Waste Management Symposia 2017

Current Status and Challenges at Fukushima Daiichi Decontamination and Decommissioning

@Phoenix City, Arizona

March 6, 2017

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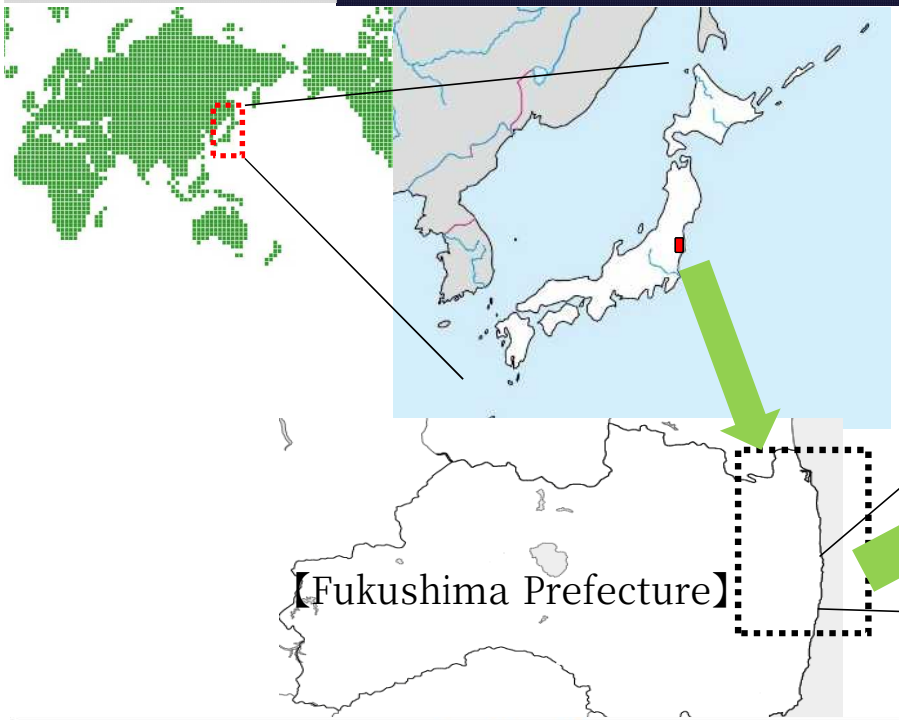
Tokyo Electric Power Company Holdings, Inc.

TEPCO

Fukushima Daiichi (1F) and Daini (2F) Nuclear Power Station



Fukushima Daiichi Nuclear Power Station

1 F

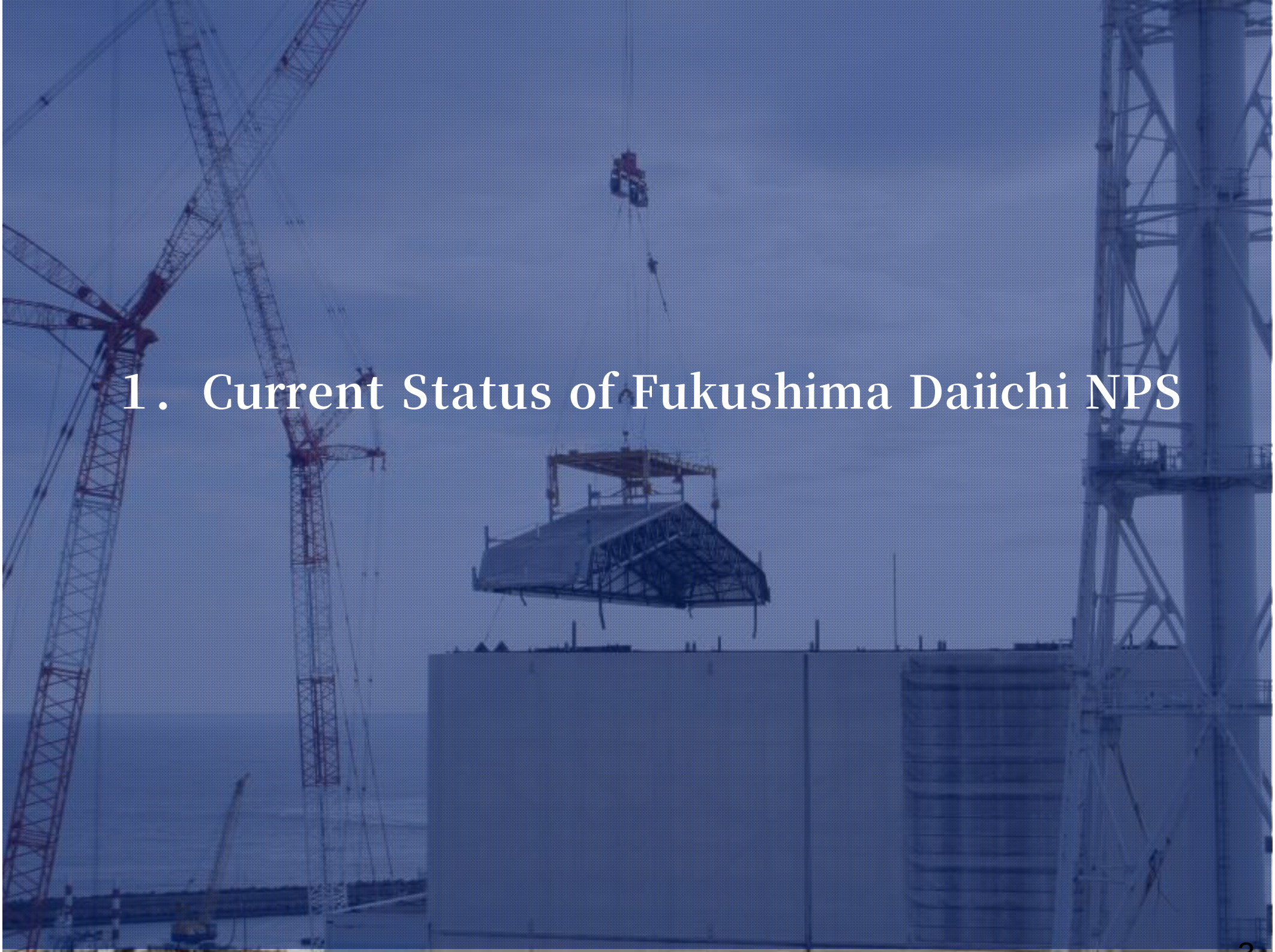
Fukushima Daiini Nuclear Power Station

2 F

Plant	Unit	Start of Operation	Reactor Type	Containment Type	Power Output (MWe)	Main Contractor	Pre-earthquake Status
1F	1	1971. 3	BWR-3	Mark-I	460	GE	Operating
	2	1974. 7	BWR-4	Mark-I	784	GE/Toshiba	Operating
	3	1976. 3	BWR-4	Mark-I	784	Toshiba	Operating
	4	1978.10	BWR-4	Mark-I	784	Hitachi	Outage Full core offloaded to spent fuel pool
	5	1978. 4	BWR-4	Mark-I	784	Toshiba	Outage
	6	1979.10	BWR-5	Mark-II	1,100	GE/Toshiba	Outage
2F	1	1982. 4	BWR-5	Mark-II	1,100	Toshiba	Operating
	2	1984. 2	BWR-5	Mark-II modified	1,100	Hitachi	Operating
	3	1985. 6	BWR-5	Mark-II modified	1,100	Toshiba	Operating
	4	1987. 8	BWR-5	Mark-II modified	1,100	Hitachi	Operating

Today's Topics

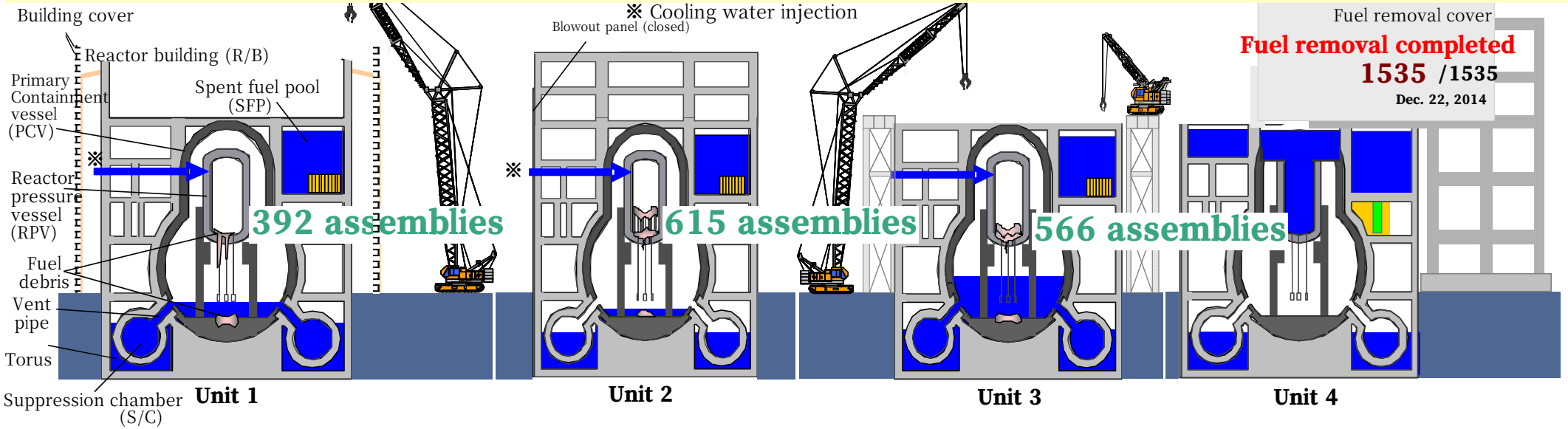
1. Current Status of Fukushima Daiichi NPS
2. Improving Work Environment
3. Three Principles for Measures to Counter Contaminated Water
4. Fuel Removal from the Spent Fuel Pools
5. Toward Fuel Debris Removal
6. Information Sharing and Communication



1. Current Status of Fukushima Daiichi NPS

（1） State of Units 1~ 4

- **Cold shutdown of all units continues to be maintained.**
- **Plant parameters including RPV and PCV temperatures are monitored continuously 24 hours/day**



Values as of 11:00 am on February 22, 2017

	Temperature at the bottom of the pressure vessel	Temperature inside the containment vessel	Fuel pool temperature	Reactor coolant volume
Unit 1	１４℃	１５℃	２４℃	３．０ ㎥/hour
Unit 2	１８℃	１９℃	２６℃	４．５ ㎥/hour
Unit 3	１７℃	１８℃	２６℃	３．２ ㎥/hour
Unit 4	—	—	１４℃	—

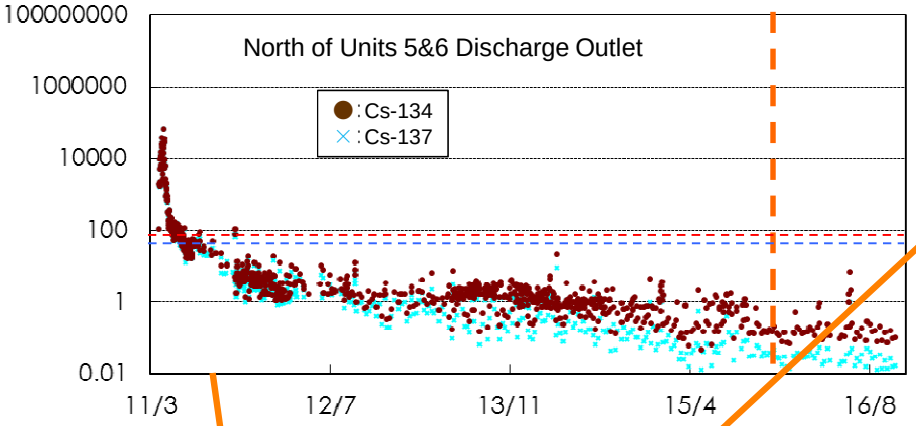
(2) Monitoring Level in the Sea

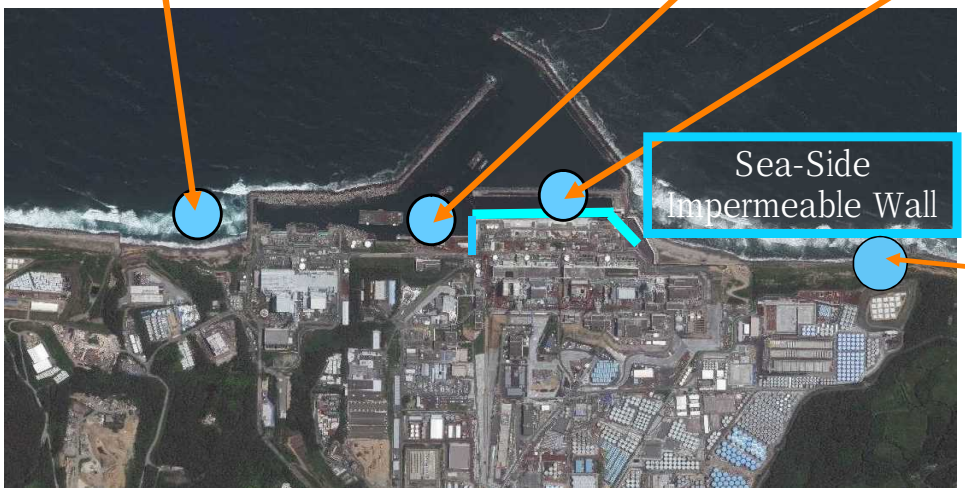
- **Compared to the situation just after the accident, the current level of radioactivity has been lowered to parts per hundred thousand, to per million.**
- **Concentration levels decreased further after closure of the sea-side impermeable wall.**

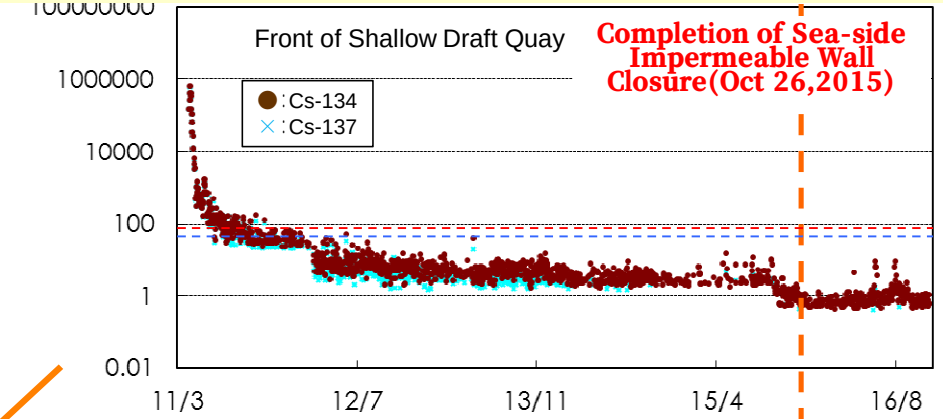
- The concentrations outside the port are substantially below regulation limits

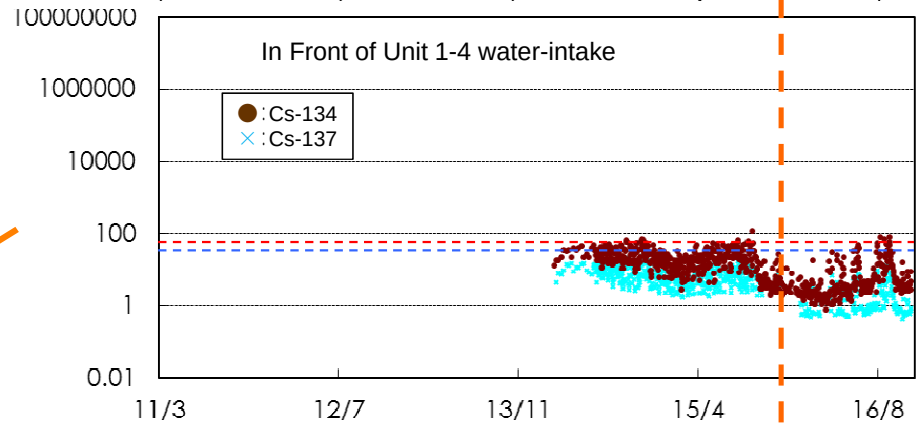
Regulation Limit
- Cesium 137: 90Bq/L
- Cesium 134: 60Bq/L

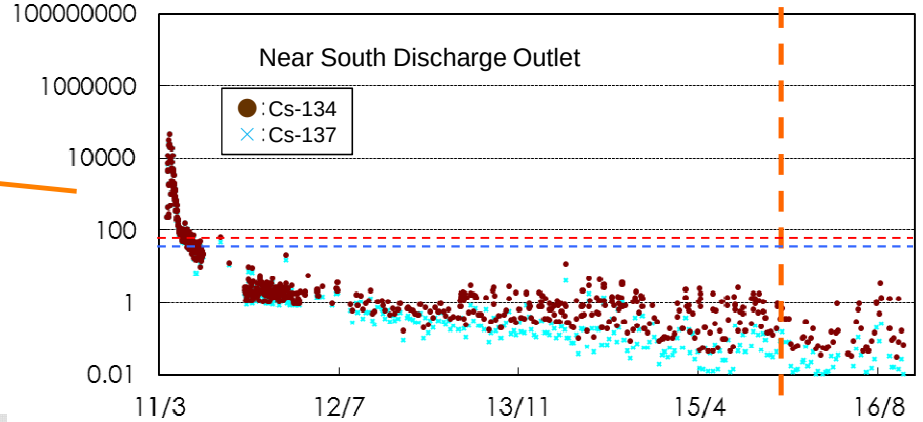
Bq/l











(3) Airborne Radiation Level

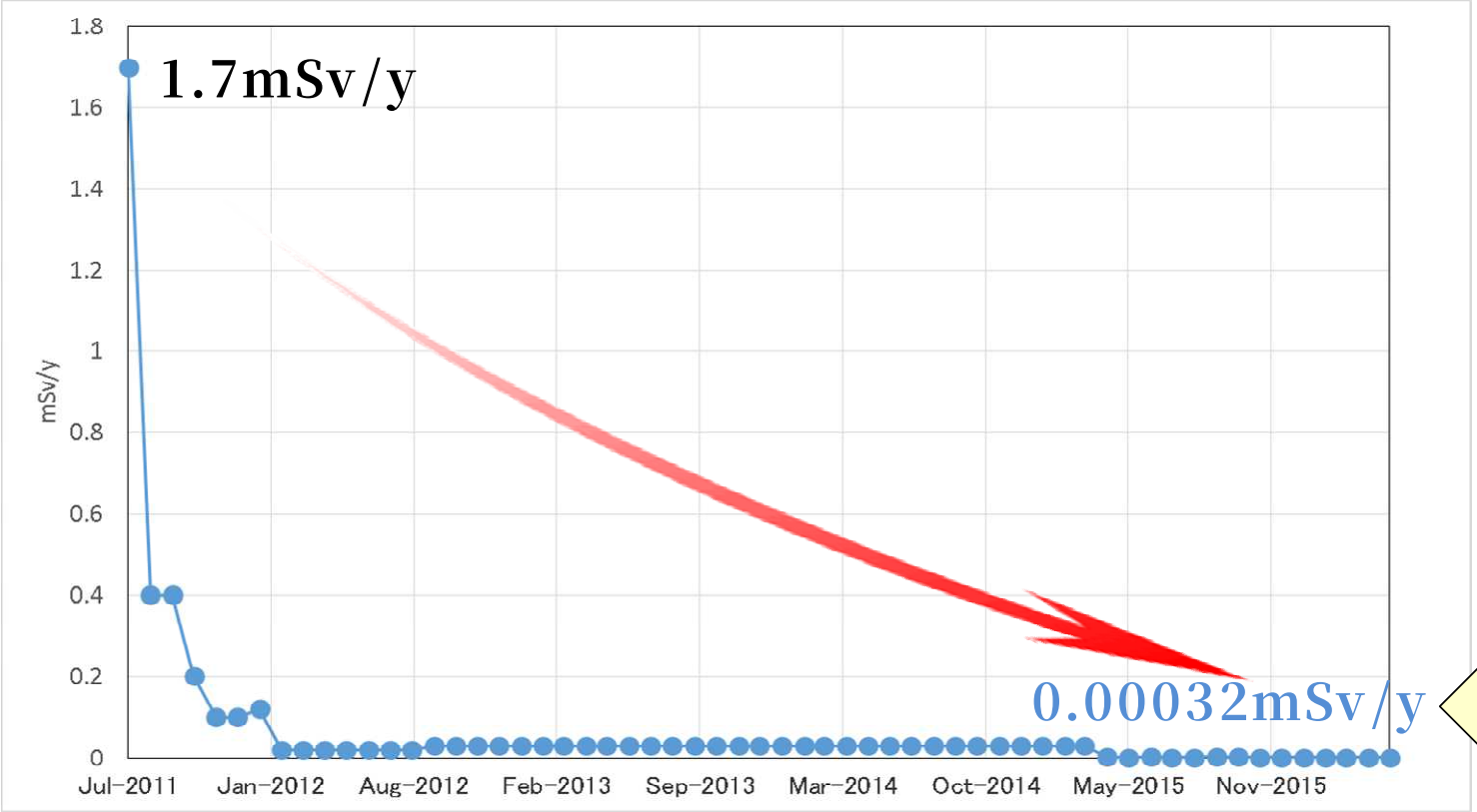
Release of radioactive materials has significantly decreased

Amount of radioactive materials (cesium) released from Unit 1-4 PCVs is assessed based on airborne radioactive material concentrations at top of reactor buildings

Estimated value of total release amount **(as of August 2016)** about 53 thousand Bq/hr

- Accordingly, assessed the exposure dose at site boundary as maximum 0.00032 mSv/yr
  (Excluding effect of already released radioactive materials)

Exposure dose by radioactive materials (cesium) from Units 1 to 4



About one-18,900th compared to Jul 2011 (1 billion Bq/hr)

2. Improving Work Environment

（1）Decreasing Site Radiation Dose

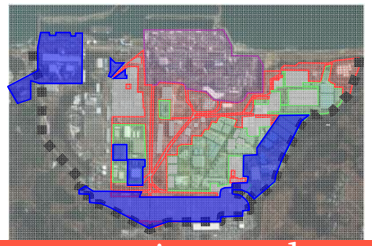
- **As a result of radiation reduction measure, workers don't have to wear full-face respirator or half-face respirator anymore in most parts of the site.**

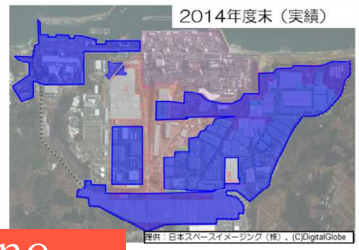
Decreasing radiation dose

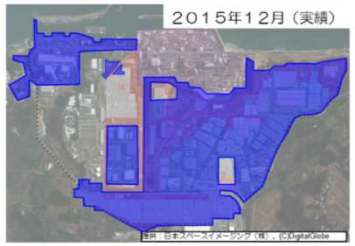
FY2013	FY2014	As of Dec. 2015	As of Mar. 2016
40 %	77 %	89 %	100 %

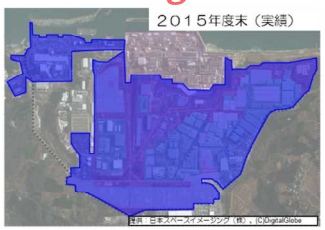
FY2015 Target Achieved

: Area confirmed below 5μSv/h



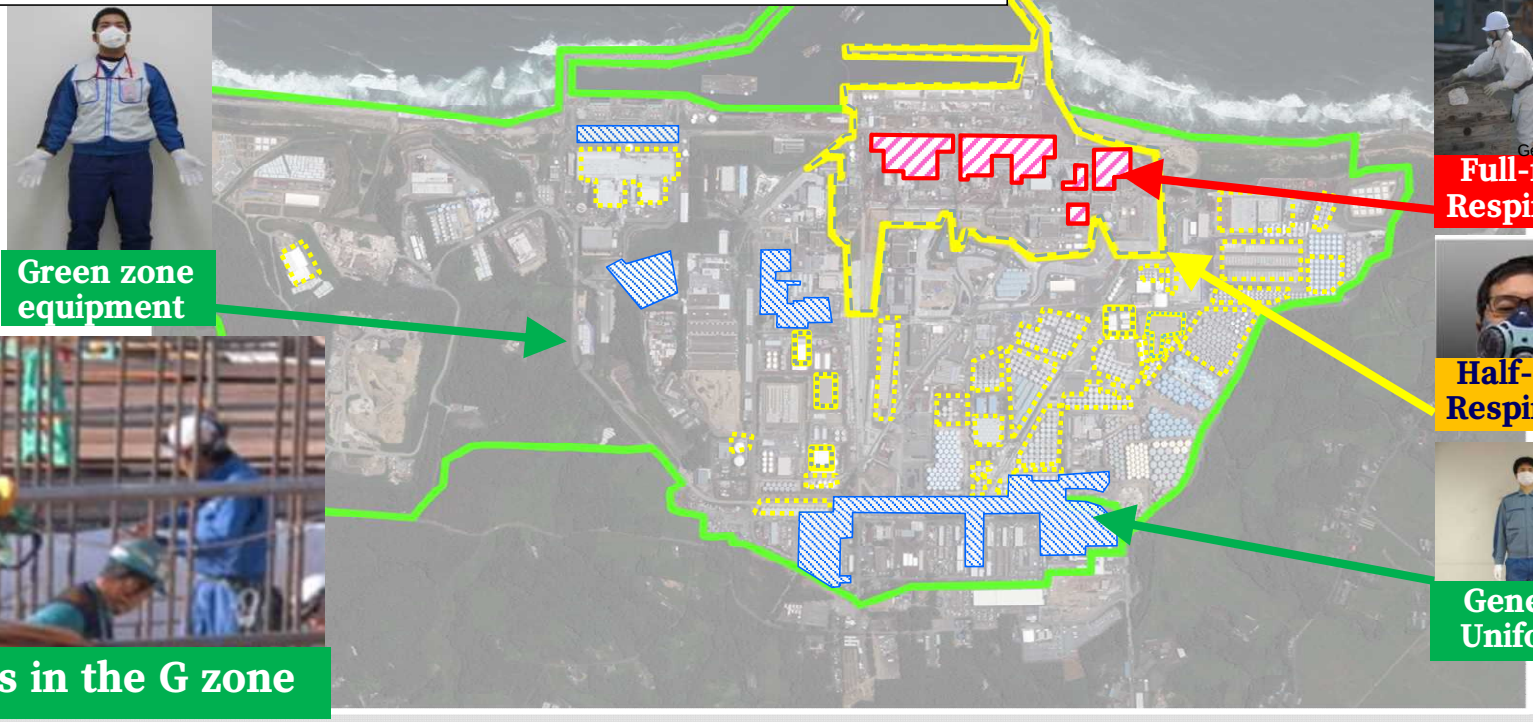






Personal protective equipment in each zone

R zone ［Area with anorak and full face mask］
Y zone ［Area with coverall］
G zone ［Area with general work uniform］



Green zone equipment

Workers in the G zone

Full-face Respirator

Half-face Respirator

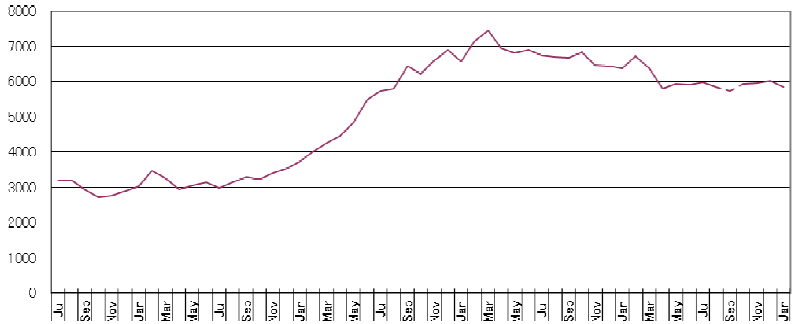
General Uniform

（2）Worker Security and New facilities

- **Currently about 6,000 persons／day are working on weekdays, which is twice as many as several years ago.**
- **Facilities such as Contractors' Office Building have created the environment where TEPCO and contractors can address the decommissioning work in an integrated manner.**

Changes in number of workers

- Number of workers (TEPCO employees and contractors) per weekday engaged in work during October assumed as approx. 5,850 people as of Jan. 2017.
- Percentage of workers from local area approx. 55% as of Jan. 2017.



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

New Facilities

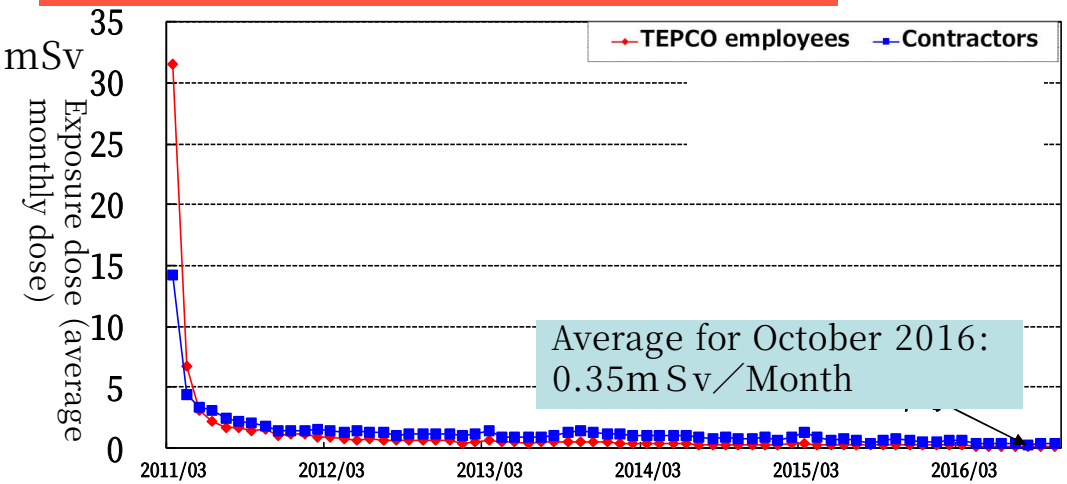
- Large rest house with a capacity of approx. 1,200 workers (from May 2015)
  →Convenience store "Lawson" opened in March , 2016
- Fukushima Revitalization Meal Service Center (from March 2015)
  - Providing warm meals to Fukushima Daiichi
  - Creation of employment opportunities
  - Dispelling harmful rumors about Fukushima food
- Contractors' Office Building which opened in Feb. 2017 is located in the vicinity of TEPCO's office building, which allows them to work closely.

Large Rest House

Contractors' Office Building

New Office Building for TEPCO

Trend of monthly exposure dose rate



Ensuring stable long-term employment

- Currently, more than 90% of orders fulfilled by negotiated contracts, which enables contractors to secure workers in a long term.

Pursuit of safety on-site

- On January 19, TEOCO and contractors jointly held a congress to pledge for no human-caused accident to happen.

3. Three Principles for Measures to Counter Contaminated Water

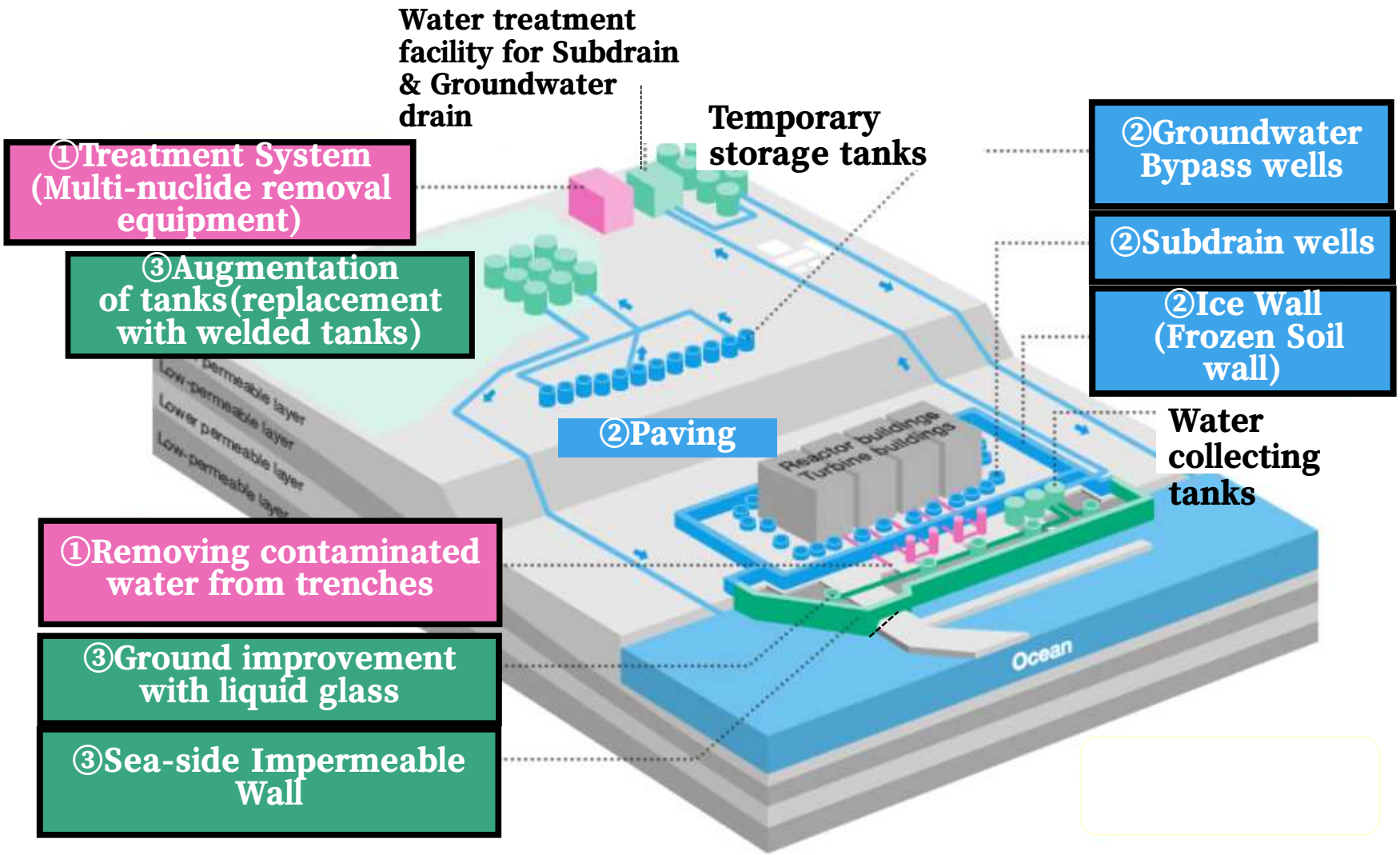
（1）Three Principles for Measures to Counter Contaminated Water

Three Principles

①Removing source of contamination

②Isolating fresh water from contaminated areas

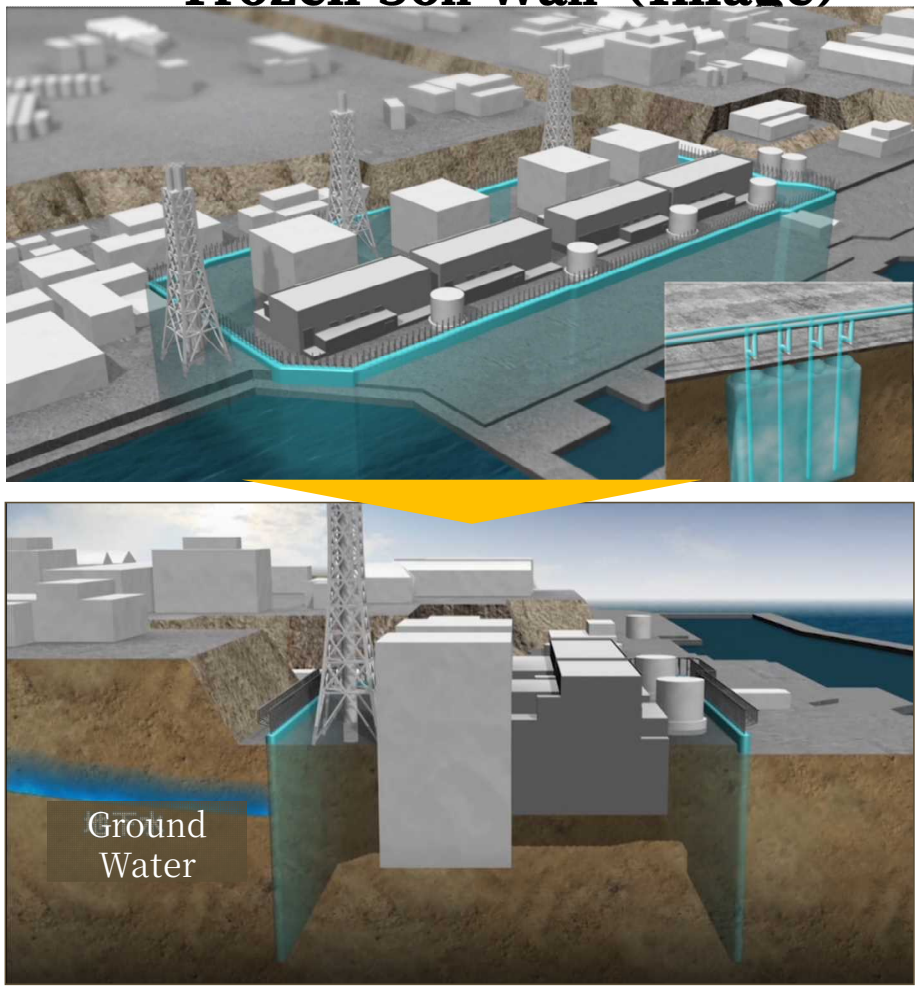
③Preventing leakage of contaminated water



(2) Ice Wall (Frozen Soil Wall) ①

- **Freezing pipes have been installed 1m apart (30 m deep) and started freezing surrounding soil in Mar. 2016**
- **As of Feb, 2017, all but five places are in freezing mode.**
- **Once completed, formed barrier around reactors will eventually block the flow of ground water from the landside.**

Frozen Soil Wall (Image)

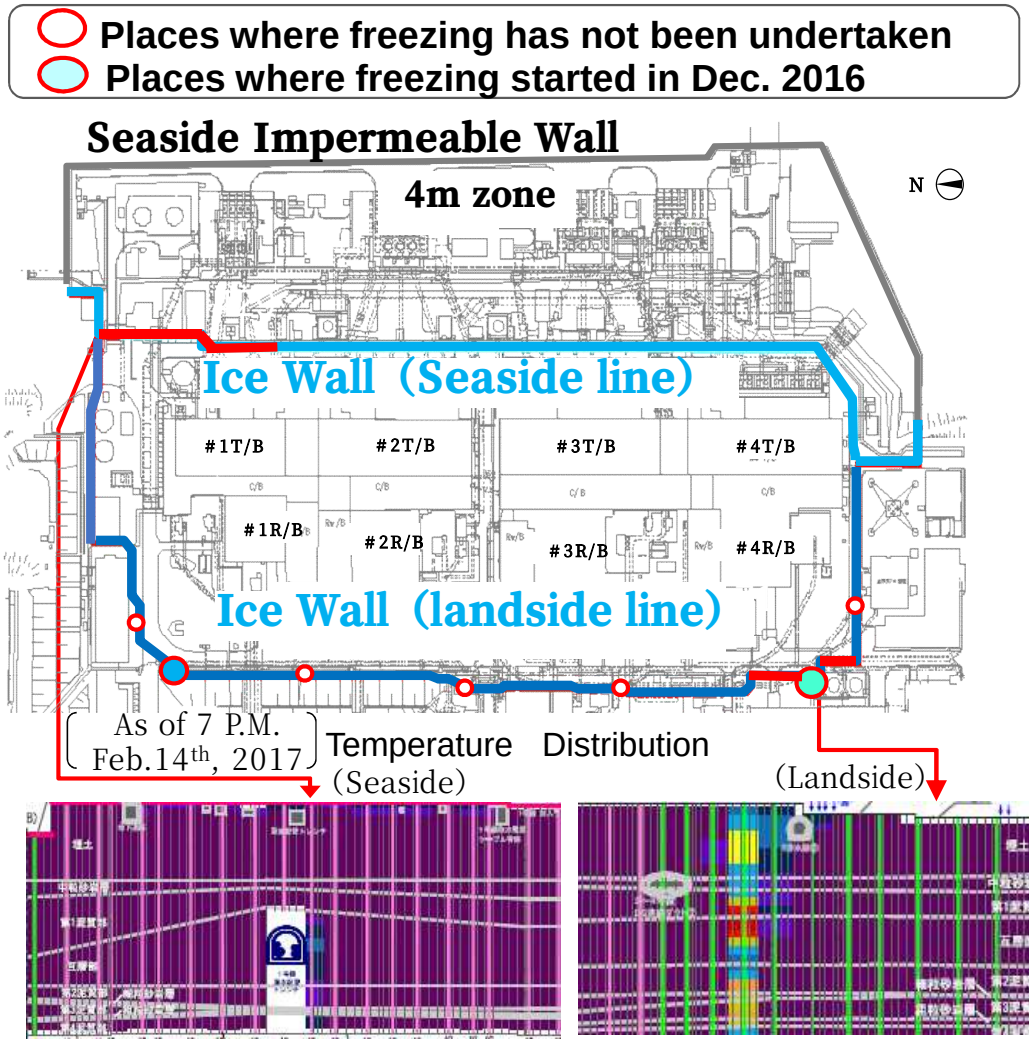


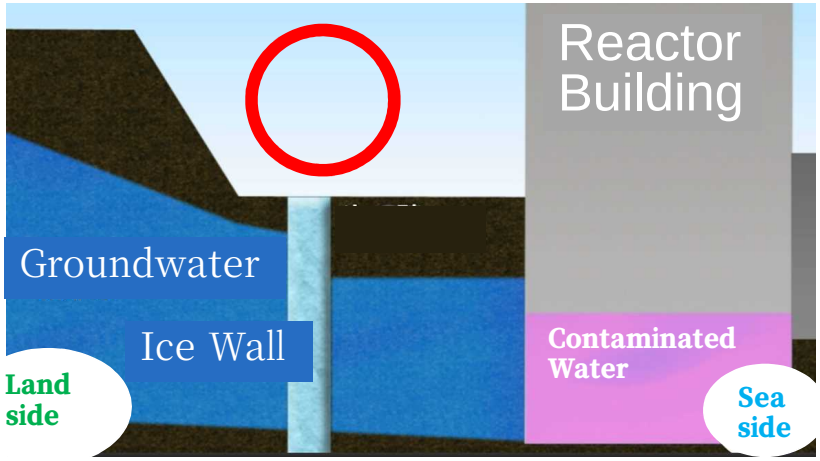
Blocking the groundwater penetration into the buildings (Image)

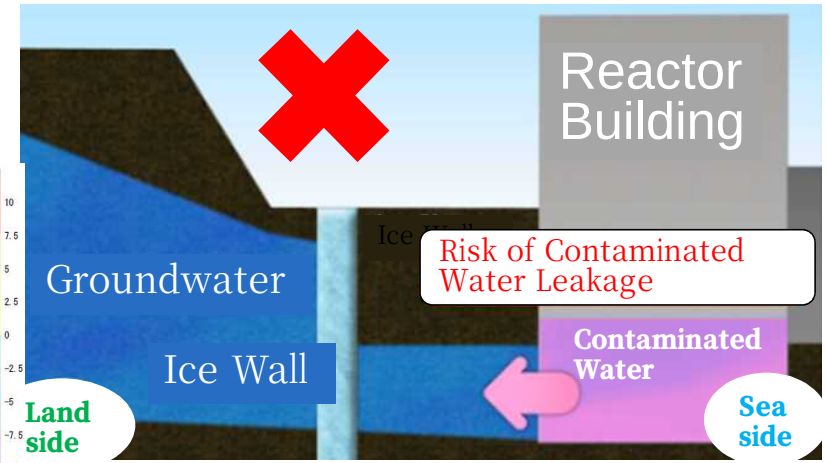
Pipe arrangement for coolant

(2)Ice Wall (Frozen Soil Wall) ②

- In order to prevent contaminated water in R/B and T/B from escaping, TEPCO constantly monitors the water level to ensure that groundwater always keeps higher than water level inside the buildings.







4. Fuel Removal from the Spent Fuel Pools

(1) Fuel Removal from the Spent Fuel Pool (Unit 4)

- Fuel removal started on November 18, 2013.
- Removal of 1535 fuel bundles completed on December 22, 2014 as scheduled
- No risk from fuel remains at unit 4. This gives confidence to proceed to fuel removal at units 1, 2 and 3

September 22, 2011

July 5, 2012

November 12, 2013: Completion of building steel framework (The volume of steel used is equivalent to those of Tokyo Tower.)

Process of removing fuel rods at SFP Unit 4

5. Toward Fuel Debris Removal

(1) Investigation of the Primary Containment Vessel (Unit 2) ①

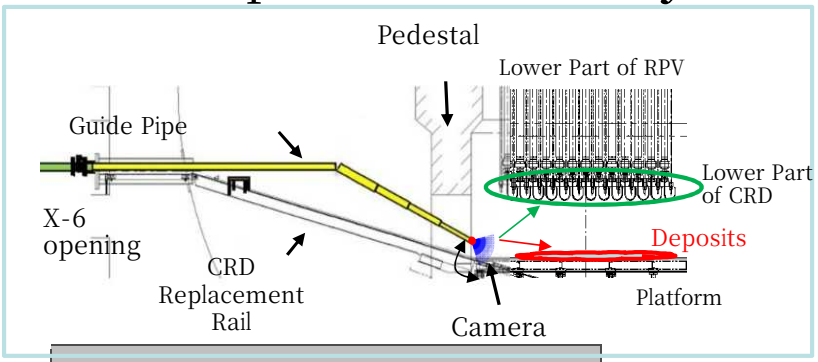
- **Exploration inside the PCV and at the bottom of the RPV was conducted in order to investigate conditions such as the location of fuel debris inside the PCV.**
- **X-6 opening was used as a path for devices shown below to proceed inside the pedestal.**

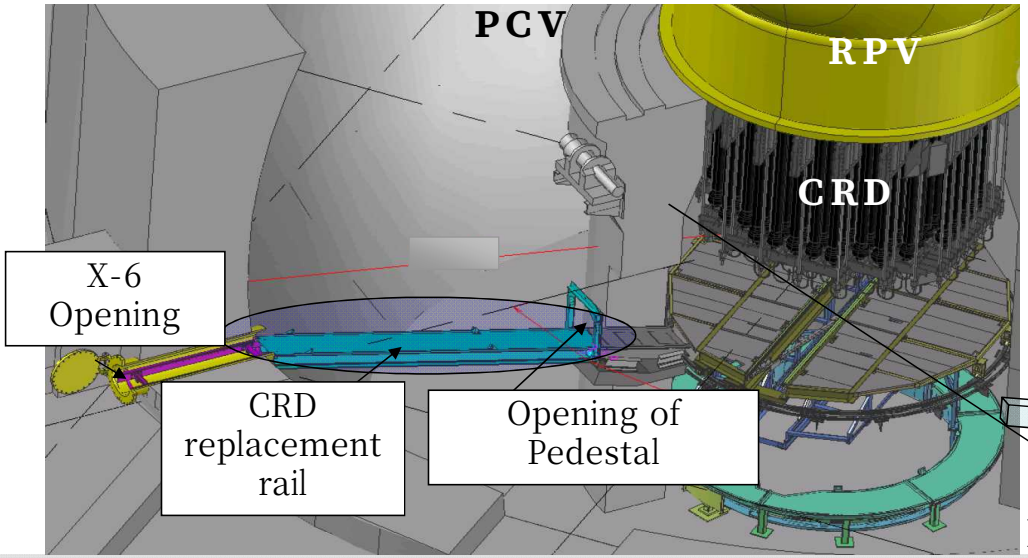
Robot for Survey

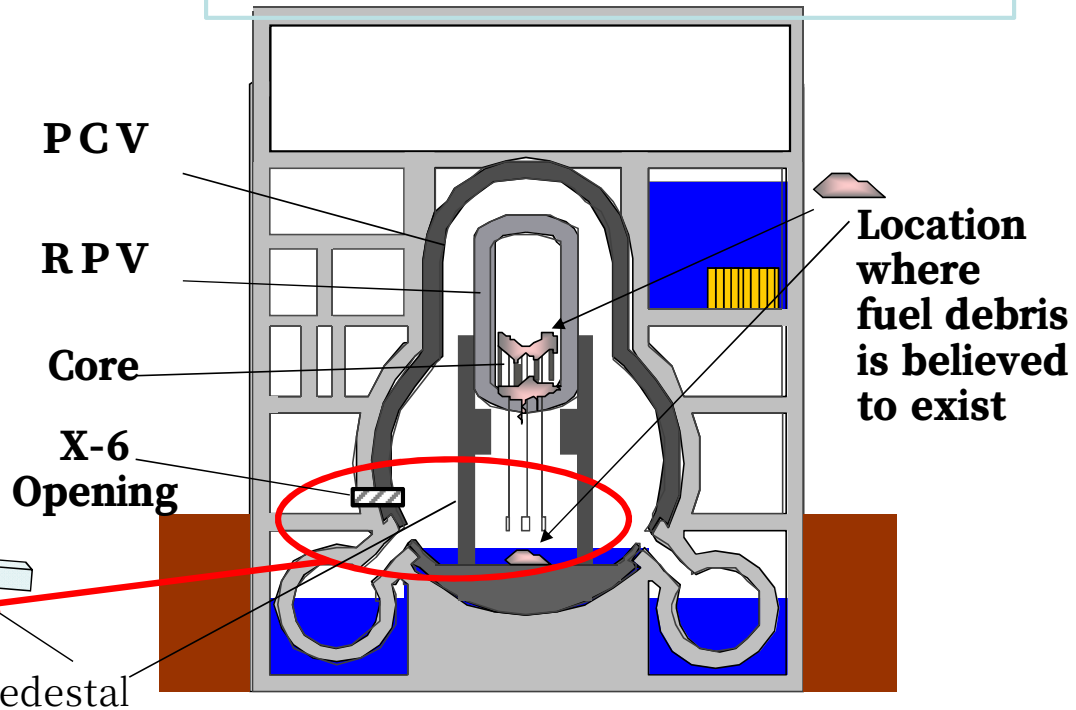
The head camera with a lamp had a tilting and panning function. The robot also has a dosimeter and a thermometer.

The Guide pipe had a camera with a tilting and panning function.

Guide Pipe for Pre-survey



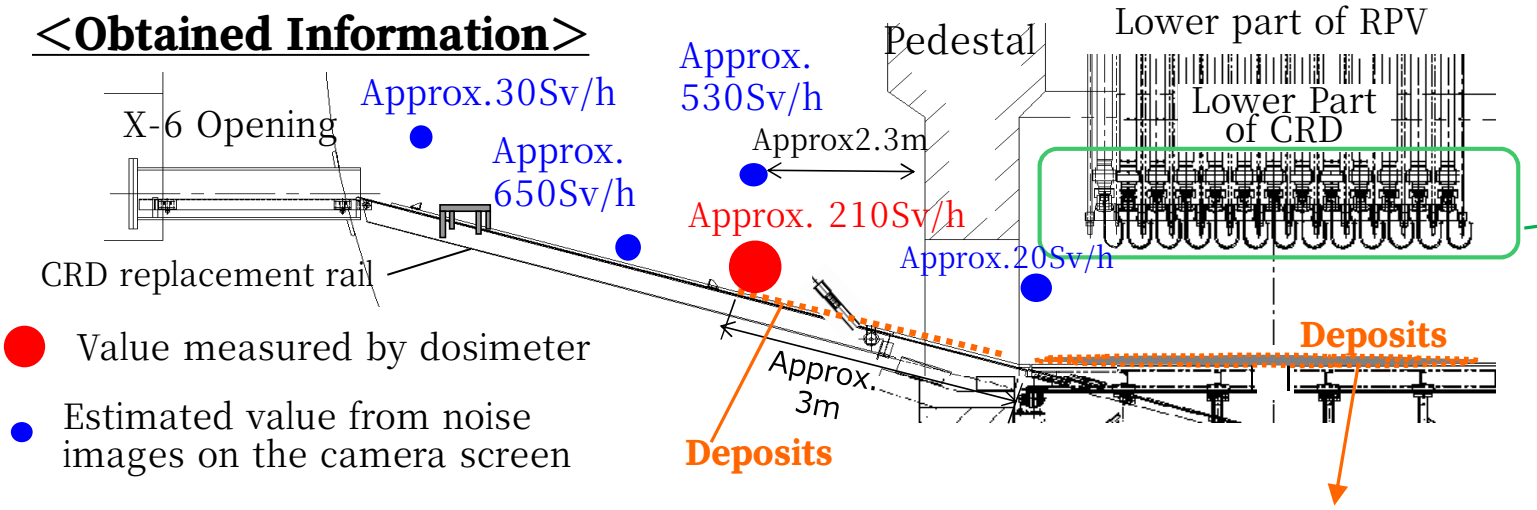




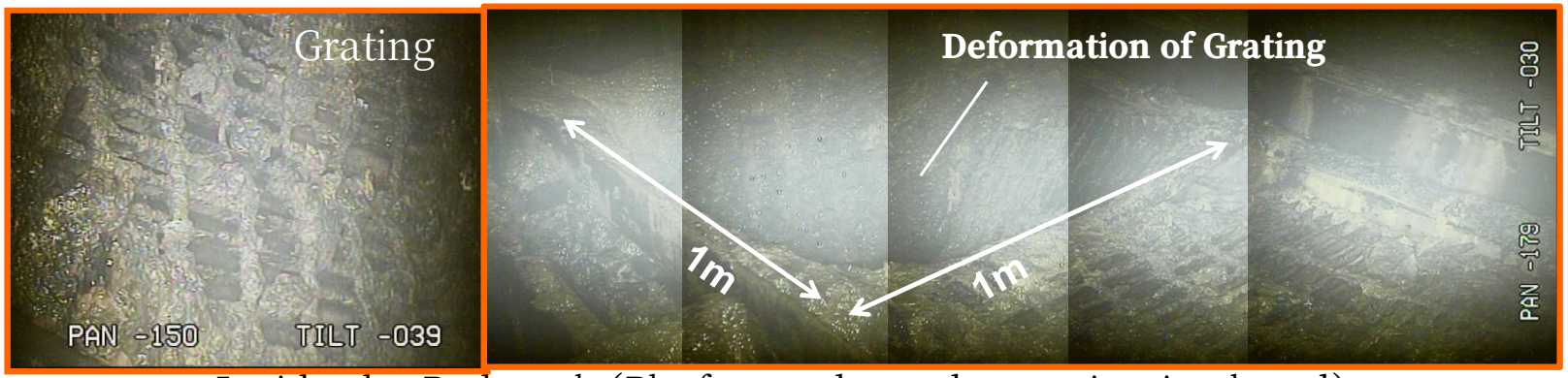
(1) Investigation of the Primary Containment Vessel (Unit 2) ②

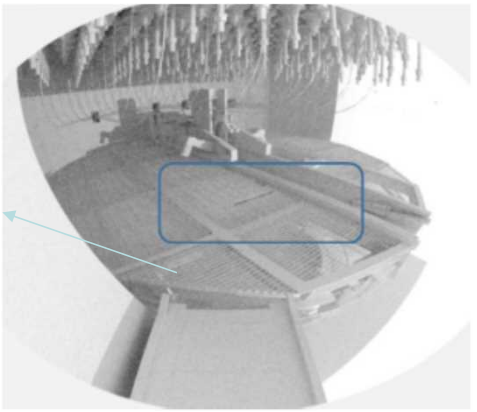
- **In the pre-survey conducted in Jan. 2017, deposits were found on the CRD rail and inside the pedestal. Deformation of grating was also found inside the pedestal.**
- **A robot was inserted on Feb. 16. The radiation levels were measured as approx. 210Sv/h.**

<Obtained Information>



Lower Part of CRD





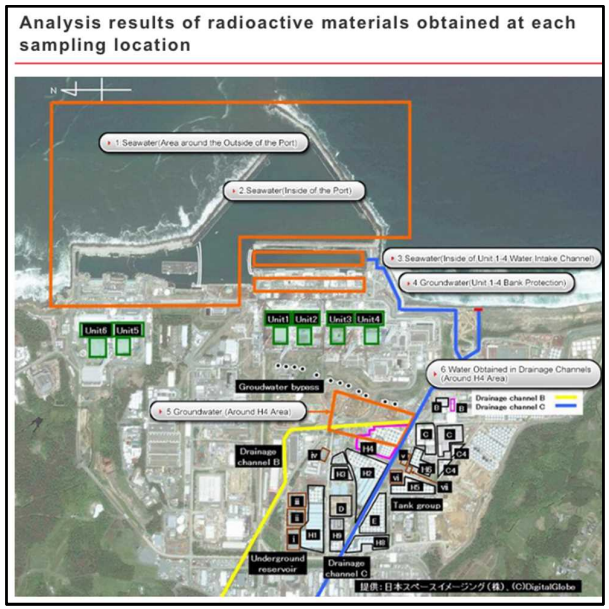
Inside the Pedestal (Platform where the grating is placed)

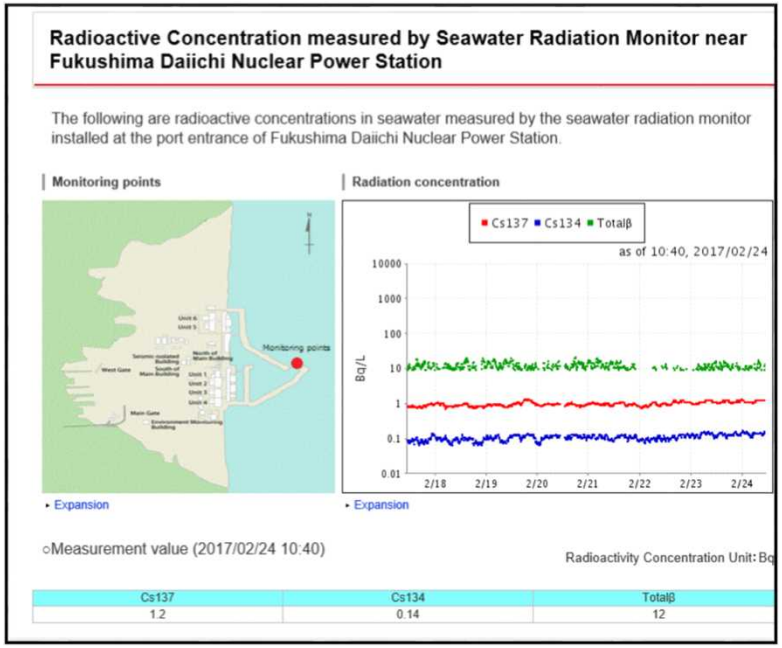
6. Information Sharing and Communication

(1) Information Sharing and Communication

- In accordance with agreements, TEPCO reports to local governments about the progress of decommissioning tasks. TEPCO also informs them of any accidents and troubles at Fukushima site.
- TEPCO reviewed how to report the results of data analysis so that the latest data of radioactive dose can be easily accessible.
- More visualized information and video footage is available to enhance the understanding of decommission work.
- The layout of website (http://www.tepco.co.jp/nu/fukushima-np/index-j.html) was reviewed to make search of specific topics easy.

＜Example of website＞





＜Results of radiation level ＞

＜Explanation of Roadmap ＞

(2) Two-Way Communications with Local Residents

Explanation at public meeting

- **Status Updates with regards to decommissioning are given to the public at the regular public meetings hosted by Fukushima Prefecture**

Left : Ishizaki, Representative of the Fukushima Revitalization Headquarters

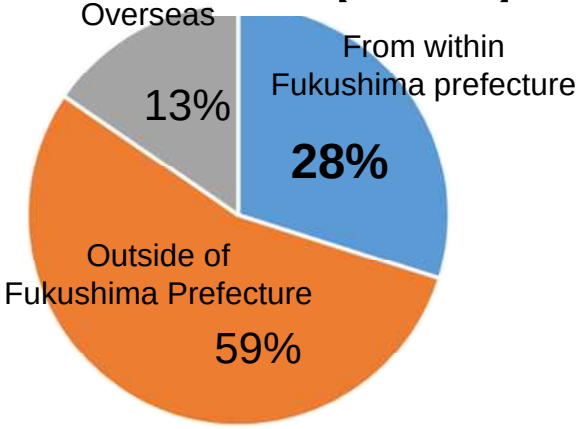
Right : Masuda, Chief Decommissioning Officer, President of Fukushima Daiichi Decontamination and Decommissioning Engineering Company

Opinions to TEPCO have been reflected to decommissioning measures

Invitation to Site Visits

- **Inviting prefectural government and organizations**
- **Percentage of visitors from within the prefecture has increased to 30% (from 20% in FY2014)**

【FY2015】



Number of visitors: 6,723

More than 17,000 visitors since the accident

Example of a comment received: “Decommissioning is a big undertaking done with the cutting edge technology”

Briefings

- **Briefings are held on the issue of great concern to residents**

【Briefing held in Hirono Town】
(December 2015)

Participants: 29
Explanation on :
- The current state of dismantling the Unit 1 building cover
- Overview of the training yard facility in Hirono Town

Thank you for your kind attention!!

TEPCO

Fukushima Daiichi NPS Map