

A person wearing a full white protective suit, including a hood and a respirator mask, is working in a laboratory. They are holding a small white container and appear to be performing a task. The background shows laboratory equipment, including a pipette and various bottles on a counter. The overall scene is dimly lit with a blue tint.

Current Status and Challenges at Fukushima Daiichi Decontamination and Decommissioning

January 30, 2017

Naohiro MASUDA

Chief Decommissioning Officer,

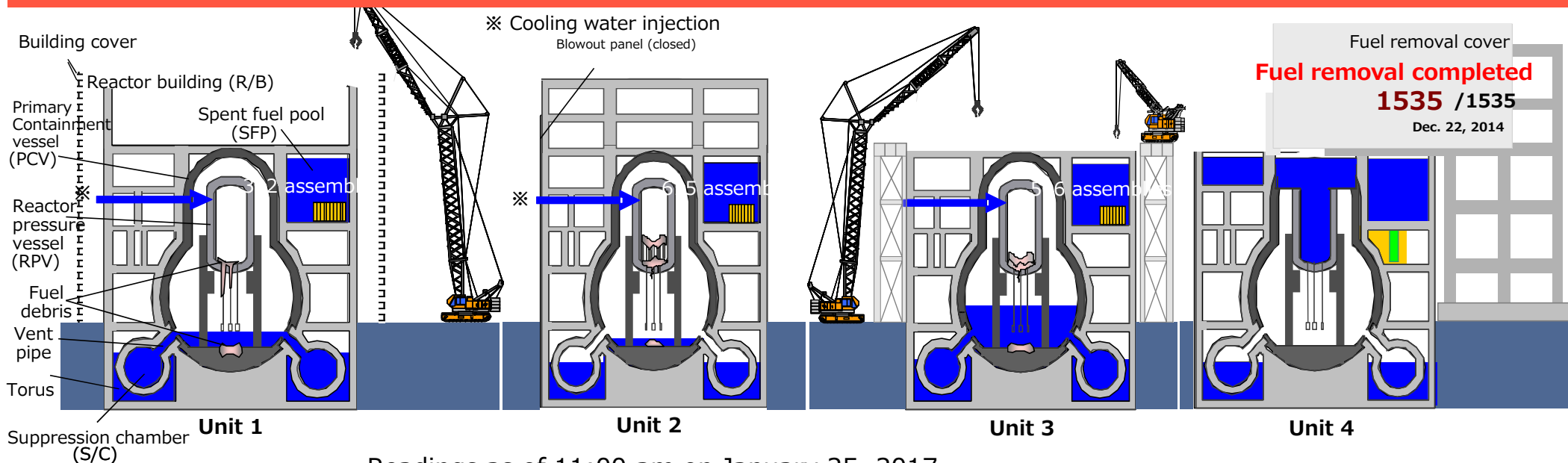
President of Fukushima Daiichi Decontamination and
Decommissioning Engineering Company,
Tokyo Electric Power Company Holdings, Inc.

TEPCO

1. Current conditions at the Fukushima Daiichi NPS ①

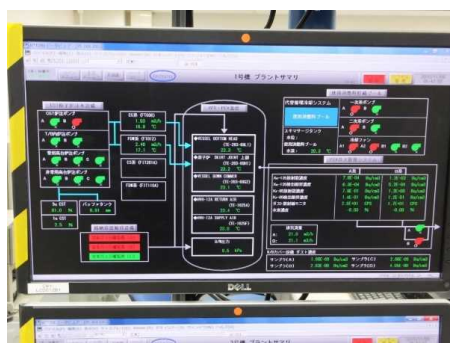
(Conditions at Units 1~4)

- Cold shutdown of all units continues to be maintained.
- The amount of coolant injected into Unit 1 has been reduced (4.5→3.0m³/h) (December 2016~January 2017), and temperatures are fluctuating within predicted ranges. Coolant amounts will also be reduced at Unit 2 (March) and Unit 3 (February).



Readings as of 11:00 am on January 25, 2017

	Temperature at the bottom of the pressure vessel	Temperature inside the containment vessel	Fuel pool temperature	Reactor coolant volume
Unit 1	approx. 14 °C	approx. 16 °C	approx. 18 °C	approx. 3.0 m ³ /hour
Unit 2	approx. 18 °C	approx. 18 °C	approx. 19 °C	approx. 4.5 m ³ /hour
Unit 3	approx. 17 °C	approx. 17 °C	approx. 19 °C	approx. 4.4 m ³ /hour
Unit 4	Monitoring unnecessary due to absence of fuel	Monitoring unnecessary due to absence of fuel	approx. 13 °C	—



Plant parameters including RPV and PCV temperatures are monitored continuously 24 hours/day.

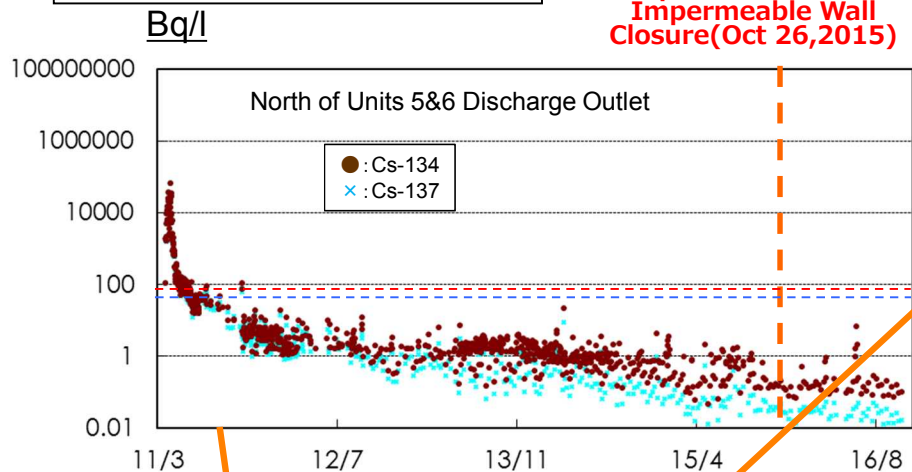
1. Current conditions at the Fukushima Daiichi NPS ② (Ocean monitoring)

- Concentration of radioactive materials has been gradually decreasing since the accident.
- Concentration levels decreased further after closure of the sea-side impermeable wall.

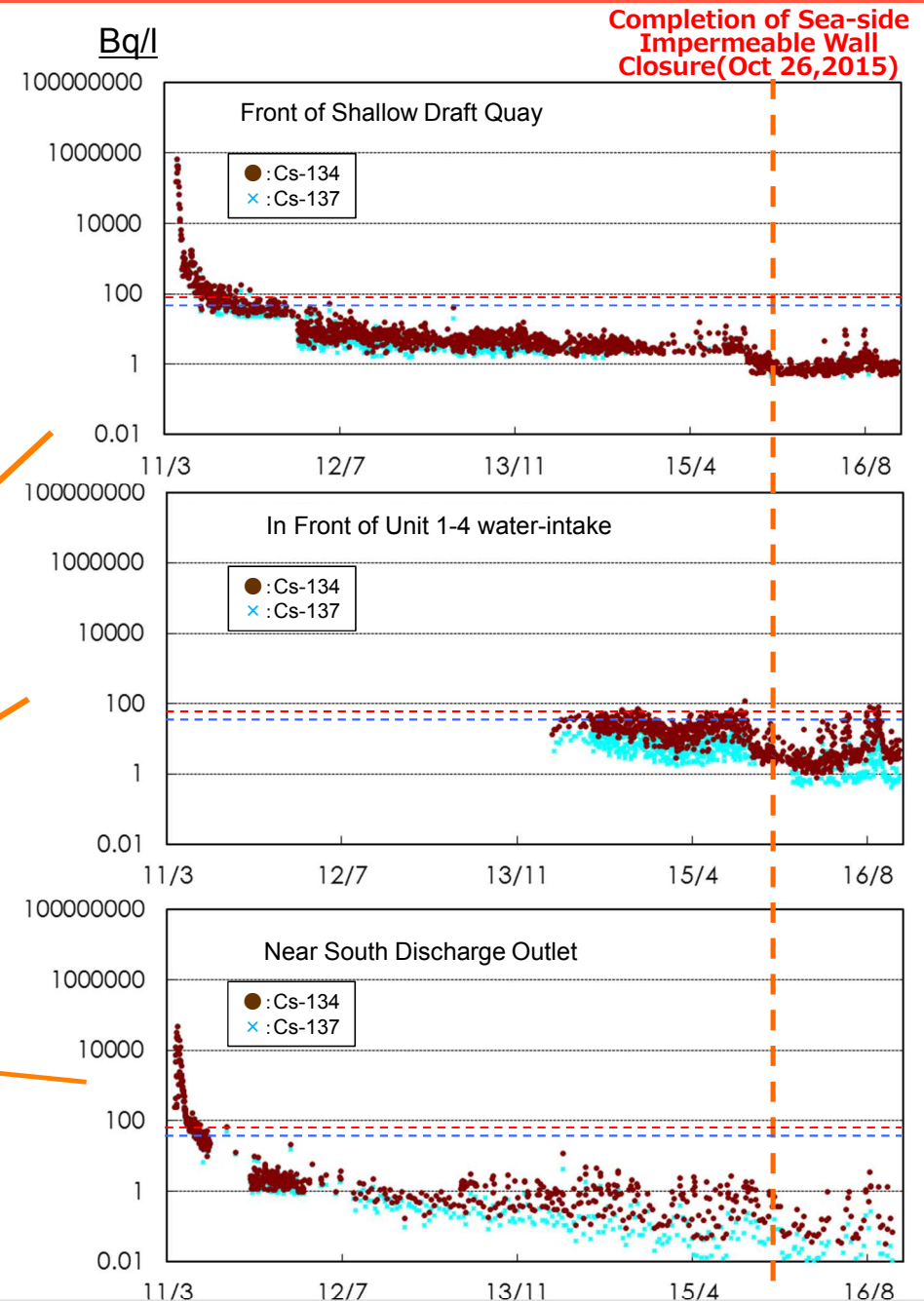
- About one-1,000,000th to one-100,000th compared to immediately after the accident
- The concentrations outside the port are substantially below regulation limits

Regulation Limit

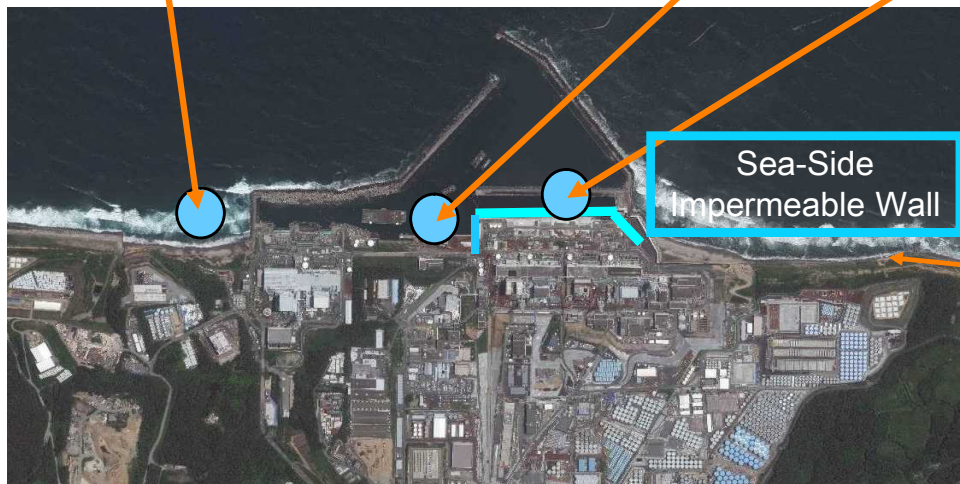
- Cesium 137: 90Bq/L
- Cesium 134: 60Bq/L



Completion of Sea-side Impermeable Wall Closure (Oct 26, 2015)



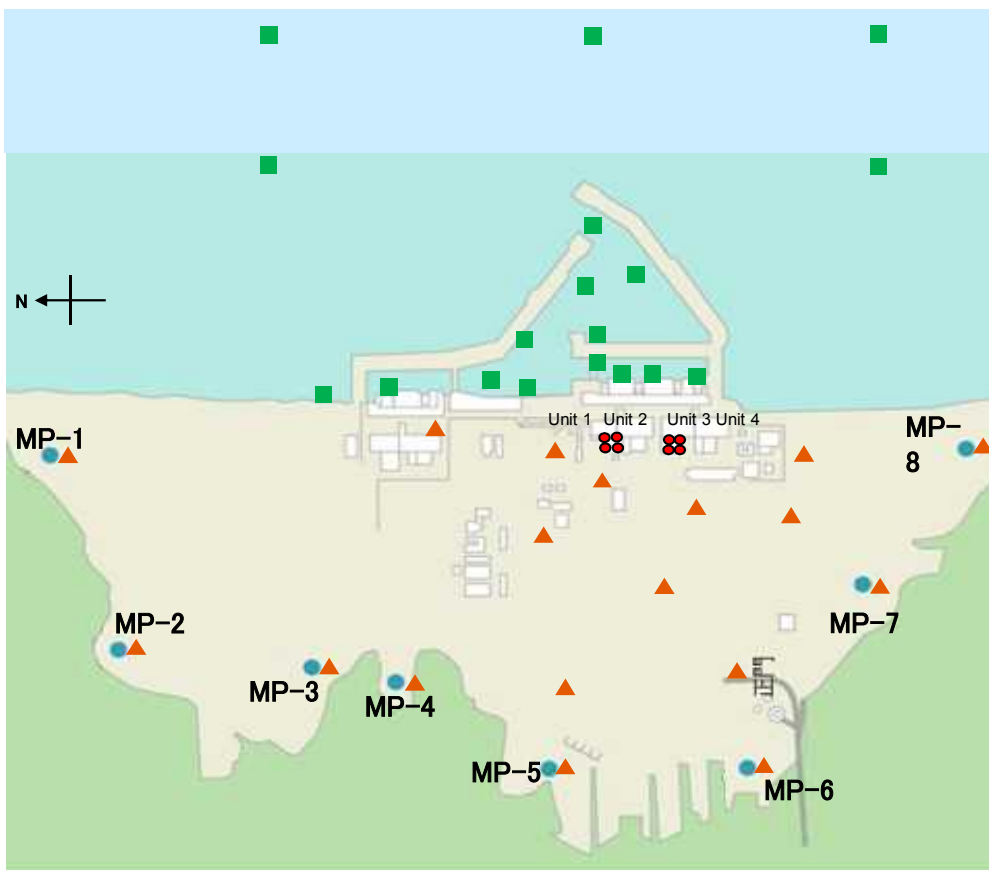
Completion of Sea-side Impermeable Wall Closure (Oct 26, 2015)



1. Current conditions at the Fukushima Daiichi NPS ③ (Sampling and monitoring post map)

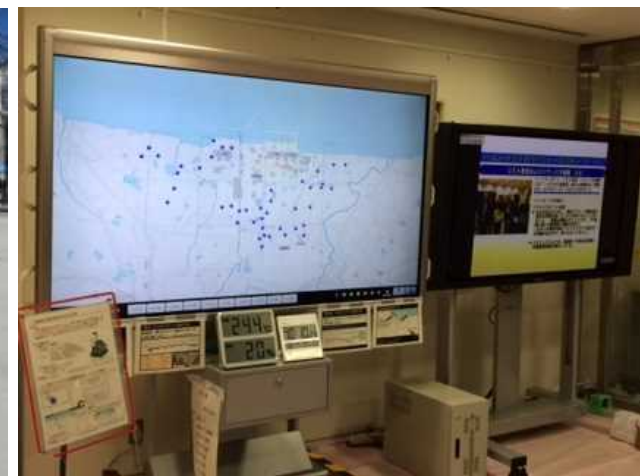
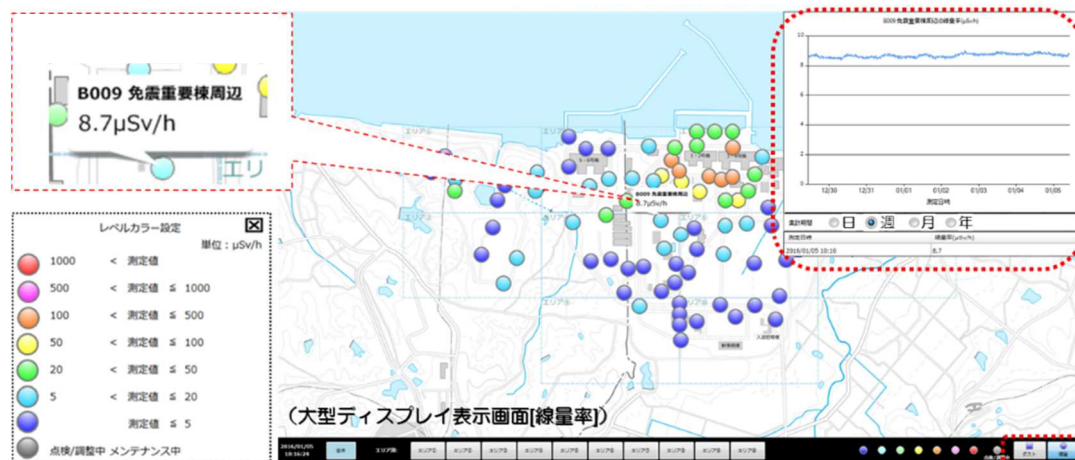
Location of sampling points, dust monitors and monitoring posts

- Dust monitors on the refueling floor
- ▲ Dust Monitors
- Monitoring Post
- Sampling points in the sea area



Installation of dose-rate monitors

- System visualizing real time dose data in place.
- Data display monitors (86 points) placed where workers can easily access. Continuous dust monitoring data also shown on display.



1. Current conditions at the Fukushima Daiichi NPS ④ (Site radiation level reductions)

Decreasing radiation dose

FY2013

40 %

FY2014

77 %

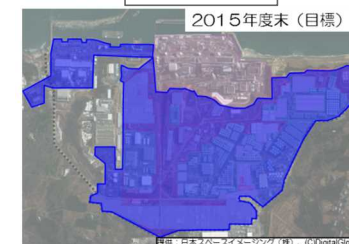
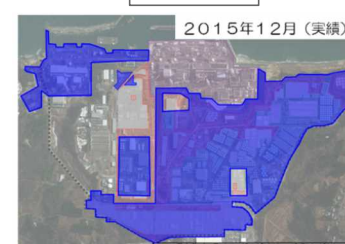
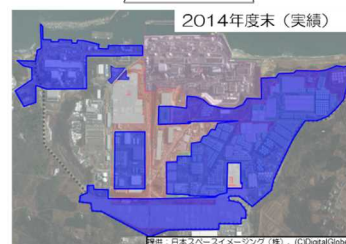
As of Dec 2015

89 %

FY2015 target

100 %

■ : Area confirmed below 5μSv/h

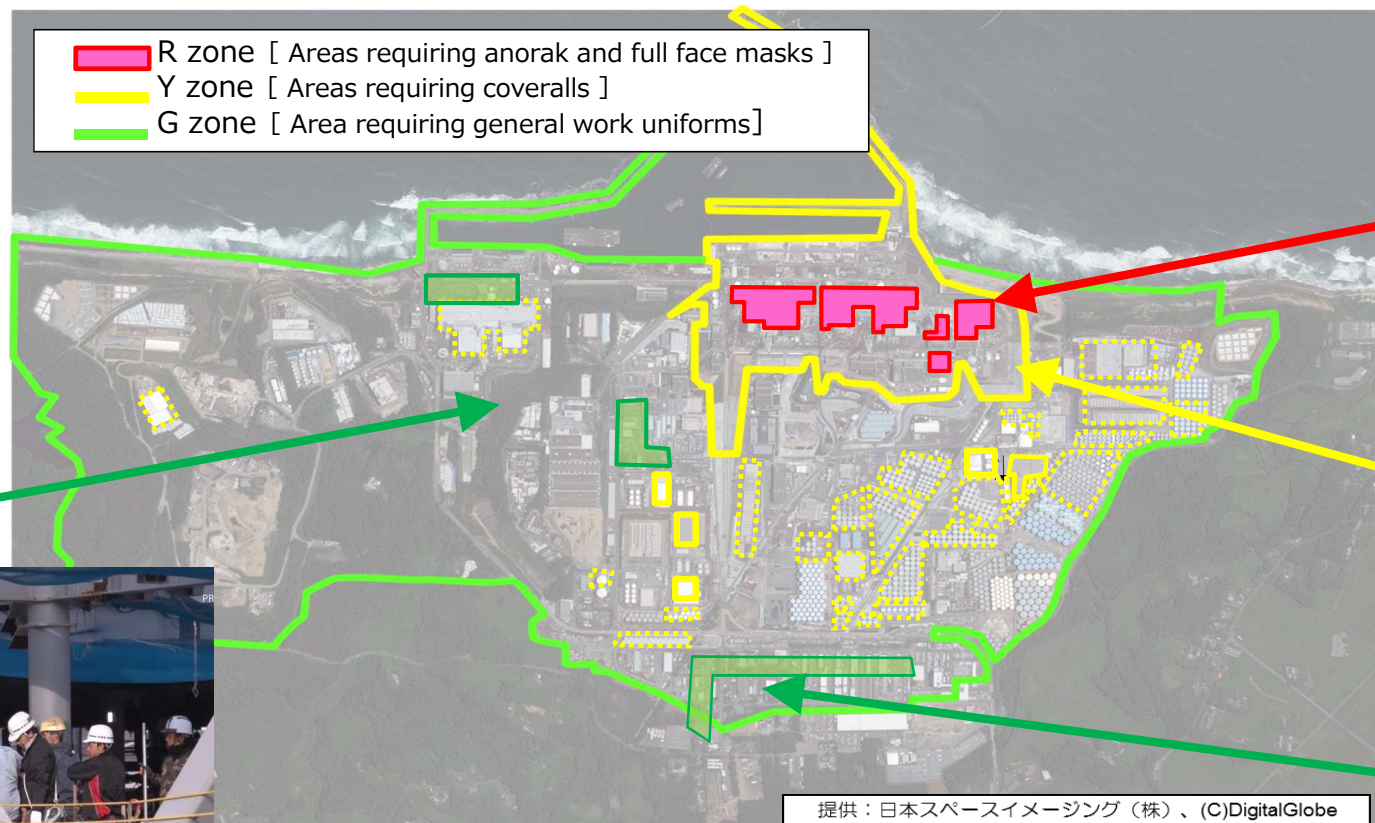


Personal protective equipment in each zone



Green zone equipment

■ R zone [Areas requiring anorak and full face masks]
■ Y zone [Areas requiring coveralls]
■ G zone [Area requiring general work uniforms]



Full-face masks



Half-face masks



General Uniform



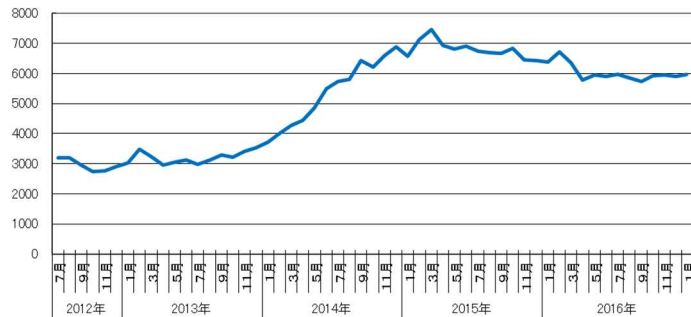
Workers in the G zone

提供：日本スペースイメージング（株）、(C)DigitalGlobe

- Efforts being made to secure personnel over long term while managing amount of worker radiation exposure.
- Further efforts made for continuous improvement of work environment while understanding worker needs.

Changes in number of workers

- Number of workers (TEPCO employees and contractors) per weekday engaged in work during October assumed as approximately 5,920 people.
- Percentage of locally born workers approximately 55% as of Oct.



Change in the average number of workers (actual value) per weekday in the months following 2012.

Ensuring stable long-term employment

- It is important to create an environment in which the people from contracting companies can work over the long term so that TEPCO HD can steadily move forward with decommissioning work over the next 40 years.
- Currently, approximately 90% of orders are fulfilled by negotiated contracts, which enables contractors to secure workers in the long term.
- By securing long term workers, more deliberate personnel assignment and human resource development are possible.

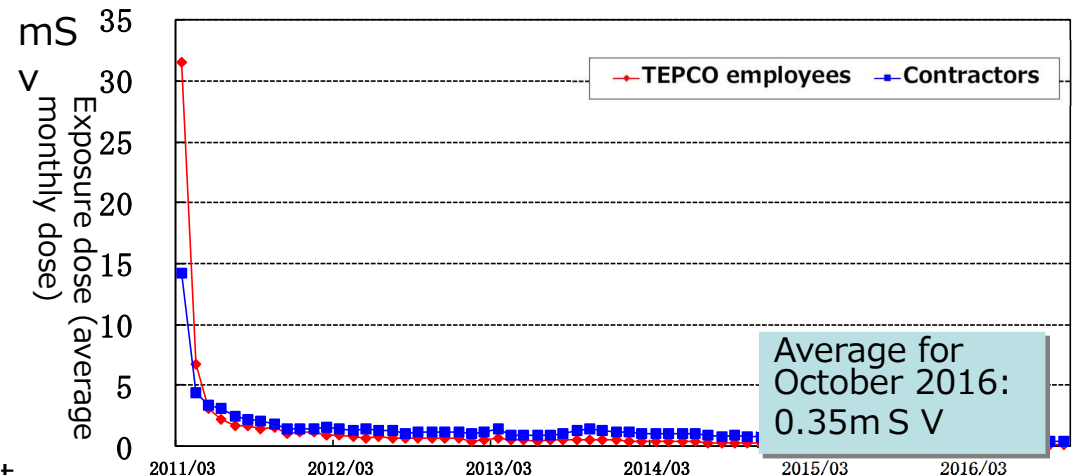
Improving work environment

- Large rest house with a capacity of approx. 1,200 workers (from May 2015)
 - Convenience store "Lawson" opened on March 1, 2016
- New office building for TEPCO employees to be renovated as contractors' office building. (Feb, 2017)
- Fukushima Revitalization Meal Service Center (from March 2015)
 - Providing warm meals to Fukushima Daiichi
 - Creation of employment opportunities
 - Dispelling harmful rumors about Fukushima food

Large rest house

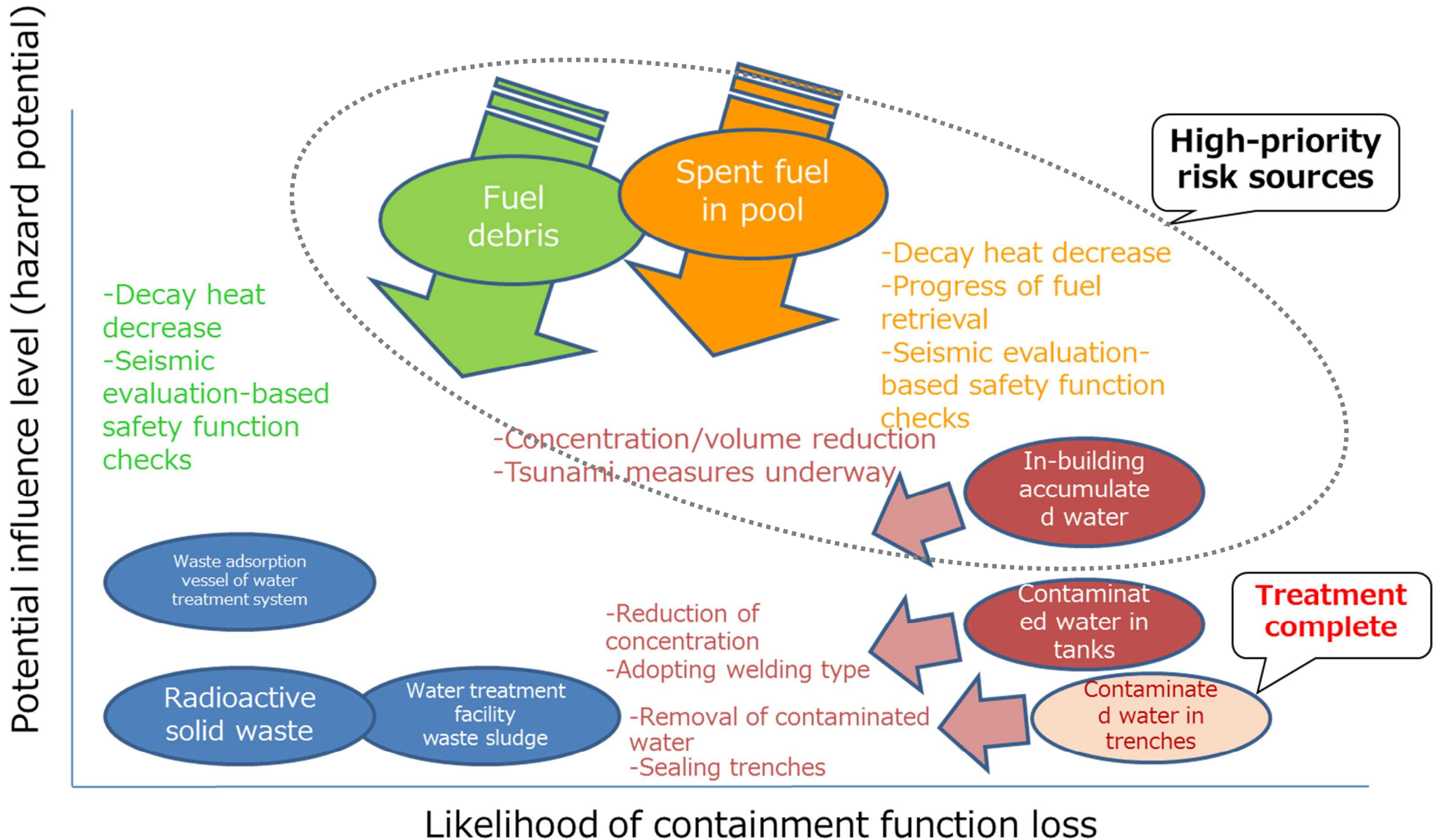


Trend of monthly exposure dose rate



3. Progress with earthquake and tsunami countermeasures ① (Fukushima Daiichi NPS risk source conditions and reduction measures)

- The decay heat of pool fuel and fuel debris has decreased over time
- In regards to hazards such as earthquakes and tsunamis, measures to reduce risks, such as the discharge of accumulated water from inside buildings, are underway.



Measures to reduce risks associated with earthquakes and tsunamis are being implemented for facilities important for safety

Post-accident emergency

Preparations for highest recorded events (design)

Preparations for events exceeding highest records (review)

Earthquake measures

Measure for design basis ground motion (600 Gal)

⇒ Building: **Confirmed** to have secured seismic resistance

⇒ Equipment: **Function ensured**, including the use of flexible responses

Measure of ground motion for reviews (900 Gal)

⇒ Building: **Confirmed** to have secured seismic resistance

⇒ Equipment: Improve reliability through flexible responses

Tsunami measures

Outer-rise tsunami measures, etc.

⇒ Temporary seawall: **Installed**

⇒ Removal of contaminated water inside the trench: **Treated**

Measures against 15 m-level tsunami

⇒ Units 1/2 turbine building (T/B), common pool building: **Completed**; high-temperature incinerator building: **Completed**

⇒ Unit 3 T/B, process main building: Arranging schedule

⇒ Units 1-3 reactor building (R/B): To be reviewed on account of progress concerning accumulated water treatment

Measure of tsunami for reviews (26.3 m)

⇒ Give priority on the treatment of in-building accumulated water

⇒ Equipment: Improve reliability through flexible responses

- The risk of a discharge of radioactive substances into the environment has decreased with the decrease in decay heat of fuel debris and pool fuel.

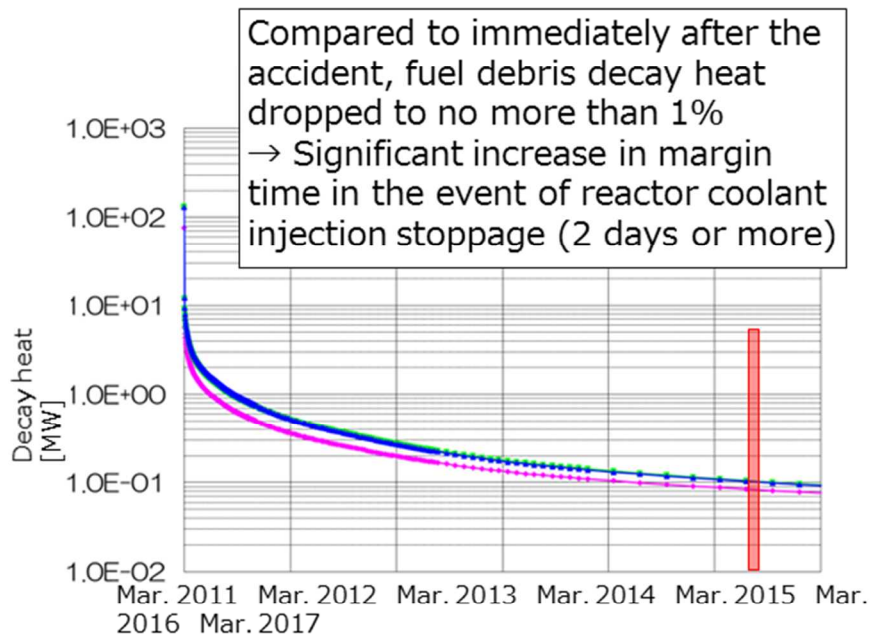


Figure 1
Transition of fuel debris decay heat

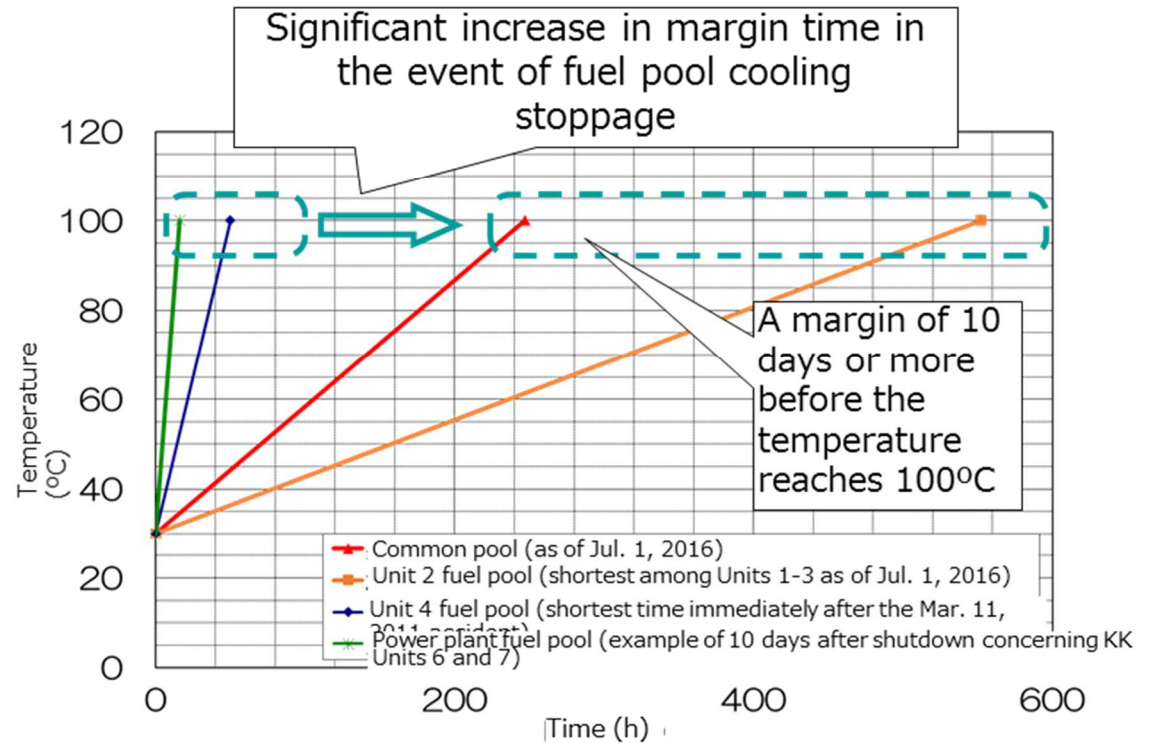


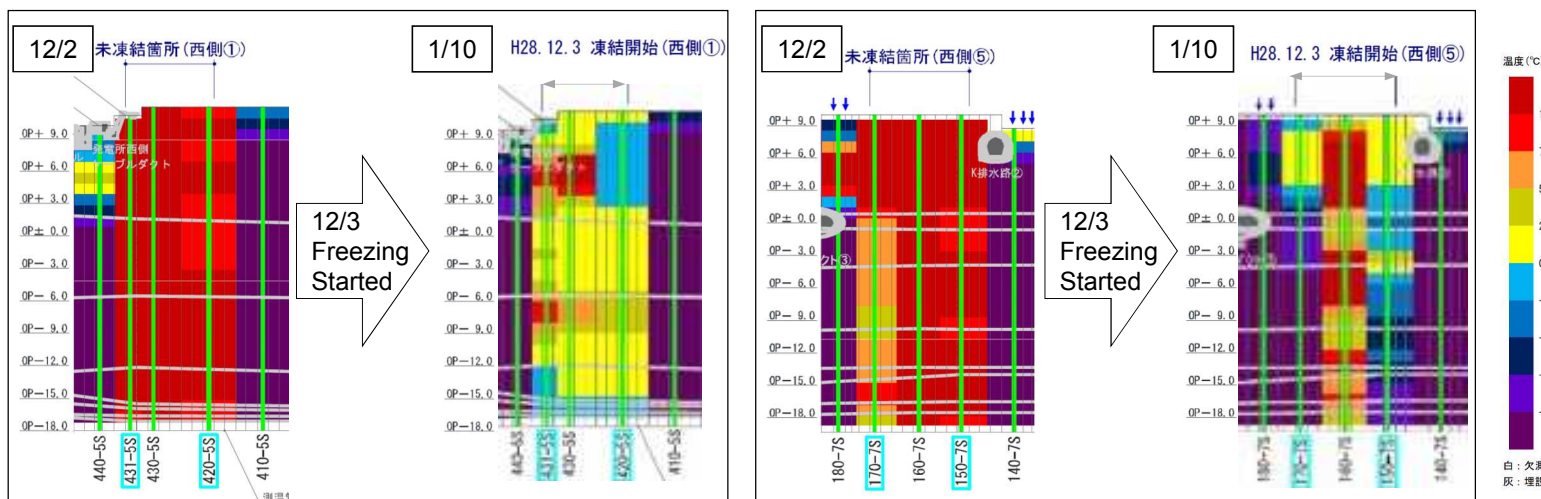
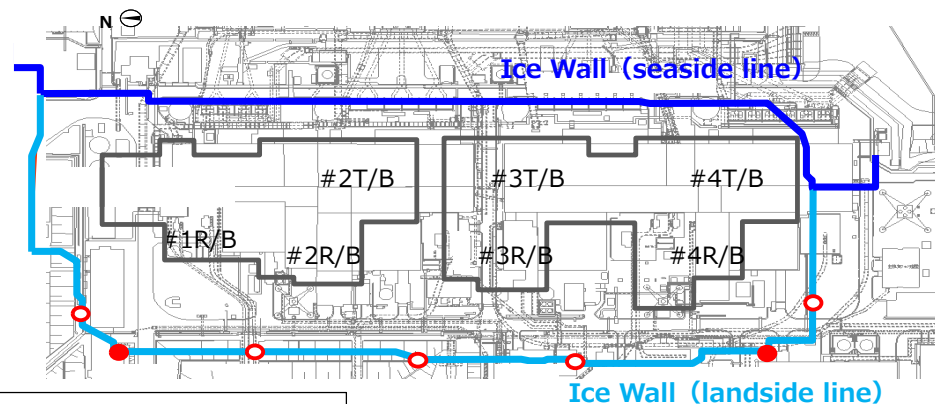


Figure 2
Assessment of water temperature rise in the event of fuel pool cooling stoppage

5-1. Contaminated Water Countermeasures ① (Land-side impermeable wall)

- Freezing started on March 31 at the entire seaside line and some parts of the landside line.
- Freezing area was expanded to 95% of the landside line on June 6.
- Supplementary method is being carried out at the places where the decrease in temperature is delayed.
- The underground temperature declined below 0°C throughout the scope requiring freezing by the end of October.
- To control the amount of groundwater flowing in from the mountain side, freezing of some of the places where freezing had not been undertaken (2 places out of the 7 places) started on December 3.

-  Places where freezing has not been undertaken
-  Places where freezing is underway (2 places)

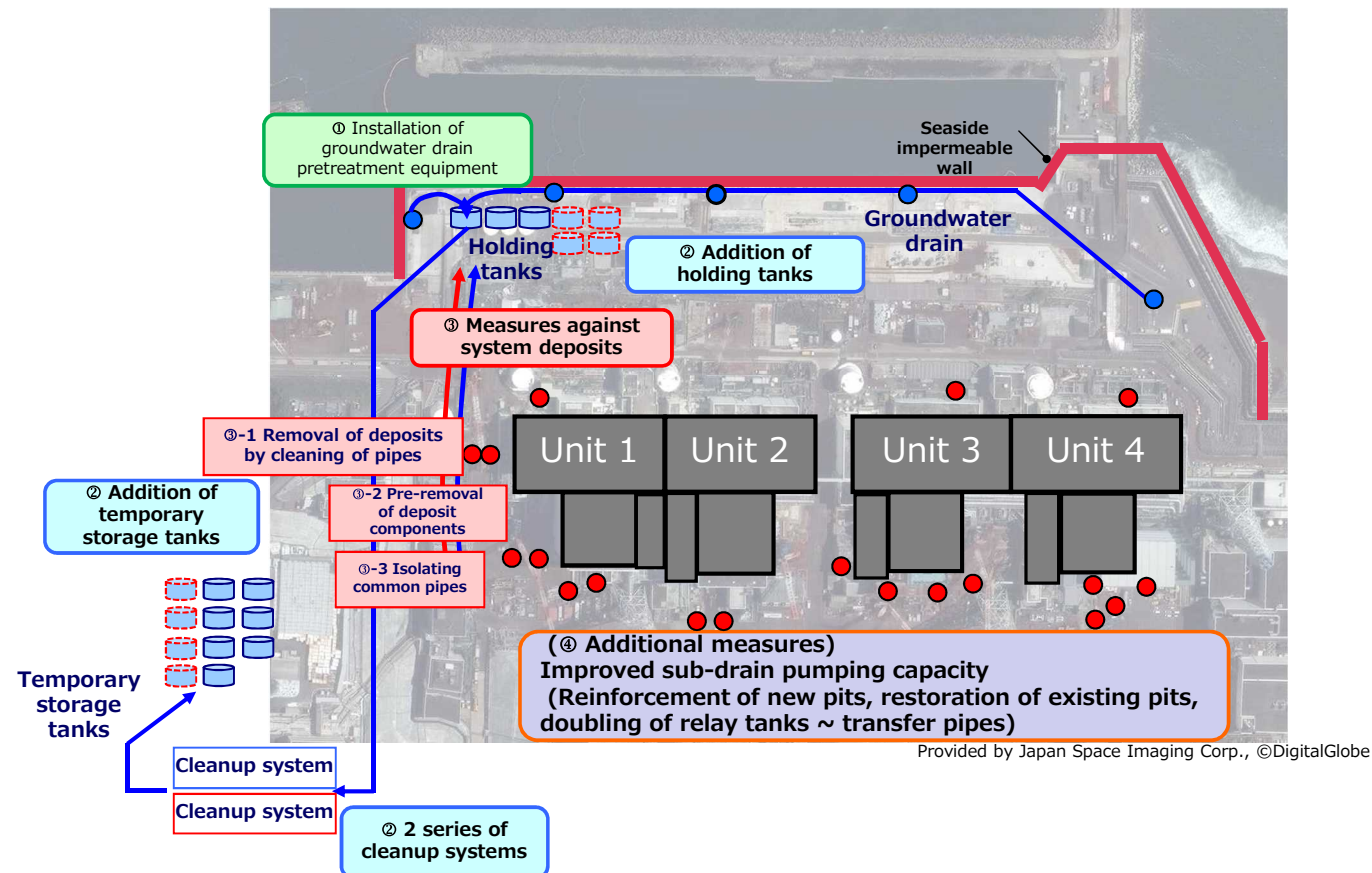


Change in temperature at the 2 places where freezing is underway

5-1. Contaminated Water Countermeasures ② (Enhancing sub-drains and other water treatment facilities)

- The following measures were taken to improve the sub-drains:

- ① Improved quality of water in groundwater drains ⇒ Installation of groundwater drain pretreatment equipment
- ② Increased system capacity ⇒ Addition of holding tanks and temporary storage tanks, two series of cleanup systems
- ③ Measures against system deposits ⇒ Removal of deposits by cleaning of pipes, pre-removal of deposit components, isolating common pipes
- (④ Additional measures) Improved sub-drain pumping capacity ⇒ Reinforcement of new pits, restoration of existing pits, doubling of transfer pipes



5-2. Preparations to remove fuel from the spent fuel pools ① (work on the Unit 3 reactor building refueling floor)

- Removal of large pieces of rubble on the refueling floor and spent fuel pool was completed 2015
- Decontamination work was completed in June 2016 and shielding was completed in Dec 2016

Before removal of large pieces of rubble



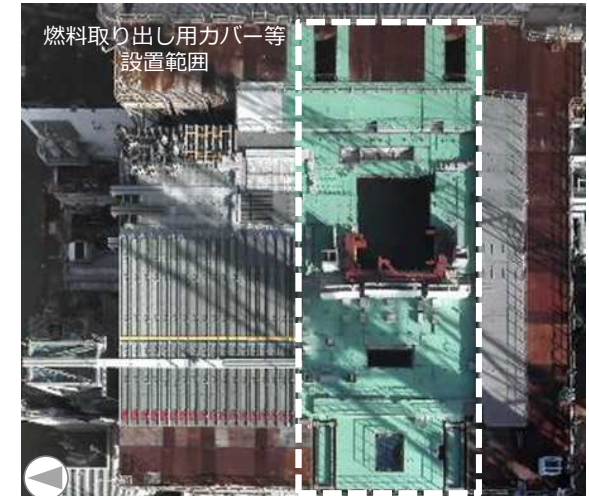
Mar. 2013

Removal of the largest piece of rubble from spent fuel pool



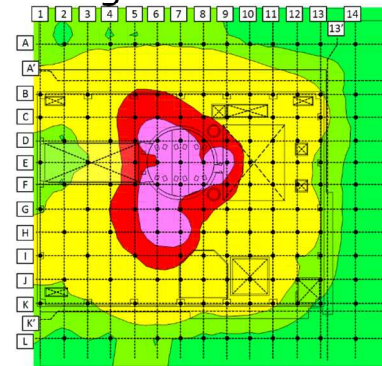
Aug. 2015

Decontamination & Shielding

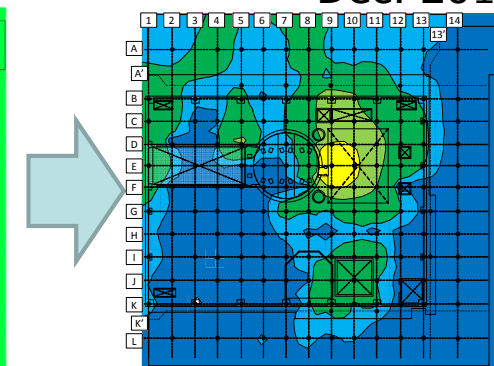


Dec. 2016

Horizontal maximum dose rate between before and after the installation of shields



Average 32.55mSv/h



Average 1.65mSv/h (degree 95%)

【Major Tasks in the Future】

① Shielding (complete)



② Installing Cover & Fuel Handling Machine



③ Undertaking Fuel Removal

5-2. Preparations to remove fuel from the spent fuel pools ② (Unit 3 fuel removal cover installation)

Preparations for the installation of a cover for fuel removal have started from January 5, 2017

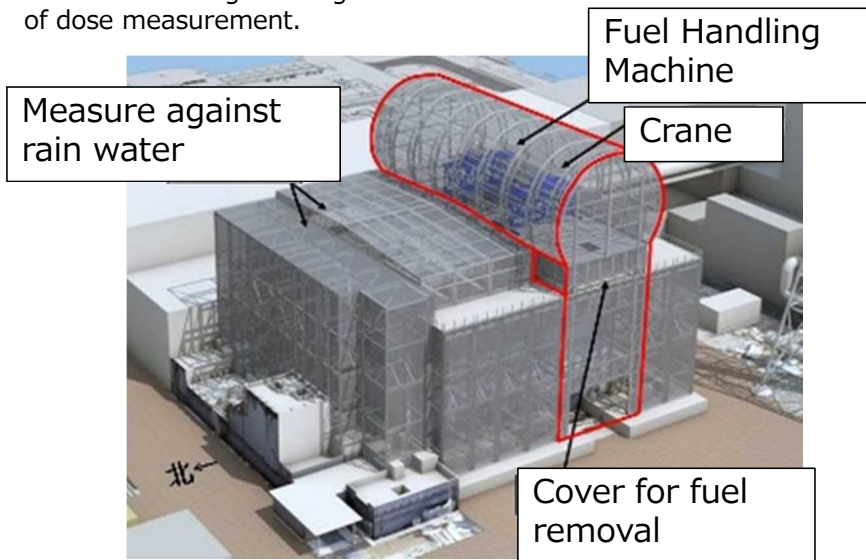
I, II, III~: Indicate the work step number for P2 : Dose measurement

	FY 2014	FY 2015	FY 2016										FY 2017	
			1-6	7	8	9	10	11	12	1-3	4-6			
Decontamination	[Blue bar]		[Blue bar]										[Blue bar]	
I Installation of a shield	[Blue bar]		[Blue bar]											
II Installation of a support frame for the transfer container												[Blue bar]		
III~ Installation of cover for fuel removal												[Blue bar]	[Blue bar]	[Blue bar]

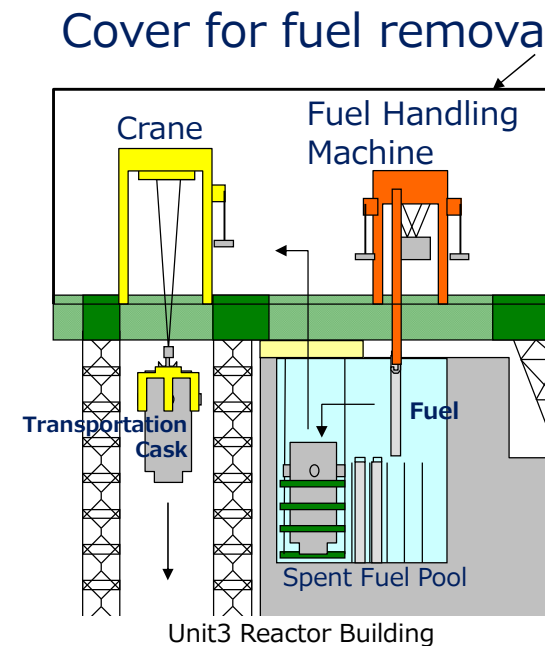
Dose measurement after installation of the entire shield is complete

Future schedule

The schedule might change due to interference with other tasks and addition of dose measurement.



Cover for Fuel Removal (Image)



Fuel Removal at Unit 3(Image)

The status of the refueling floor in 2011



Northwest side
(Jun, 2011)



Southeast Side
(Jun, 2011)



South Side

West Side

The current status (Dismantling)

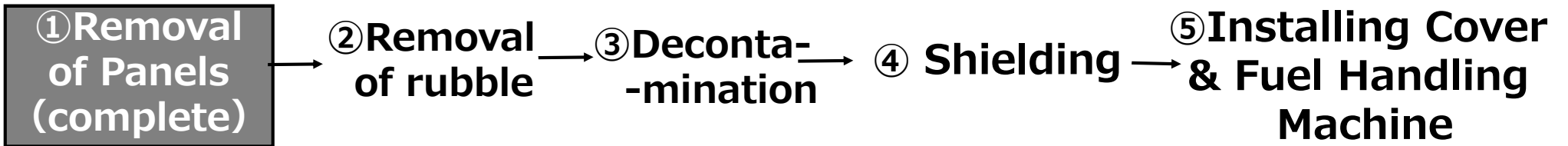


Removal of panels
(Nov, 2016)



Complete removal
(Nov, 2016)

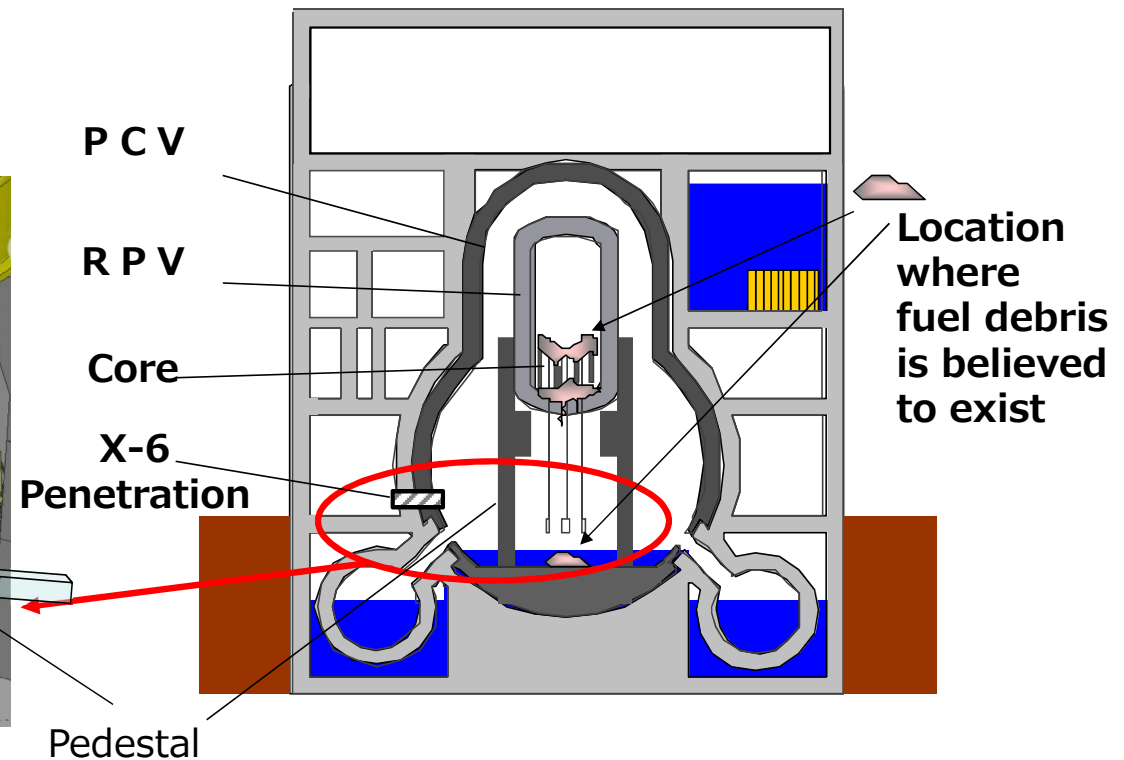
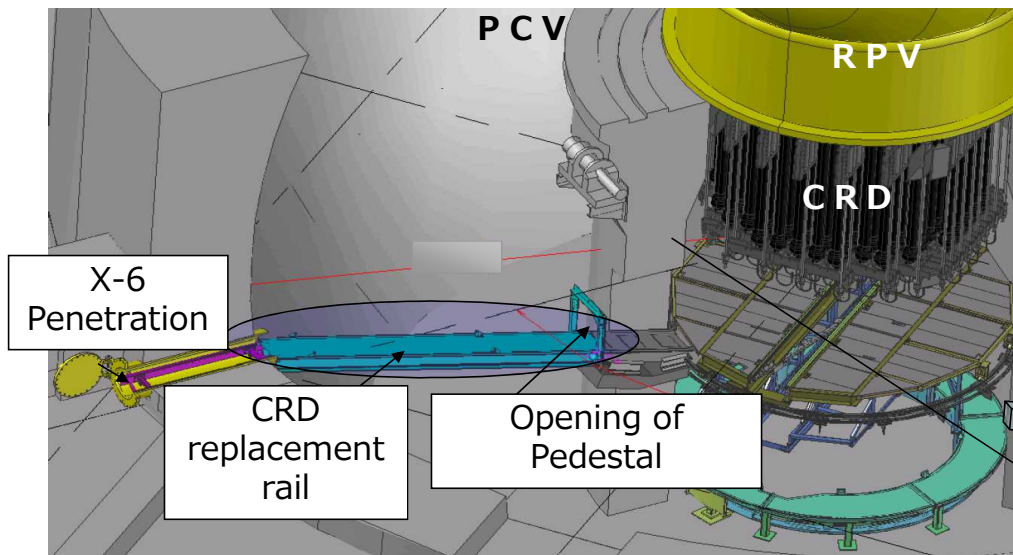
【Major Tasks in the Future】



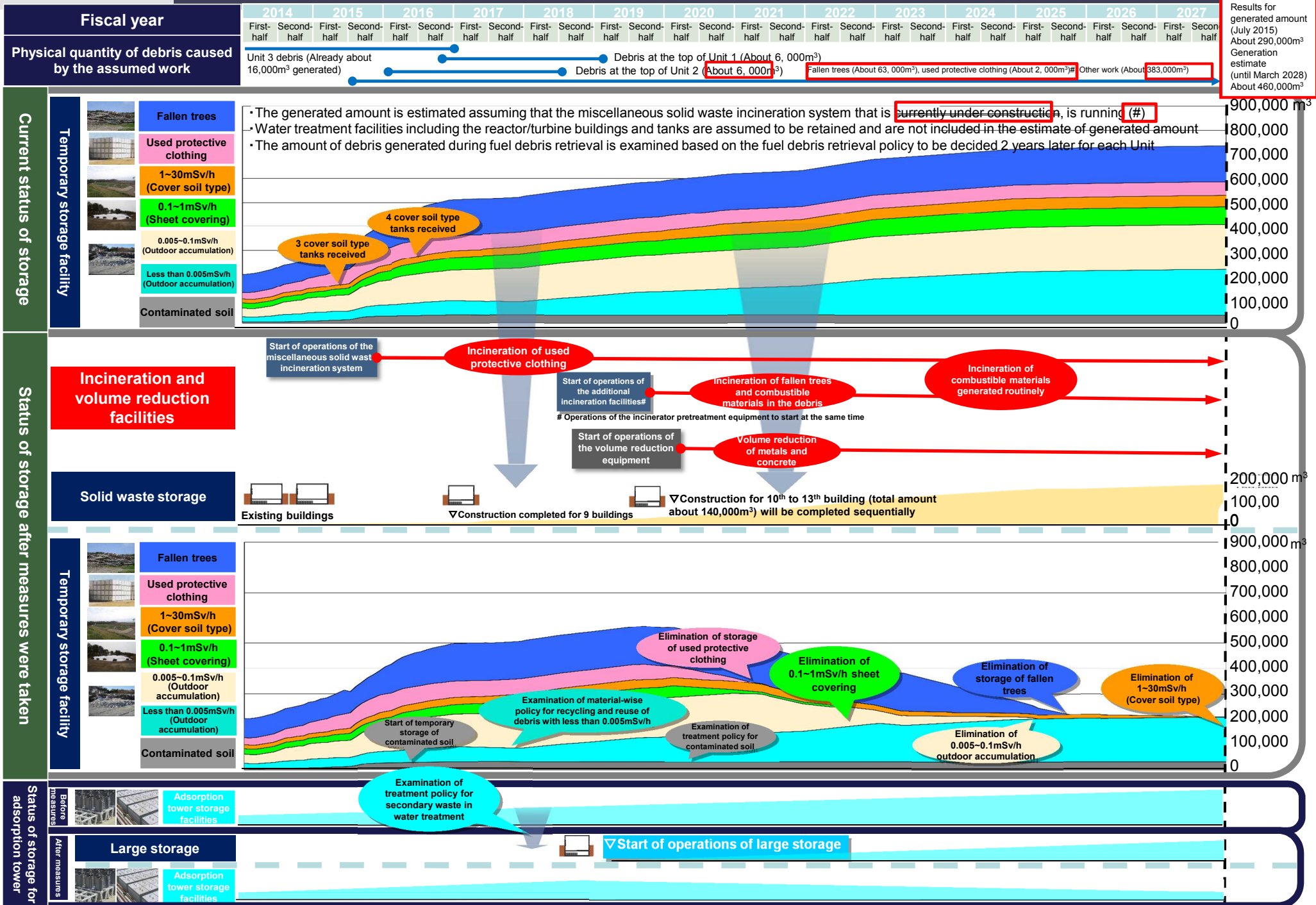
In preparation for fuel debris removal, exploration inside the Unit 2 reactor is scheduled in order to investigate conditions such as the location of fuel debris inside the PCV.

- X-6 penetration and CRD replacement rail will be used as a path for the robot to proceed inside the pedestal.
- It was found that the dose rate in the ducts at mid-to-high places on the first floor of the Reactor Building was high, so the dose rate in the ducts was reduced and the drilling work for X-6 penetration was completed on December 24. A preliminary survey will be conducted inside the pedestal using guide pipes, and then a self-propelled survey device will run inside the PCV, and an internal examination will be conducted.

The head camera with a lamp has a tilting and panning function.



5-4. Waste-related initiatives ①



Initiatives for solid waste

- Start of miscellaneous solid waste incineration system operations

Start of operations: From March 18, 2016

Processing results: used protective clothing 882t

- Prior understanding of waste-related equipment and facilities

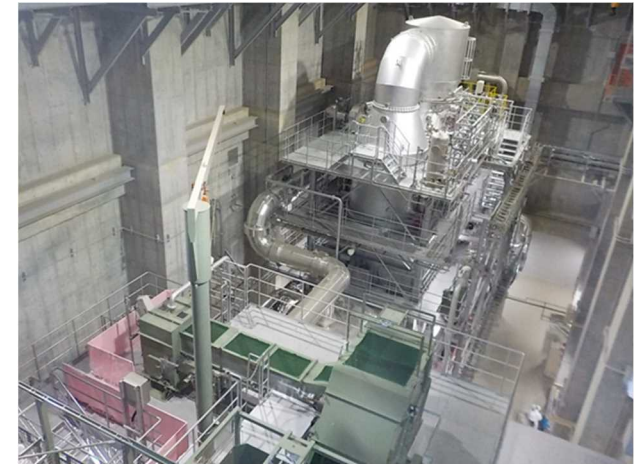
Prior understanding: December 21, 2016

Target: Expanded miscellaneous solid waste incineration system

- Incinerator pretreatment equipment
- Volume reduction equipment (metal, concrete)
- Solid waste storage (10 buildings or more)
- Contaminated soil temporary storage facilities
- Large waste storage

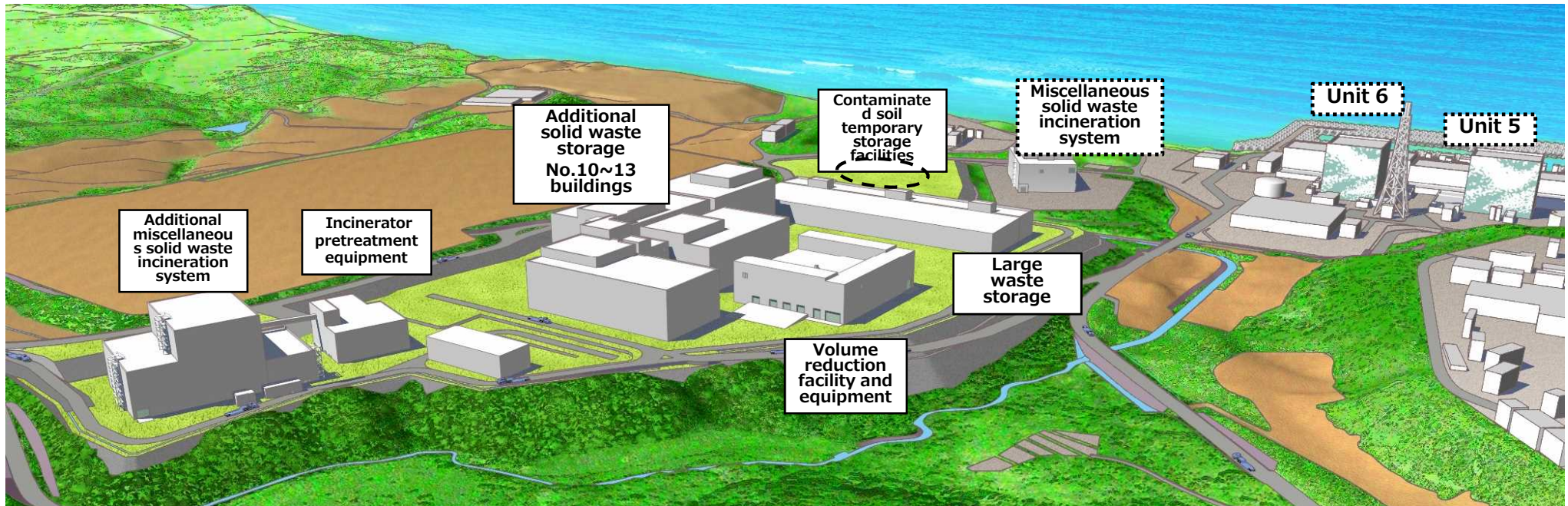


Miscellaneous solid waste incineration system building



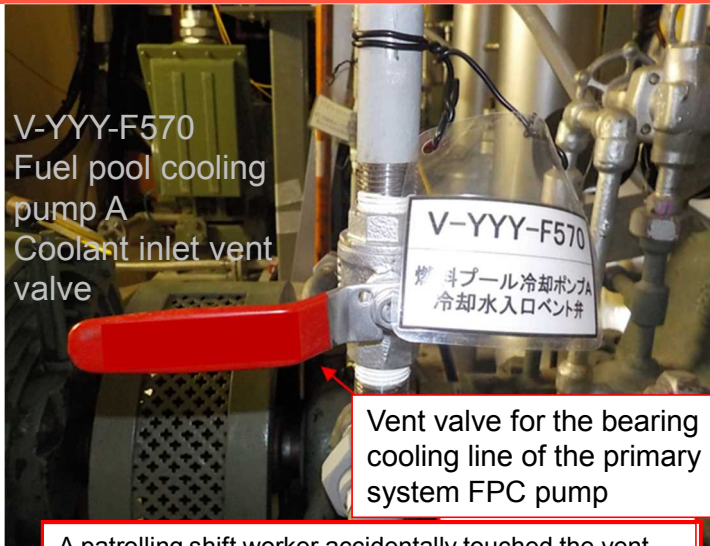
Overall incineration system (A system)

Conceptual diagram of installation of equipment and facilities



5-5. Shutdowns of important safety equipment due to human error

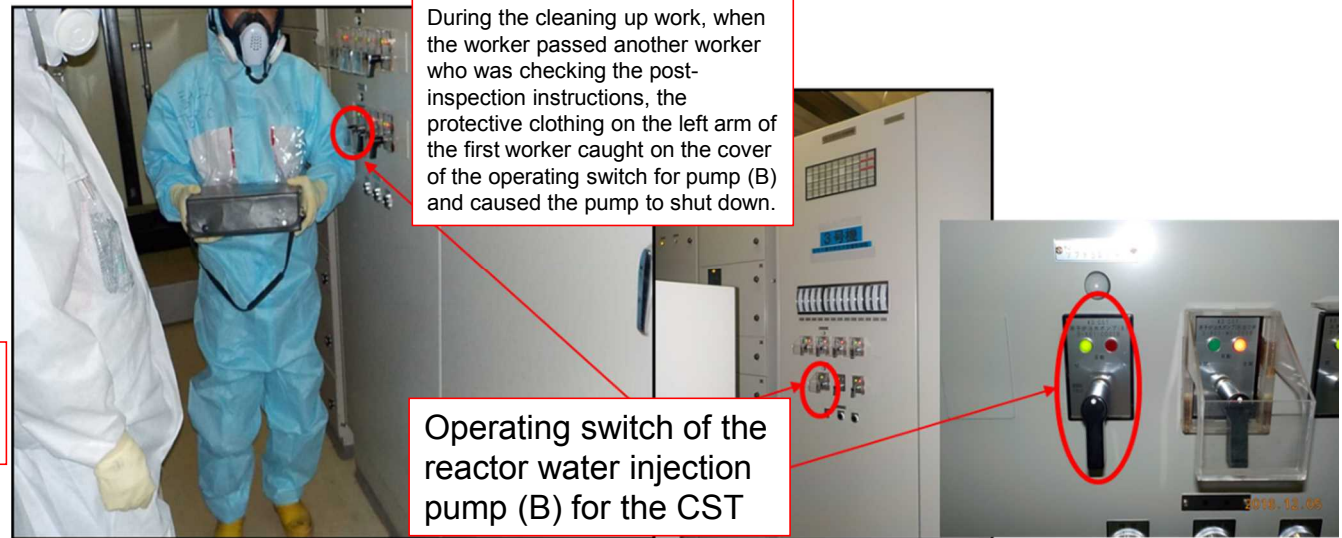
- On Dec 4, a patrolling shift worker accidentally touched the vent valve (fully closed) of the bearing cooling line of the primary system FPC pump for the Unit 1 Spent Fuel Pool (called SFP hereafter), thereby opening it slightly. Consequently, the system pressure of the secondary system for the common equipment in Units 1 to 3 gradually dropped to warning levels, and the common equipment was shut down manually.
- On Dec 5, while inspecting the meters of the reactor water injection equipment for Unit 3 Condensate Storage Tank (called CST hereafter), the protective clothing on the left arm of a contractual worker caught on the operating switch cover of the running water injection pump (B) and moved the operating switch to shutdown position. Consequently, Unit 3 reactor water injection shut down.
- For important safety-ensuring equipment, such as the cooling equipment, recurrence prevention measures will be implemented for equipment as well as management and operating aspects so as not to cause shutdowns of important functions. **In particular, if the possibility of human error cannot be completely eliminated in regards to equipment, sound physical protection measures will be implemented to ensure that the issue does not lead to a shutdown of important functions.**



V-YYY-F570
Fuel pool cooling pump A
Coolant inlet vent valve

Vent valve for the bearing cooling line of the primary system FPC pump

A patrolling shift worker accidentally touched the vent valve due to which that valve opened slightly. Thereafter, the system pressure gradually dropped through that valve, and as a result, lead to the shutting down of the pump for the secondary system common equipment.



During the cleaning up work, when the worker passed another worker who was checking the post-inspection instructions, the protective clothing on the left arm of the first worker caught on the cover of the operating switch for pump (B) and caused the pump to shut down.

Operating switch of the reactor water injection pump (B) for the CST

Dec 5 Reactor water injection equipment shut down

Dec 4 Common cooling equipment for Spent Fuel Pool shut down

