide pipe

Time	Investigation
May to Sep. 2017	Investigation of RPV using muon analysis method
Jul. 2017	Investigation inside the PCV using a remotely operated vehicle

※The analysis of accident progression is also factored in.

Trial retrieval to start at Unit 2 in the near future

First Fuel debris retrieval to start at Unit 2

- **The progress in reactor internal investigations, improvement of the environment and there being no interferences to fuel removal are the main factors in Unit 2 being chosen.**

		Unit 1	Unit 2	Unit 3
Safety	Dose at the workplace	High (approx. 600mSv/h)	Low (approx. 5mSv/h)	Slightly high (approx. 10mSv/h)
	Containment of radioactive materials	Slightly high airtightness	High airtightness (no hydrogen explosion and sound building integrity)	Low airtightness
Certainty	Condition of debris	No information	Information obtained	Information obtained
	Access route	No information	Information obtained	Information obtained
Obstacles		Removal of high-dose pipes is required	Workplace improved	Decrease of water level inside PCV is required
Interference to fuel removal		Yes	No	Yes

Fuel debris retrieval at Unit 2

- The first trial retrieval to be rescheduled for FY2022 due to the corona virus in the U.K.
- Stepwise expansion of the retrieval scale to follow after the first trial.

Experimental retrieval

Robot arm

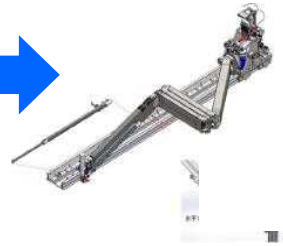
Collection equipment

Metal brush

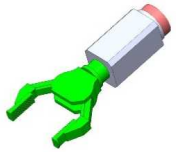
Vacuum container

Stepwise expansion of the scale

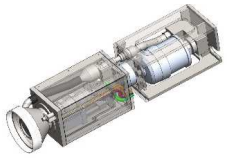
Robot arm



Collection equipment

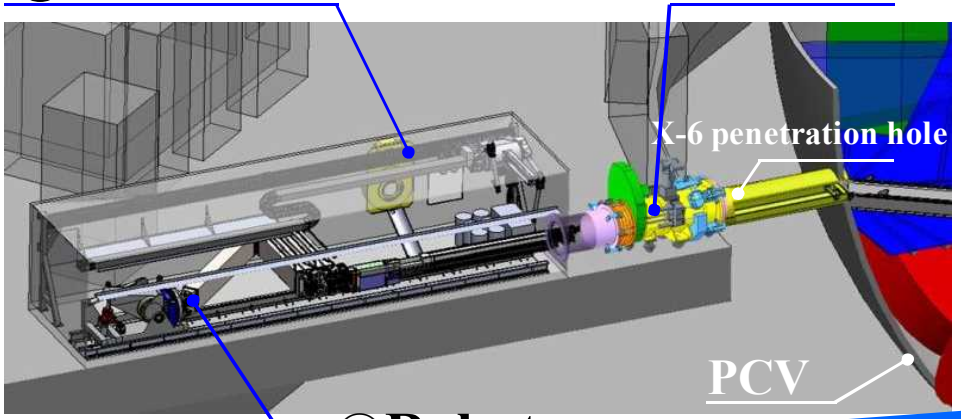


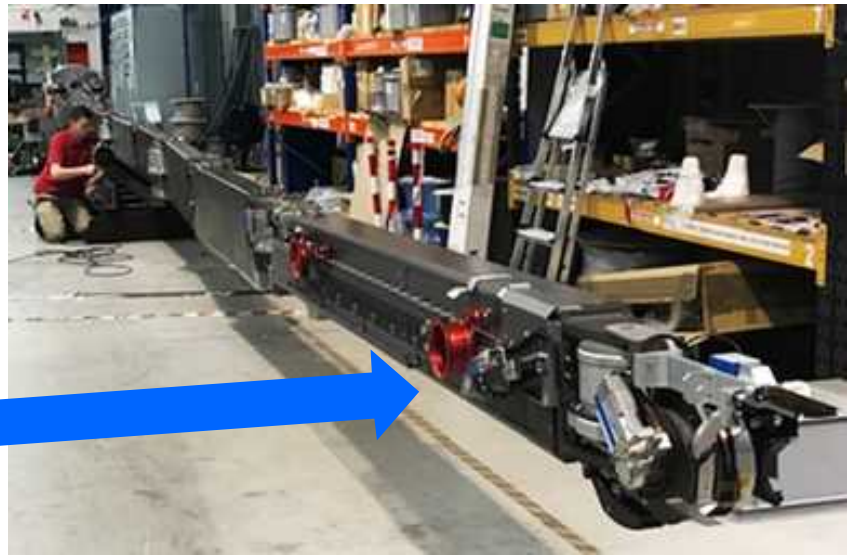
Gripper tool



Drilling retrieval tool

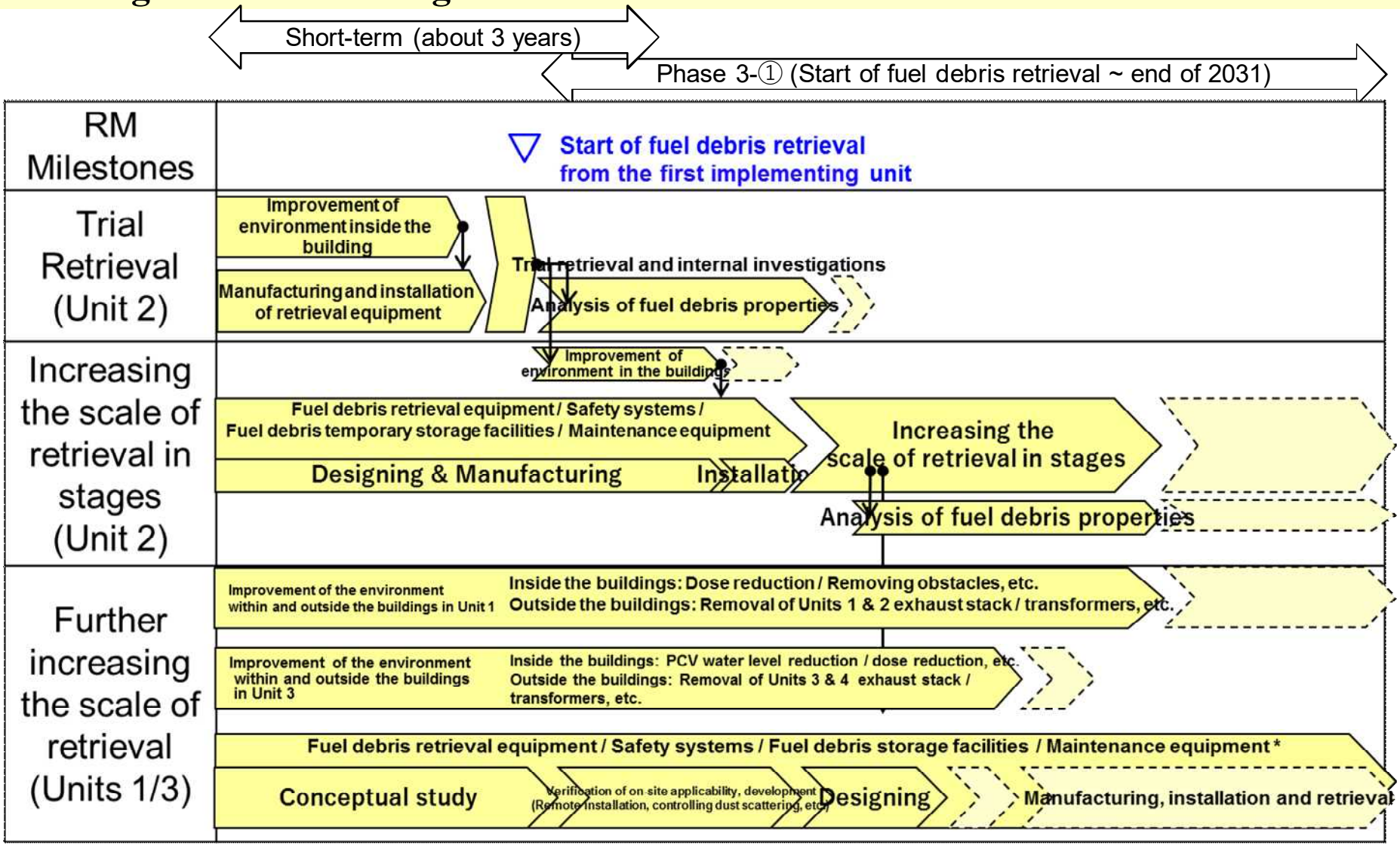
Overall Picture





Major Work Processes until 2031

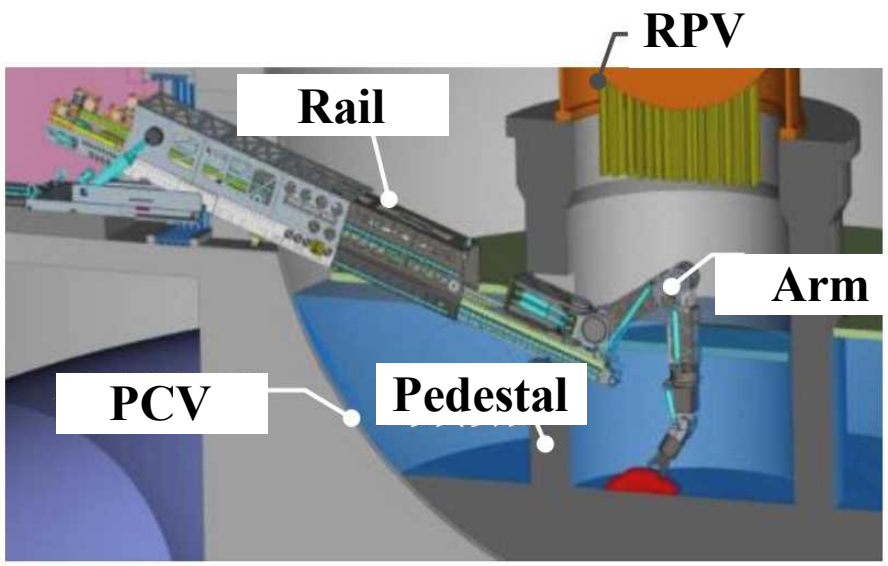
- **We will conduct studies and other internal investigations inside the PCVs and RPVs.**
  - **At Unit 1, a boat-type submersible device will be used in the near future.**
- **The method for expanding the scale of retrieval will be determined based on the knowledge obtained through the trial retrieval at Unit 2.**

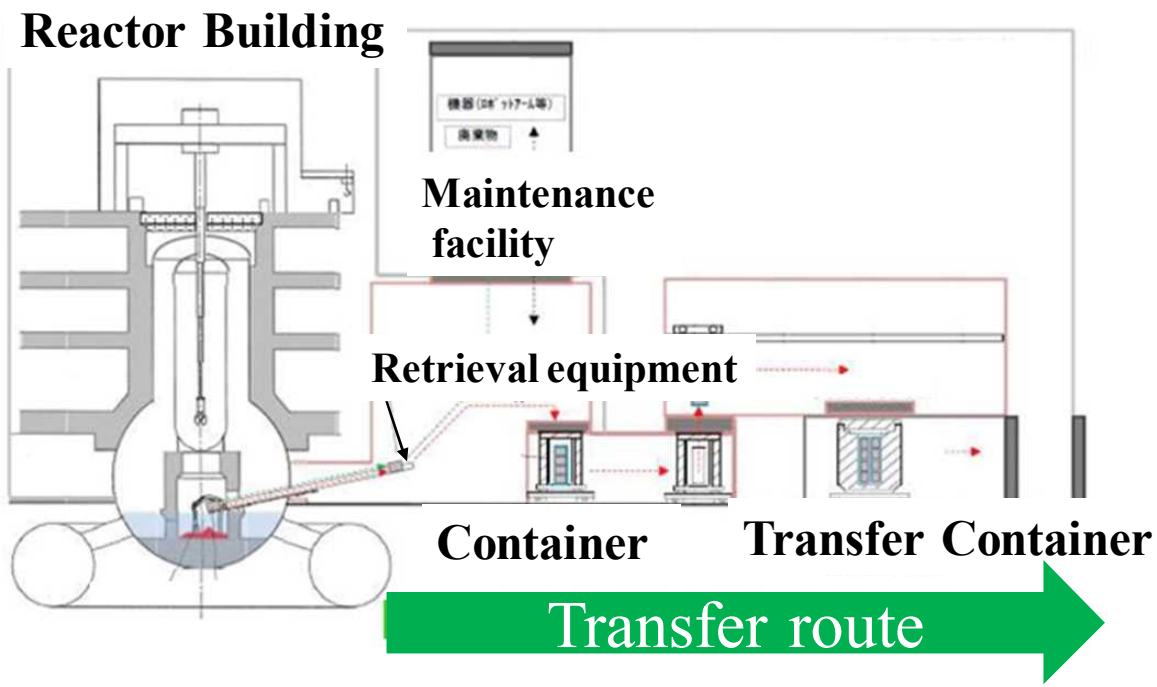


* Assuming that studies will be carried out giving precedence to Unit 3, and Unit 1 will be studied thereafter.

Conceptual image of equipment for large-scale retrieval

- Design, manufacturing and installation of fuel debris retrieval equipment, safety systems, fuel debris temporary storage facilities etc. will be carried out.
- In order to secure the related space on the site, we may dismantle some of the existing facilities.





4. Improved Work Environment

Reduced radiation dose & increased green zone


Felling of trees / mowing of grass


Removal of rubble

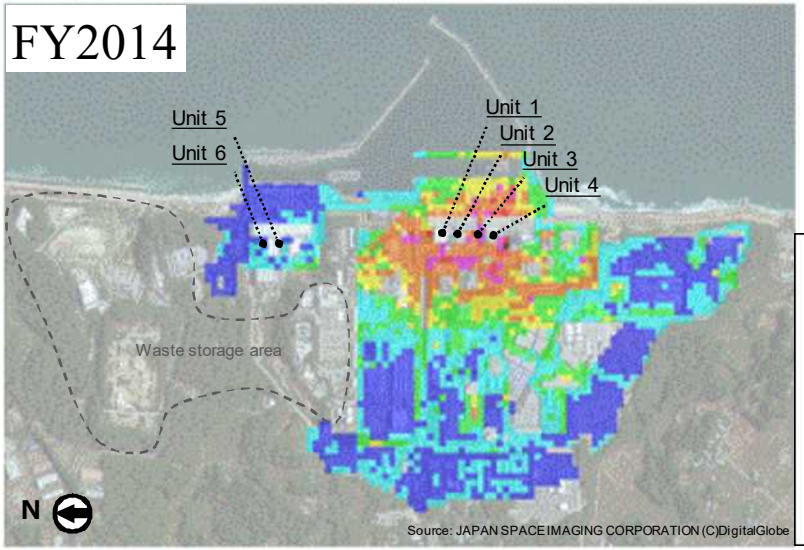

Removal of surface soil

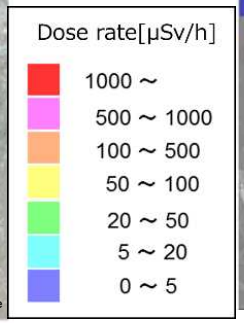

Paving (mortar spraying)


Paving completed

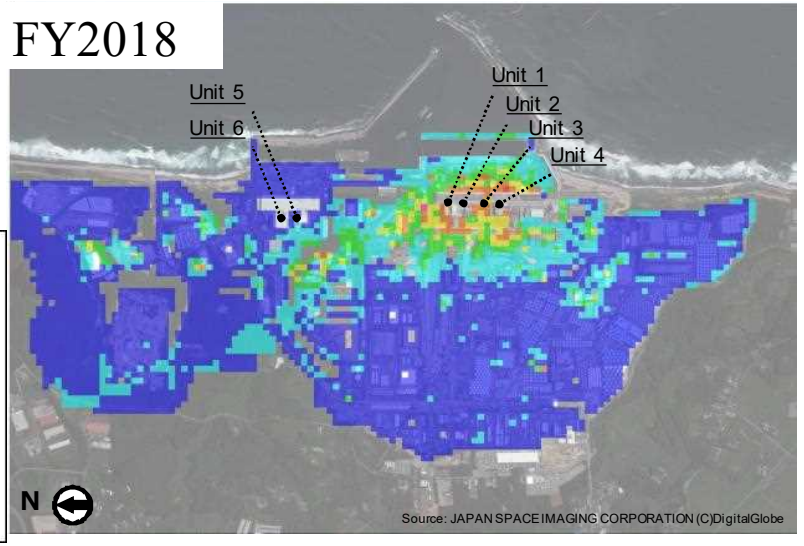
Dose rate

FY2014





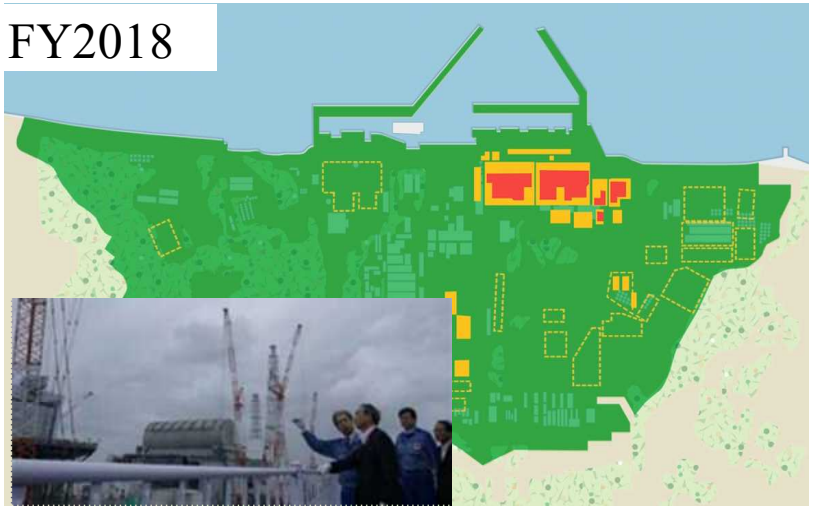
FY2018



Zoning

FY2013

FY2018

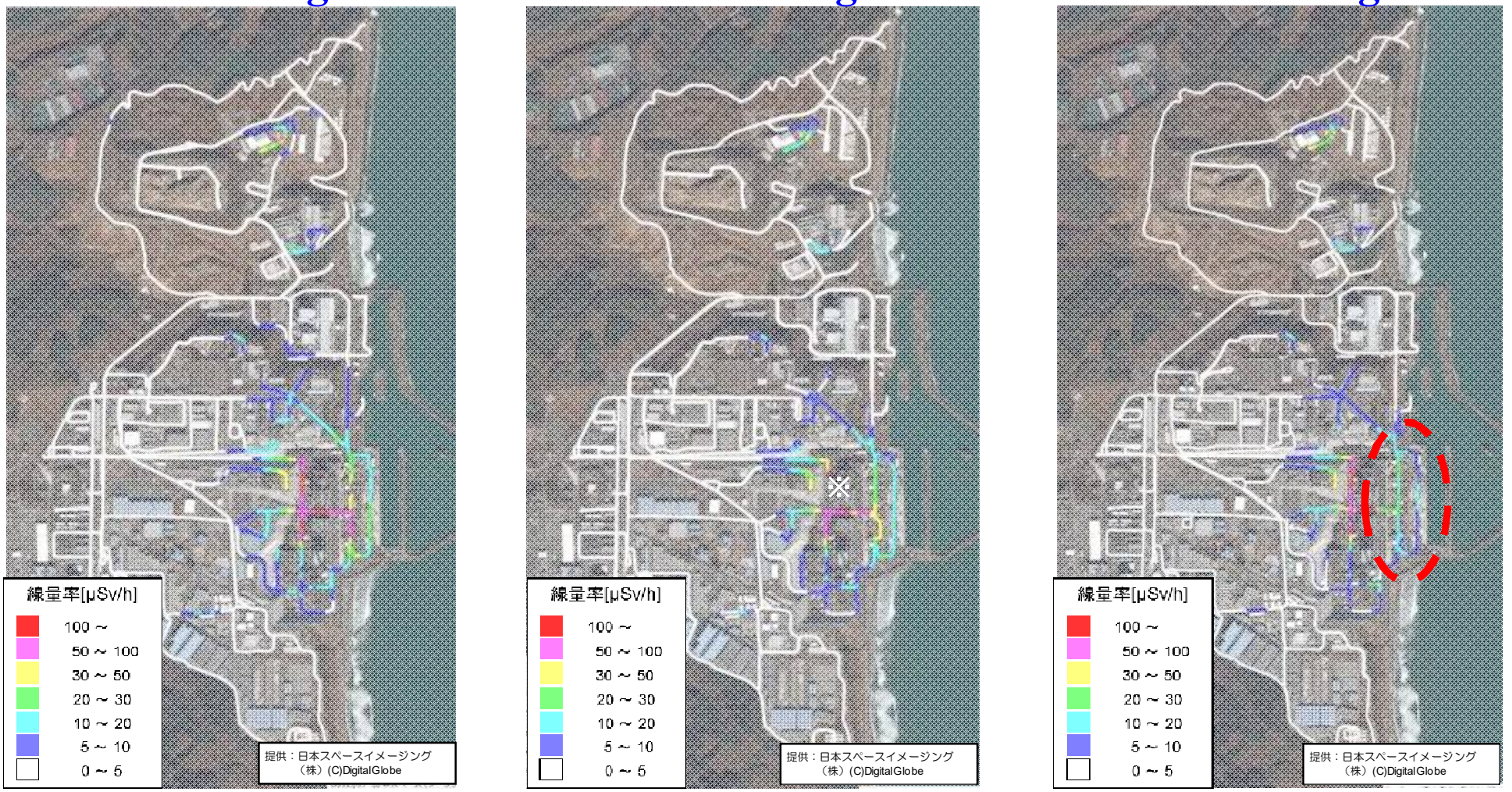


The latest dose reduction-The survey results on on-site roads-

- Our efforts to reduce dose rate on the site have continued.
- Steep dose reduction in the east side of the turbine buildings have been confirmed as a result of paving and rubble removal.

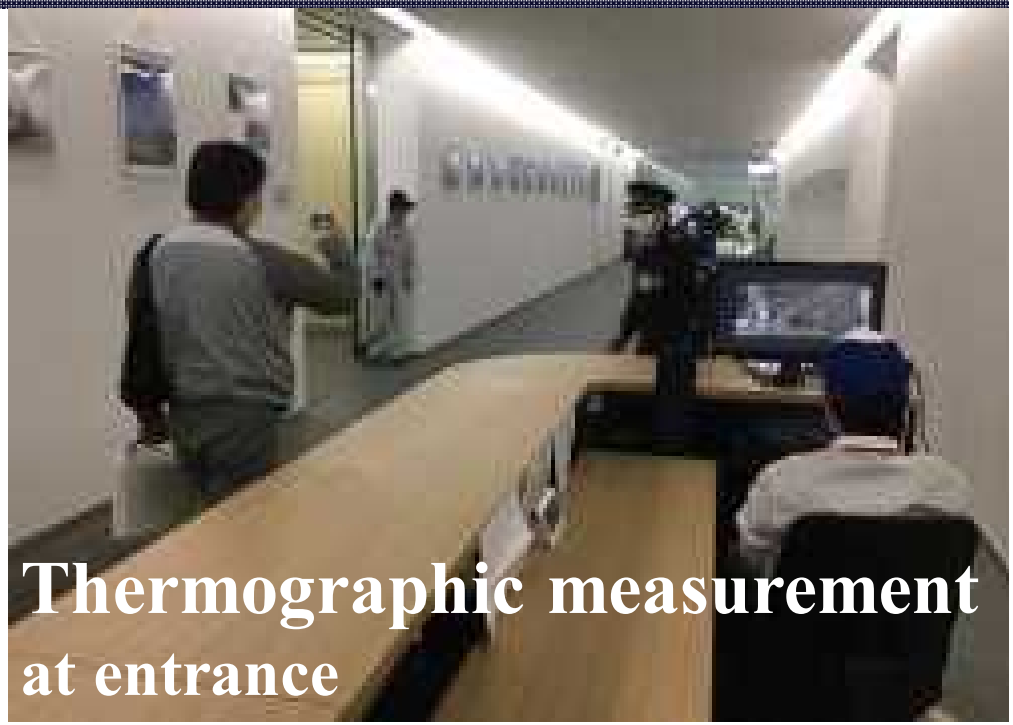
<2Q in FY2018> ➡ <2Q in FY2019> ➡ <2Q in FY2020>

（Measured in Aug. 2018）（Measured in Aug. 2019）（Measured in Aug. 2020）



The New Norm at Fukushima Daiichi

No face-to-face sitting
at Cafeteria



Thermographic measurement
at entrance

All employees wearing masks

5. Striking a Balance between Reconstruction & Decommissioning

Mid-and-Long-Term Roadmap and TEPCO's Action Plan

Dec. 2011 cold shutdown announcement

Nov. 2013 (start of Unit 4 spent fuel removal)
Apr. 2019 (start of Unit 3 spent fuel removal)

Start of fuel debris retrieval

2031

30~40 years after cold shutdown announcement

Phase 1	Phase 2	Phase 3-(1)	Phase 3
Period until start of fuel removal (in 2 years)	Period until start of fuel debris retrieval (in 10 years)	Period until completion of decommissioning (in 30 to 40 years)	

"Mid-and-Long-Term Decommissioning Action Plan 2020"

✓**Show Major work processes for each activity until 2031**

- Complete stagnant water treatment except for Unit 1 to 3 reactor bldgs. etc. in 2020
- Complete fuel removal from pools at all Units (Units 1 to 6) by 2031
- Start fuel debris retrieval from Unit 2. Expand the scale of retrieval in stages
- Eliminate temporary waste storage in FY2028

https://www.tepco.co.jp/en/hd/decommission/information/dap/index-e.html

<TEPCO>

Proceed with tasks safely steadily, and efficiently, looking to the future

<The Locals>

- **Understand future work in a concrete manner**
- **Join the decommissioning work proactively**

Two-way communications

- **We strive to gain the understanding and trust of local residents by holding various kinds of dialogues and interactions.**
  - **The number of people visiting Fukushima Daiichi site topped 18,000 in FY2019.**
  - **In 2018, a virtual tour started in TEPCO's website and a decommissioning museum opened in a nearby town.**

Decommissioning forum held by NDF at Tomioka in Aug. 2019

Virtual tour on TEPCO's website


Site tour


TEPCO decommissioning museum


Thank you for your kind attention
TEPCO