

KAIF-JAIF Joint Forum

**Fukushima Daiichi
Decontamination and Decommissioning
: Current Status and Challenges**

May 8, 2018

@Hotel Gajoen Tokyo

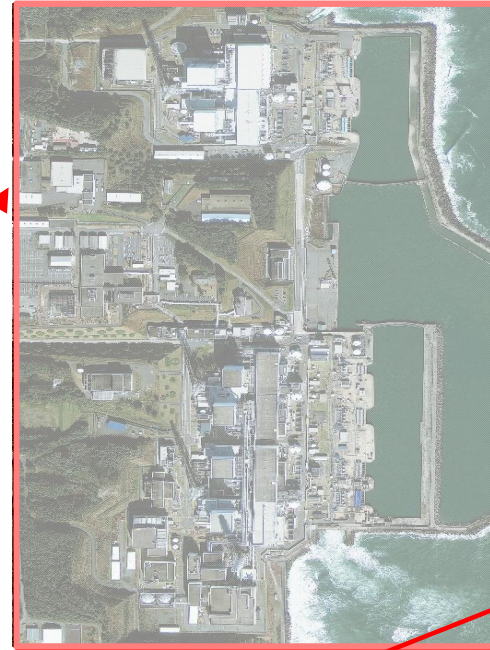
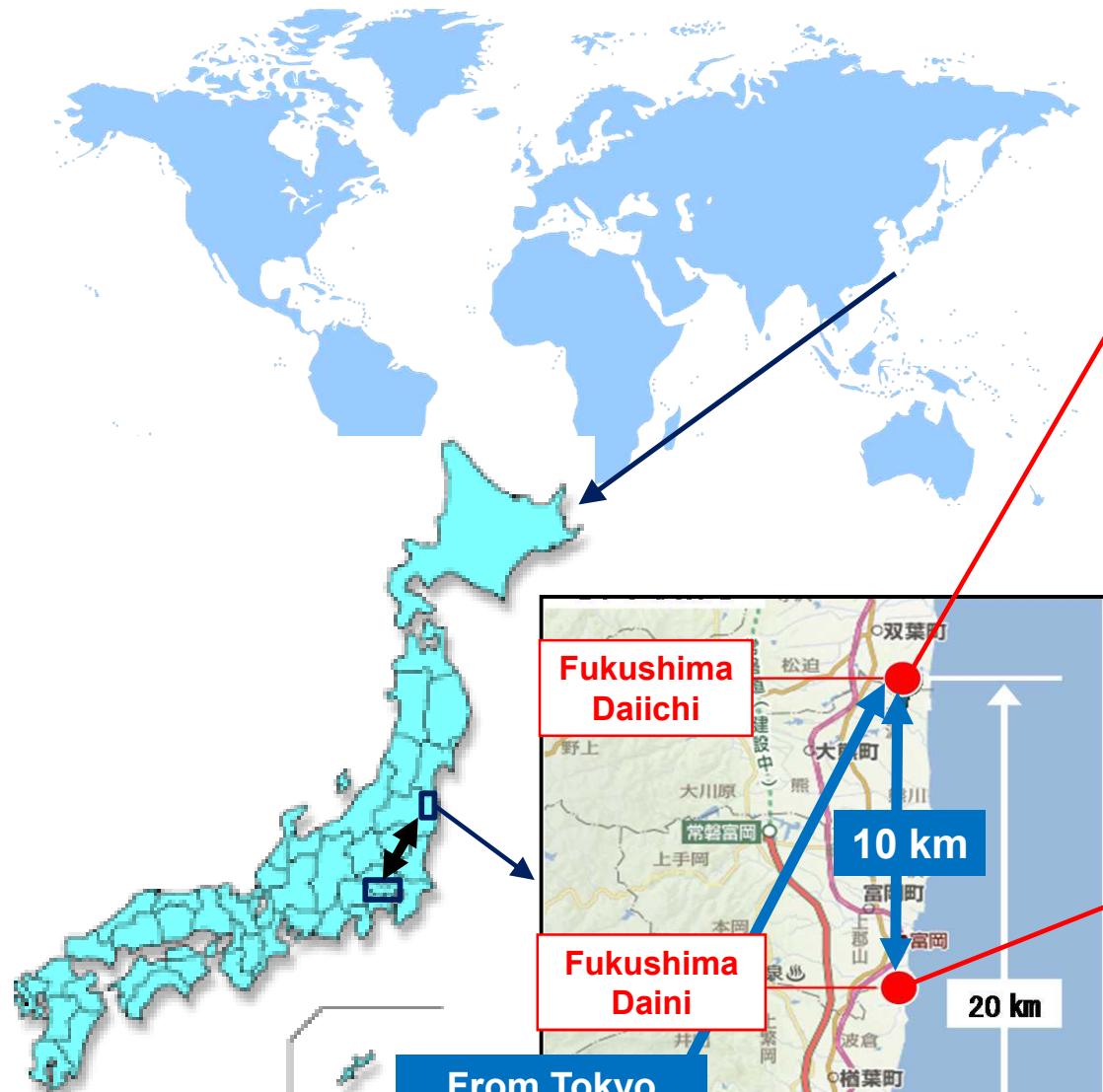
Naohiro MASUDA

Executive Vice President,

Tokyo Electric Power Company Holdings, Inc.

TEPCO





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

The background of the slide is a blue-tinted photograph of a large industrial crane at a nuclear power plant site. The crane is a lattice boom crawler crane, and its structure is visible against a light sky. The crane is positioned on the left side of the frame, with its boom extending towards the center. The overall scene is industrial and technical.

1. Current Status of Fukushima Daiichi NPS

2. Improving Work Environment

3. Contaminated Water Management

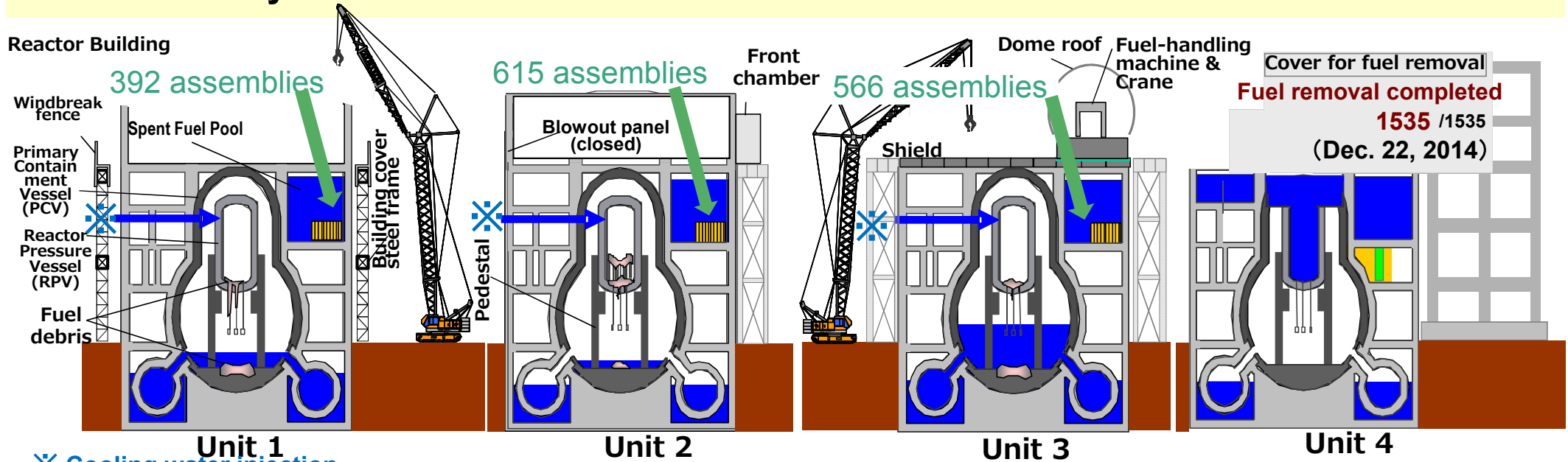
4. Fuel Removal from Spent Fuel Pools

5. Toward Fuel Debris Retrieval

6. Two-way Communications and Collection of Wisdom around the World

7. Fukushima Revitalization Activities

- All reactors are in cold shutdown condition.
- Plant parameters including RPV and PCV temperatures are monitored continuously 24 hours/day.



❖ Cooling water injection

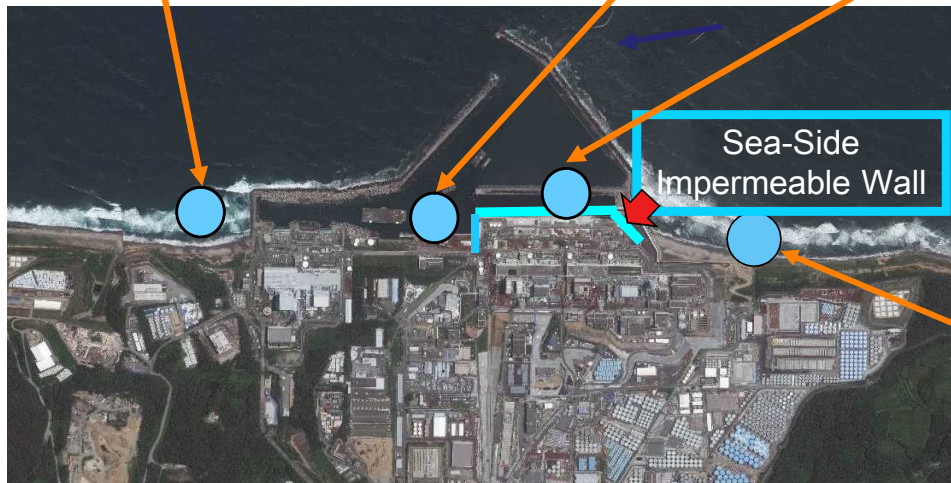
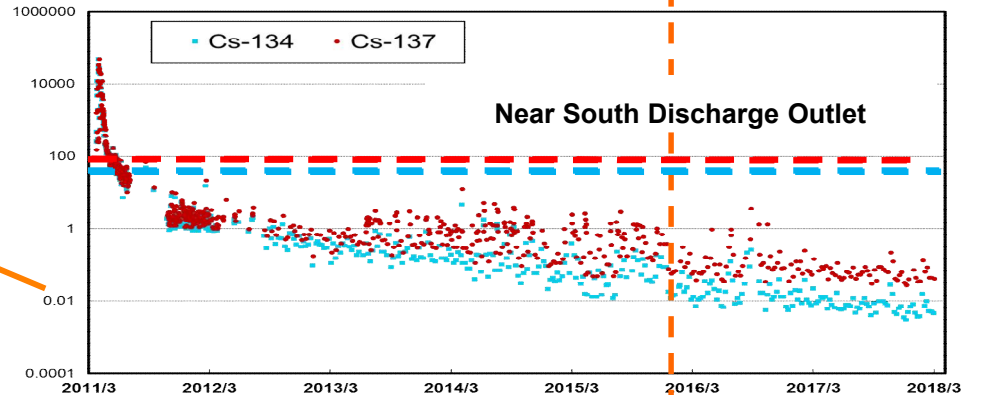
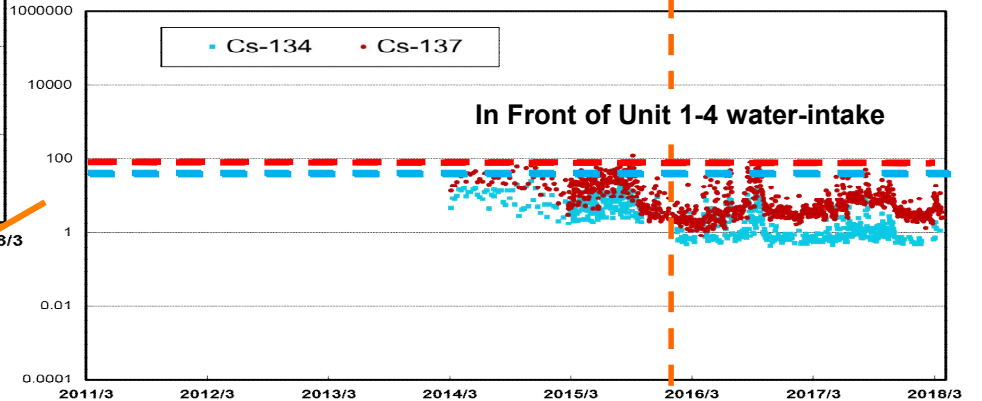
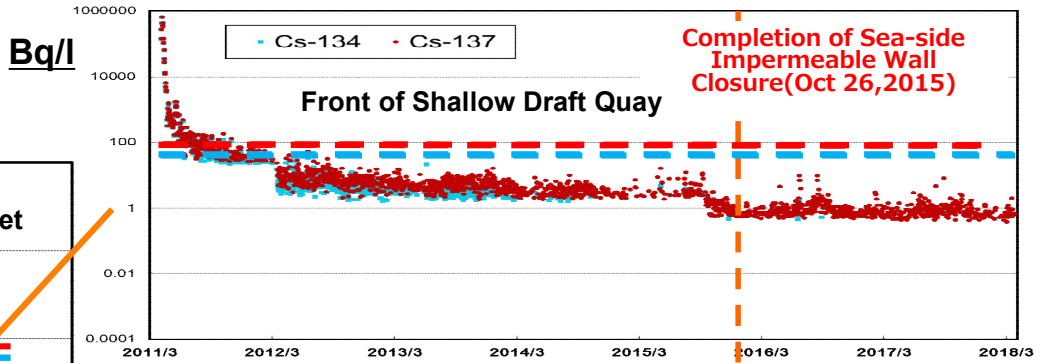
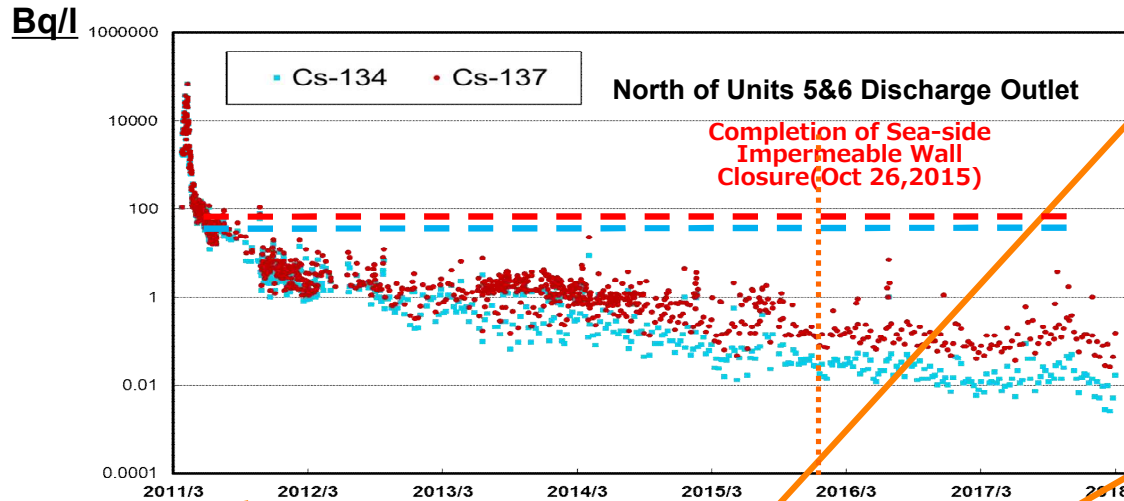
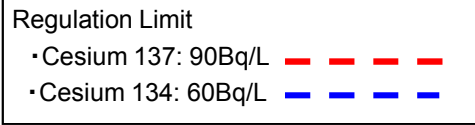
Values as of 11:00 am on May 7, 2018

	Temperature at the bottom of the pressure vessel	Temperature inside the containment vessel	Fuel pool temperature	Reactor coolant volume
Unit 1	18 °C	18 °C	25 °C	3. 0 m ³ /hour
Unit 2	24 °C	24 °C	26 °C	3. 0 m ³ /hour
Unit 3	22 °C	22 °C	25 °C	3. 0 m ³ /hour
Unit 4	—	—	20 °C	—



(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.
- The concentrations outside the port are substantially below regulation limits.
- Concentration levels decreased further after closure of the sea-side impermeable wall.





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(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

40 %

FY2014


77 %

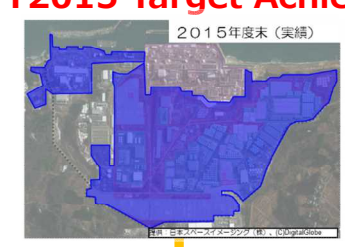
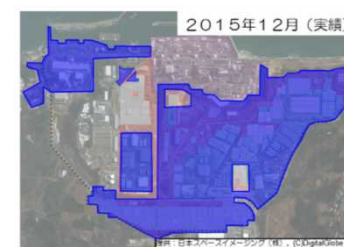
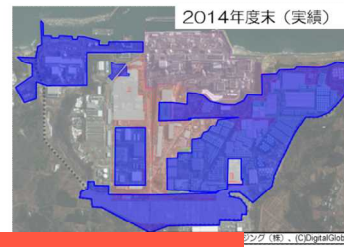
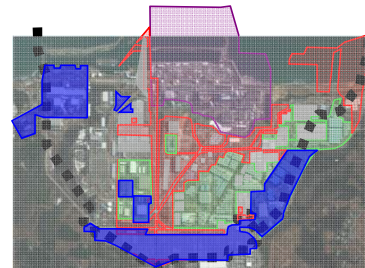
As of Dec. 2015

89 %

As of Mar. 2016

100 %


 : Area confirmed below 5μSv/h




FY2015 Target Achieved

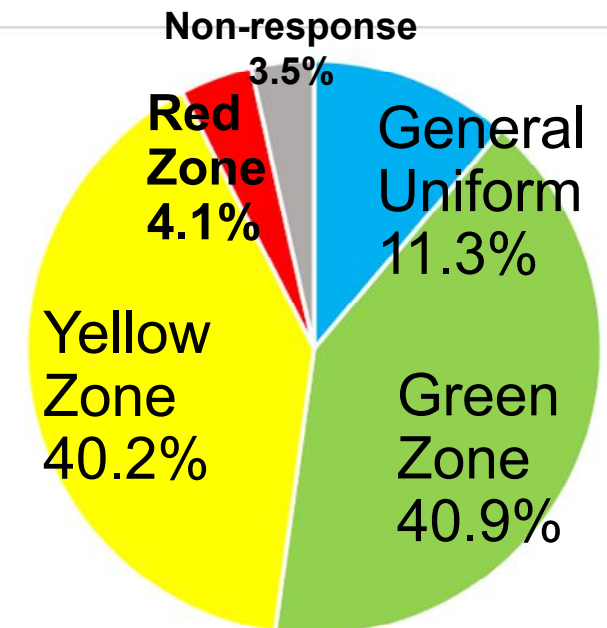
Personal equipment in each zone as of Sep. 2017



 Area where people can work in general uniforms (dust mask) [95% of the site]

 Area where people should work in protective gears (full-face respirator or half-face respirator)

Percentage of workers in each zone

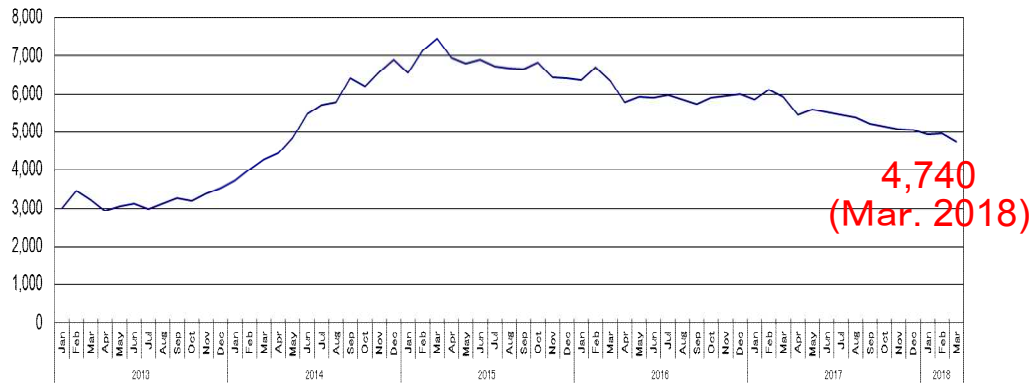


(results from questionnaire in FY2017)

- Currently about 5,000 people/day are working on weekdays.
- Facilities such as Contractors' Office Building and Large Rest House have created the environment where TEPCO and contractors can address the decommissioning work closely in the vicinity of the site.

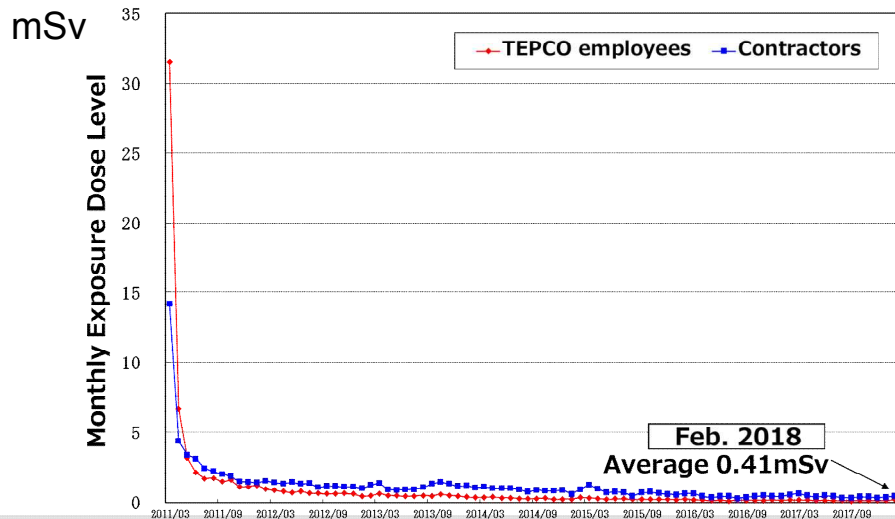
Changes in number of workers

- Average number of workers (TEPCO employees and contractors) on weekdays engaged in work is 4,740 as of Mar. 2018.
- Percentage of workers from local area is approx. 60% as of Mar. 2018.



Change in the average number of workers (actual value) on weekdays in the months following 2013.

Trend of monthly exposure dose rate



New Facilities

- Fukushima Revitalization Meal Service Center was established in Ohkuma Town (March 2015)
- Large rest house with a capacity of approx. 1,200 workers (since May 2015)
- Operation start of a heliport for emergency transportation (May 2017)



Ensuring stable long-term employment

- It is important to create the environment where contractors' workers can work free from anxiety so that they can continue to work over a long period of time.
- Currently, approximately 90% of orders are fulfilled by negotiated contracts, which enables contractors to secure workers in a long term.
- Increased workers living around Fukushima Daiichi contributes to Fukushima revitalization.

Decommissioning through close ties with contractors

- Contractors' Office Building began operating, which has enabled TEPCO and contractors work closely in the vicinity of the decommissioning site.
- On January 18, TEPCO and contractors jointly held a congress to pledge for no human-caused accident to happen.



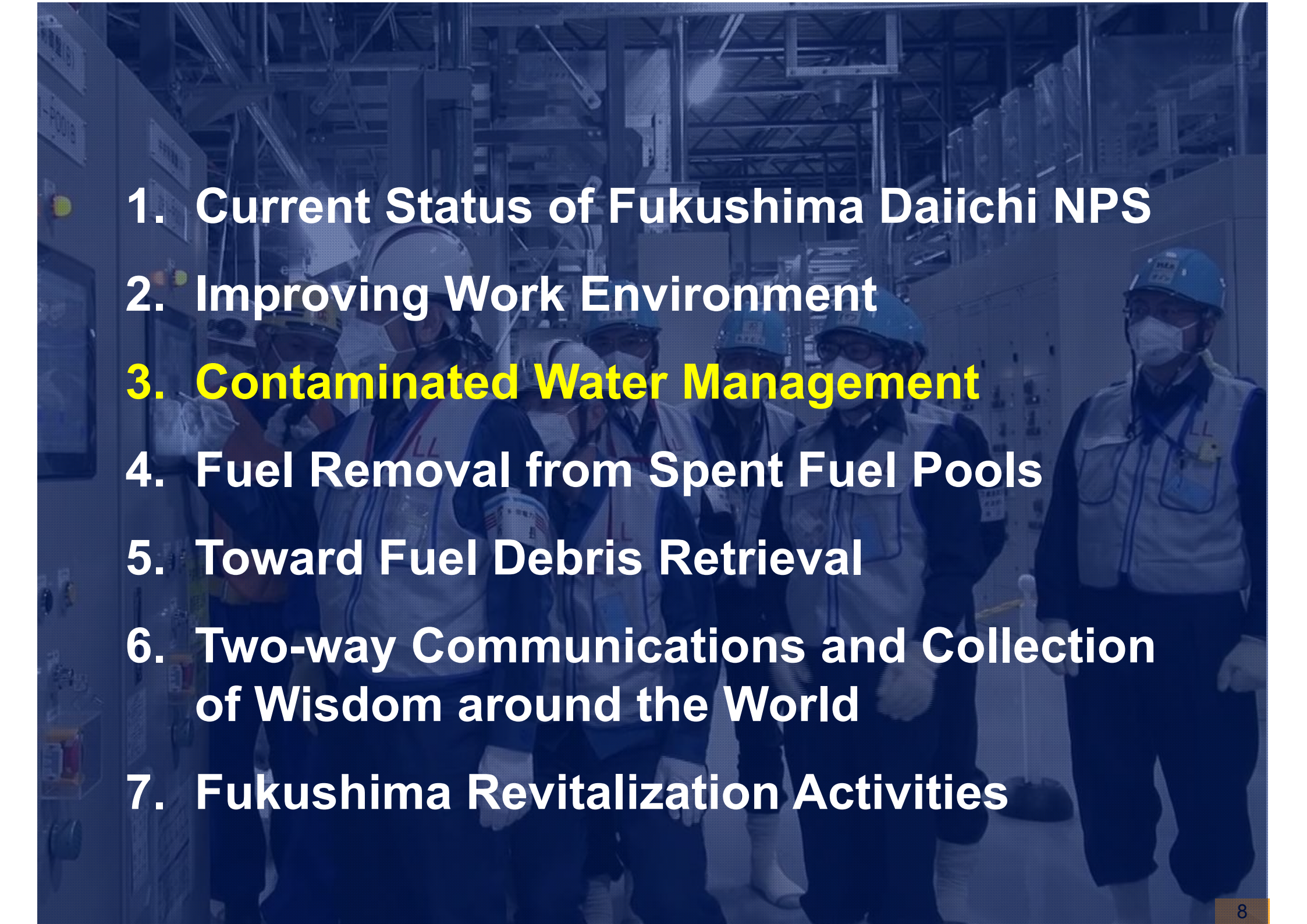
Congress held by TEPCO and contractors



Contractors' office building

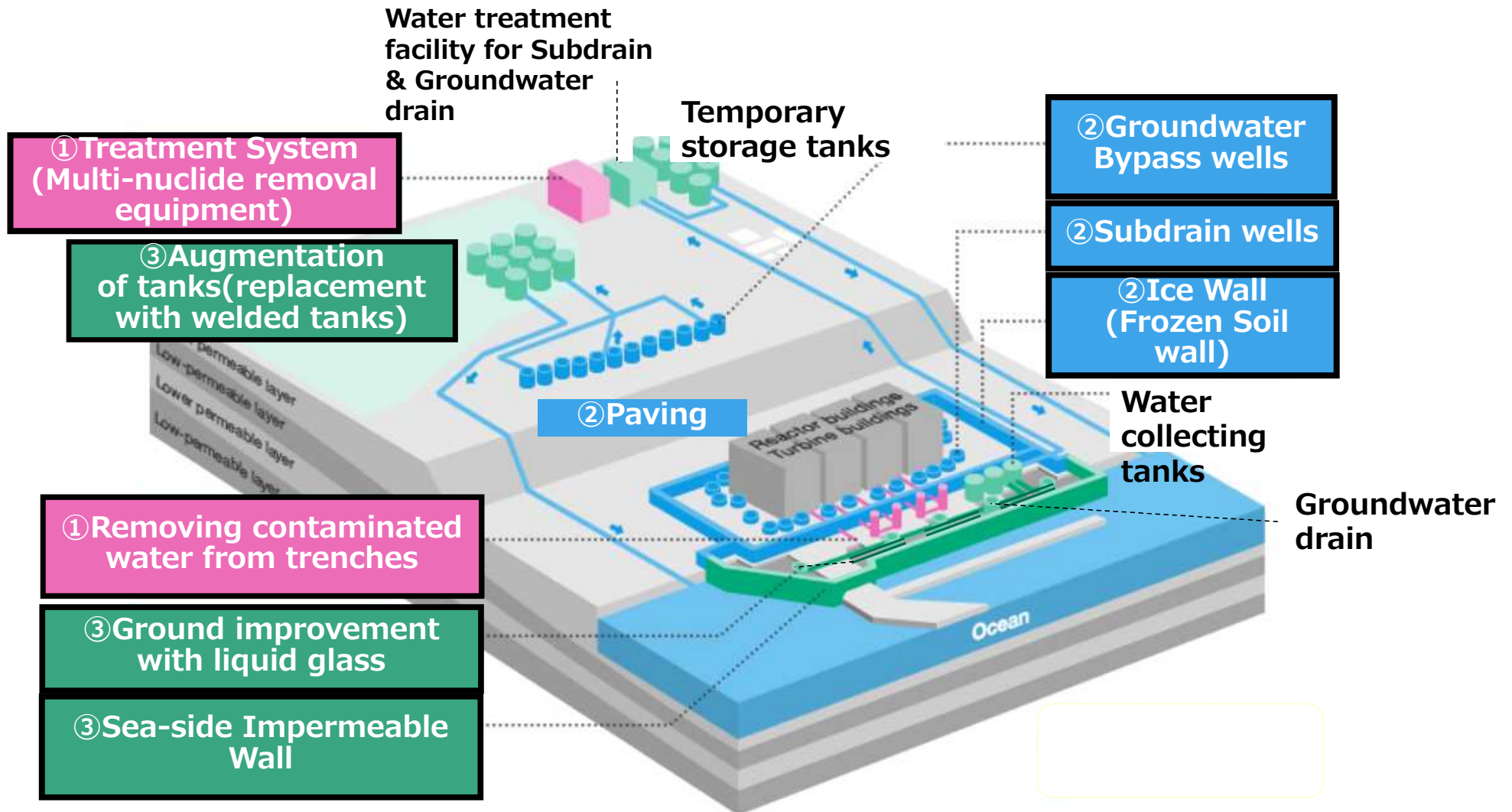


Contractors' logos

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Three Principles

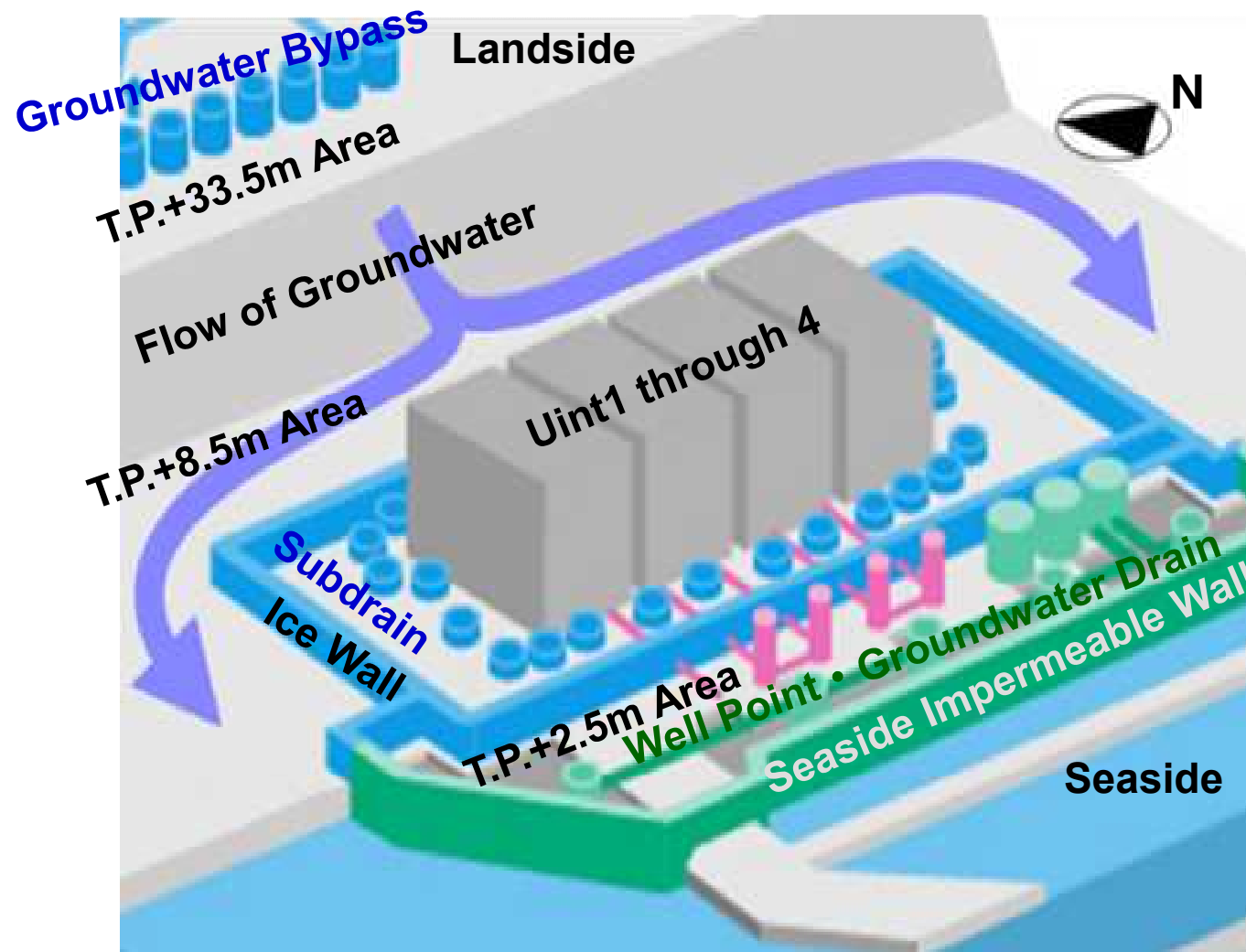
- ① Removing source of contamination
- ② Isolating fresh water from contaminated areas
- ③ Preventing leakage of contaminated water



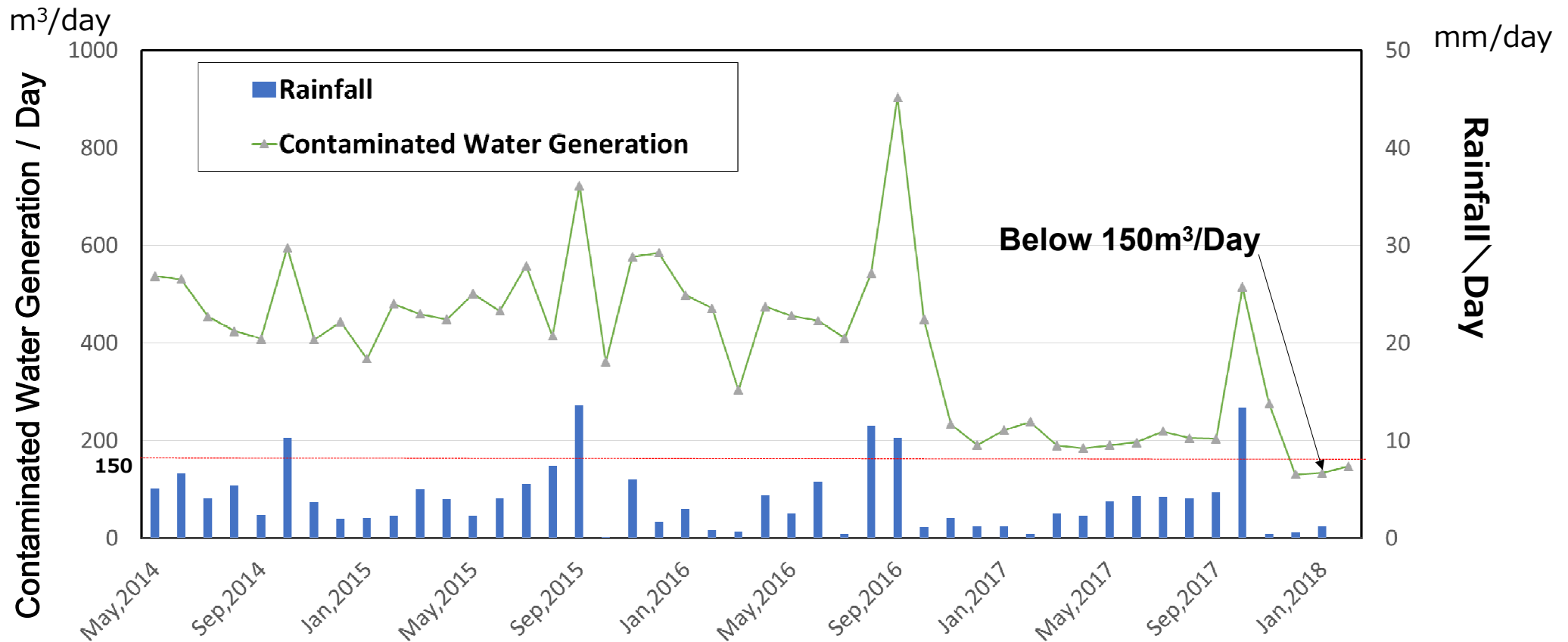
Measure		Status	
① Removing source of contamination	Purification with multi nuclide removal equipment (ALPS)	Completed RO concentrated water treatment in May, 2015	Continue operation
	Removal of contaminated water from trenches	Completed in December, 2015	Completed
	Removal of contaminated water from buildings	<ul style="list-style-type: none"> Completed water removal from the Unit 1 turbine building, Mar, 2017 Completed water removal from the Unit 1-3 condensers, Dec, 2017 	Continue removal
② Isolating fresh water from Contaminated Areas	Pump up of groundwater through groundwater bypass wells	The accumulated amount of drainage to the sea : 372,000t (As of May 2, 2018)	Continue operation
	Pump up of groundwater through subdrain	The accumulated amount of drainage to the sea : 524,000t (As of May 1, 2018) ※Including pumped up water through groundwater drain (for pumping up groundwater dammed up by seaside impermeable wall)	
	Ice Wall (Frozen soil wall)	Almost all sections reached below 0 degrees	Wall formation almost completed
	Paving to prevent rain water seepage into soil	Completed 94% of planned area as of Apr. 2018	Continue work
③ Preventing leakage of contaminated water	Ground improvement with liquid glass	Completed in Mar. 2014	Completed
	Installation of sea side impermeable wall	Completed closure in Oct. 2015	Completed
	Augmentation of tanks	Implementing replacement of flanged tanks with more reliable welded tanks and additional construction of welded tanks	Continue construction

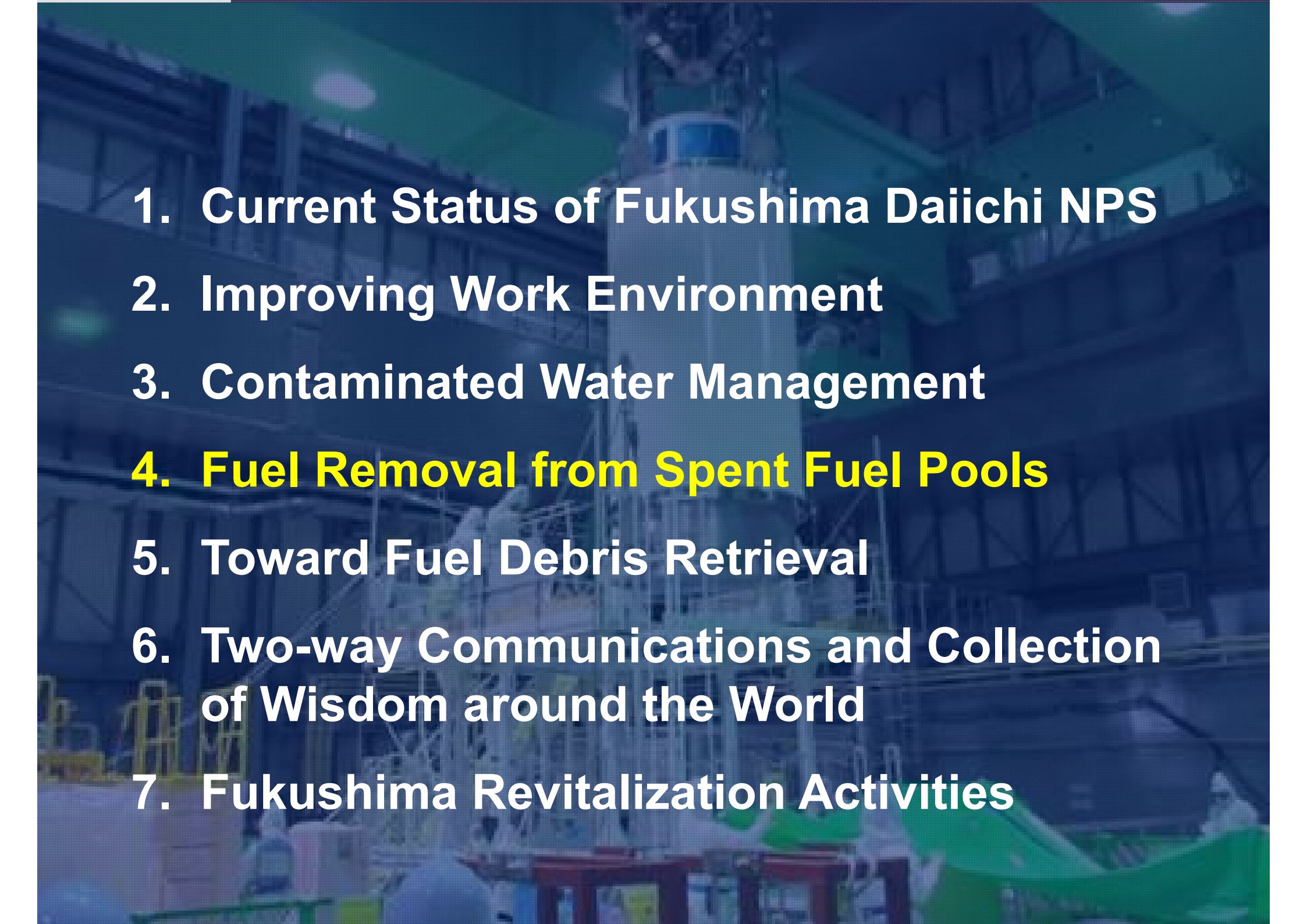
(2) Closure of the Ice Wall

- Thanks to the closure of the Ice Wall, the groundwater from the landside is dammed up and makes a detour around the buildings, and eventually flows to the seaside.



- Generation of the contaminated water originated from rainy and ground water decreased from 490m³/Day(Dec. 2015 to Feb. 2016) to 110m³/Day (Dec. 2017 to Feb. 2018) after the closure, which is about one-fourth of the initial amount.
- Generation of the contaminated water totaled 140m³/Day(Dec. 2017 to Feb. 2018) if water originated from decommissioning work was included. Even though the record was during the drought season, that amount is below the target value of 150 m³/Day set for 2020 in the Mid- and Long-term Roadmap.



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(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.
- This gives confidence to proceed to fuel removal at units 1, 2 and 3.
- No risk from fuel remains at unit 4.



September 22, 2011



July 5, 2012



November 12, 2013: Completion of fuel removal facility (The volume of steel used is equivalent to those of Tokyo Tower)



Fuel removal was completed on Dec. 22, 2014



Major risk reduction at Fukushima Daiichi



Process of removing fuel rods at SFP Unit 4

- Removal of large pieces of rubble was completed in 2015.
- Decontamination work was completed in Jun. 2016 and shielding was completed in Dec. 2016.
- Installation of a dome roof was completed In Feb. 2018.
- The fuel removal will take place in the middle of FY2018.

Immediately after the earthquake



Sep..2011

After removal of large pieces of rubble



Feb. 2016

Installation of a basis



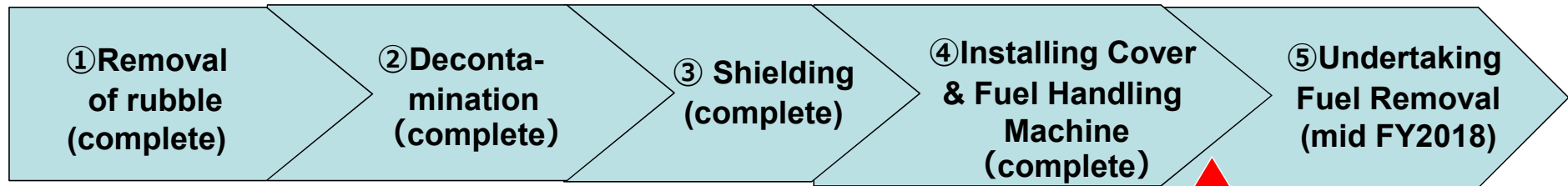
May. 2017

Installation of a dome roof



Feb. 2018

【Major Tasks in the process】



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

- Building cover was installed in Oct. 2011 to prevent dispersion of radioactive materials.
- Removal of panels was completed in Nov. 2016. After the installation of a windbreak fence, removal of rubble started in Jan. 2018.
- Fuel removal will start in FY 2023.

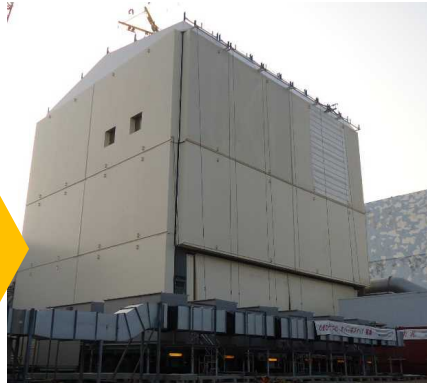
The status in 2011



Northwest side
(Jun. 2011)



Southeast Side
(Jun. 2011)



Complete installation
of building cover
(Oct. 2011)

Cover dismantling

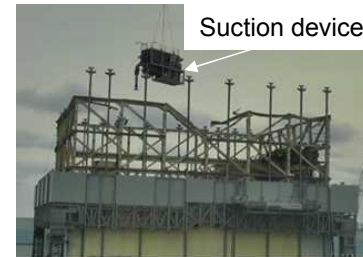
Removal of roof panels
(Jul. 2015)



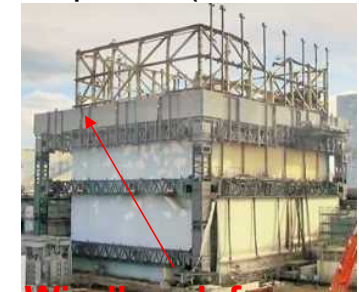
Panels removal
completed (Nov. 2016)



Removal of rubble
(as of Jan. 2018)

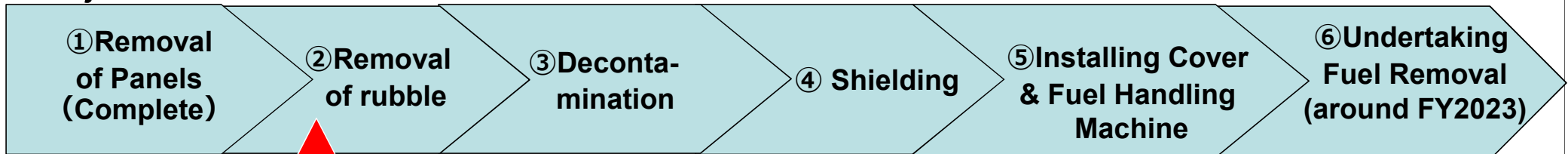


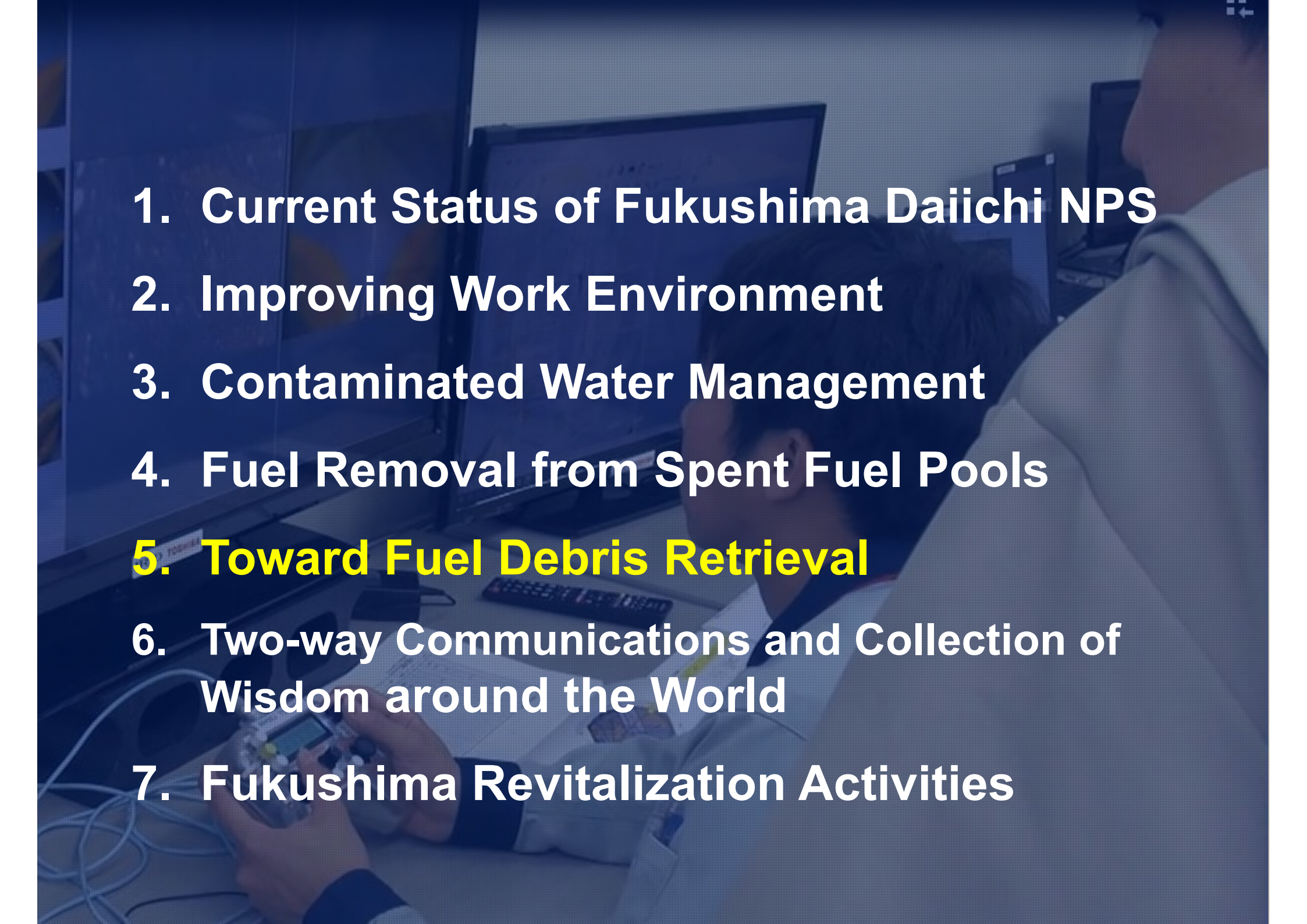
Installation of
windbreak fence
completed (Dec. 2017)



Windbreak fence

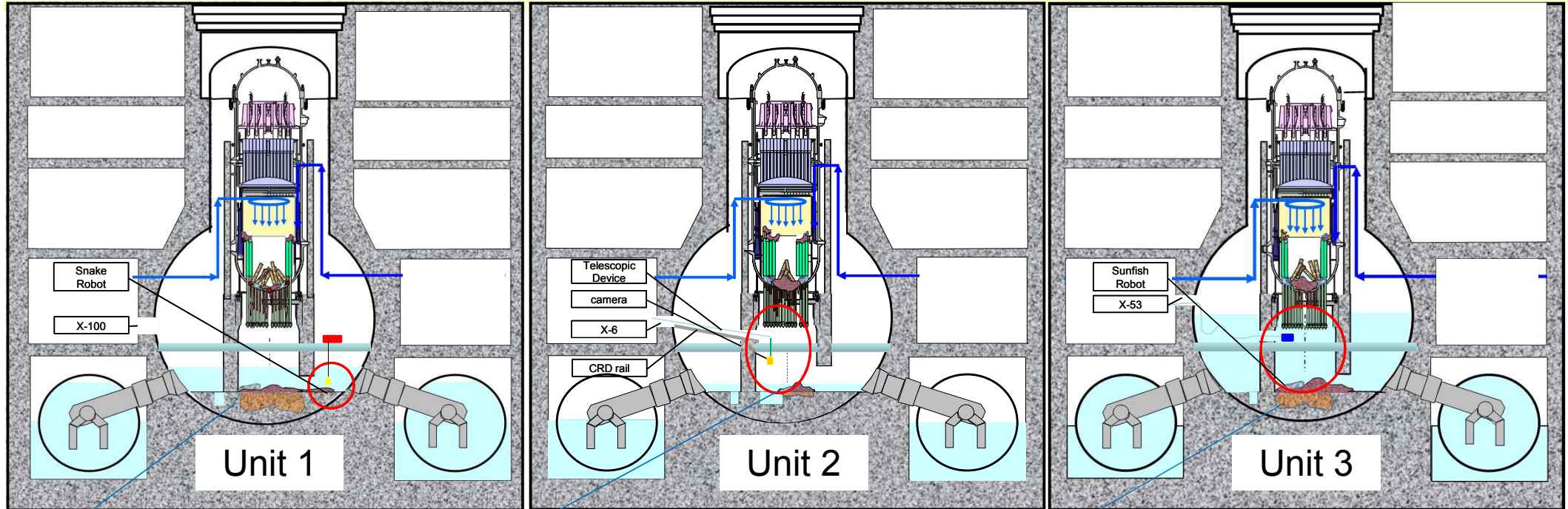
【Major Tasks in the Process】



- 
- A person in a white lab coat is seated at a desk in a control room, looking at a computer monitor. The room is dimly lit with blue ambient lighting. Several other computer monitors are visible in the background. The person is holding a small device in their hands.
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(1) Assumed Distribution of Fuel Debris

- It is assumed that at Unit 1 and 3, most of fuel debris has dropped to the bottom of PCV.
- It is assumed that at Unit 2, most of fuel debris has remained at the bottom of RPV, while only a small amount has dropped to the bottom of PCV.



Sediments were found at the bottom.



Mar. 2017

IRID

Deposits thought to be including fuel debris and fuel assembly components were identified at the bottom.



Jan. 2018

IRID

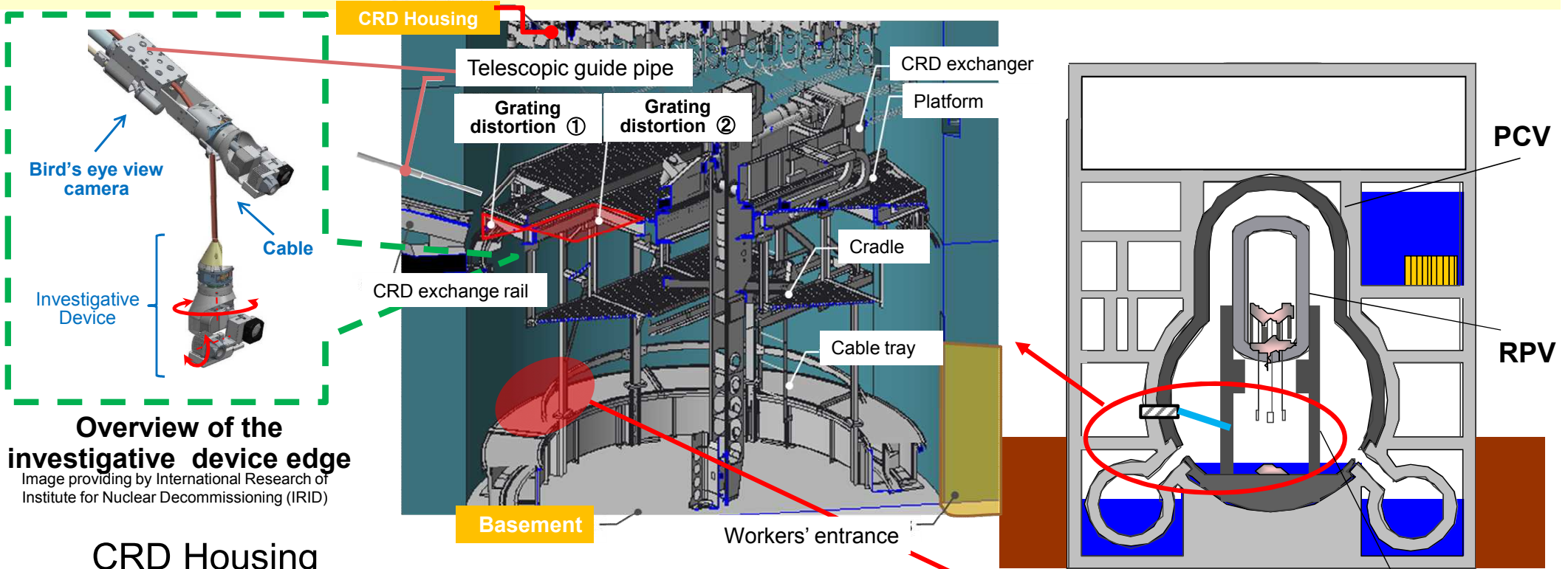
Sediments thought to be solidified molten materials and grating etc. were identified at the bottom.



Jul. 2017

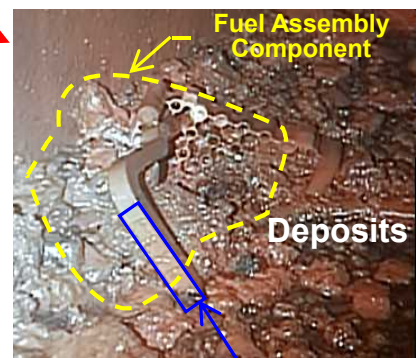
IRID

- An investigative device was lowered through distortion of the grating to the bottom of PCV inside the pedestal.
- Deposits thought to be including fuel debris as well as fuel assembly components which were located in RPV before the accident were identified at the bottom.

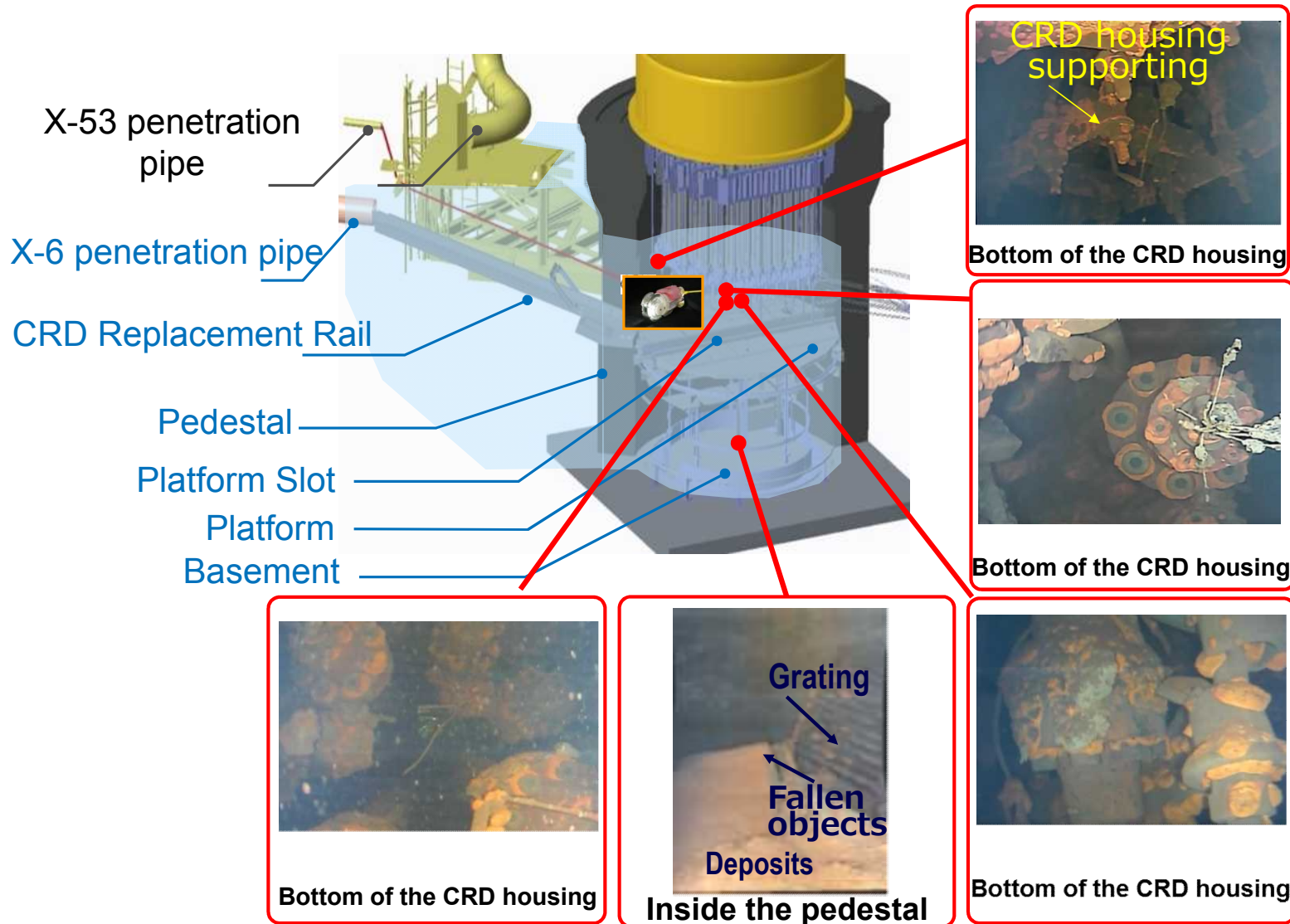


Overview of the investigative device edge
Image providing by International Research of Institute for Nuclear Decommissioning (IRID)

CRD Housing (above the grating distortion)




- Several fallen obstacles and sediments, such as solidified molten materials and grating were identified inside the pedestal.
- Analysis of image data shows, in contrast to Unit 2, a larger amount of fuel debris dropped inside the pedestal.



<Ref. >
CRD housing support of Unit 3 before 311 accident

Damage to multiple structures around CRD housing was found.

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Explanation at public meeting

- Status Updates with regards to decommissioning are given to the public at the regular public meetings hosted by Fukushima Prefecture
- Opinions to TEPCO have been reflected to decommissioning measures

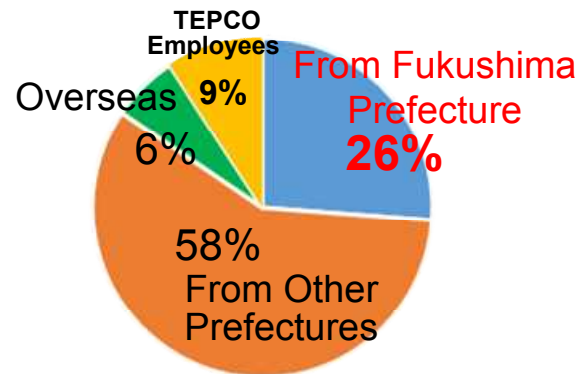


Center left : Ohkura, Representative of the Fukushima Revitalization Headquarters
Center right : Masuda, Then Chief Decommissioning Officer, President of Fukushima Daiichi Decontamination and Decommissioning Engineering Company

Invitation to Site Visits

- Inviting the prefectural government and organizations
- Visitors from within the prefecture have increased 13% to 3,274 people in FY2017.
- TEPCO aims to increase the total number of site visitors to 20,000/y by Tokyo Olympics.
- Examples of comments received:
“Decommissioning is a big undertaking done with the cutting edge technology”
“Seeing is believing”
“Every time I visited Fukushima Daiichi, I was able to find some progress”

【FY2017】Number of visitors: 12,489



Attendance at 2nd Decommissioning Forum (Jul. 2017)

- Providing an answer to what the local residents want to know about decommissioning Fukushima Daiichi
- The challenges regarding communication were also discussed.
- In the follow-up workshop held in last November, the importance of considering concerns and interests of different types of people as well as how people are affected by the contents of information regarding Fukushima Daiichi was recognized.



【Held in Hirono Town, Fukushima Prefecture by NDF】

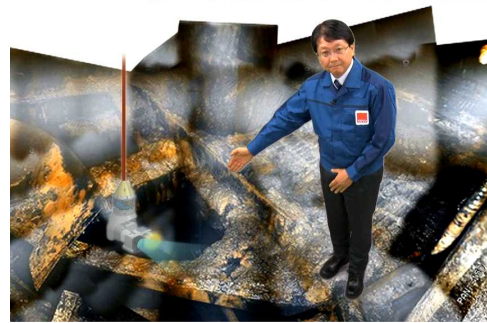
- The latest information including live footage and real time data are shared through website. Videos have been released where “Risk Communicators” respond to the interests of people .
- As for magazines, understandability and familiarity were prioritized by featuring figures who are engaged in the decommissioning work.
- Open Innovation Platform “TEPCO CUUSOO” was established in order to transmit the on-site needs and gather knowledge and expertise around the world.

Information sharing through website

<Live footage >



<An explanatory video >



Information Magazine

“1F”



“Hairo Michi”



“TEPCO CUUSOO” : <https://tepcocuusoo.com>

Challenges

Radiation measurement using drone



Hydrogen accumulation evaluation

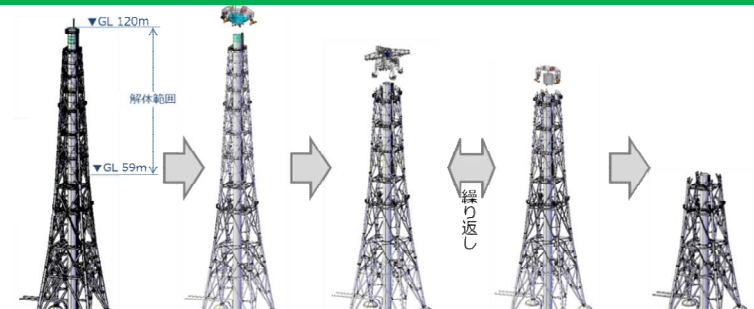


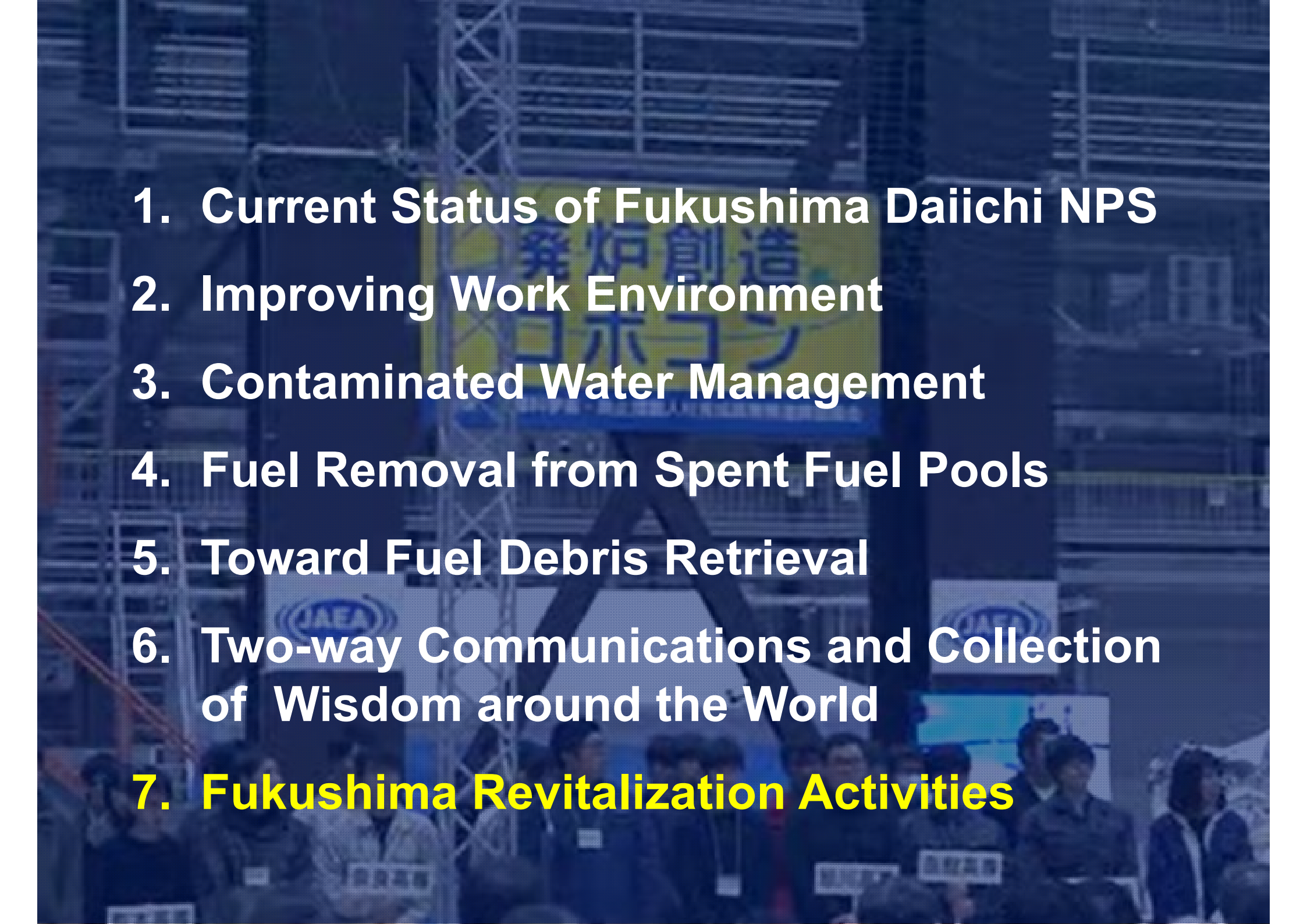
Effective treatment of Iodine and Ruthenium in contaminated water



Example

Unit 1,2 Stack dismantling optioneering



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- Bearing in mind that it is our mission and existential reason to carry through our responsibilities TEPCO owes to Fukushima, TEPCO Group employees are performing revitalization activities.
- As the return of local residents makes progress, Fukushima Revitalization Headquarters (Tomioka Town) are continuing their activities in response to their needs. The cumulative number of TEPCO Group employees engaged in the activities reached 404,485 at the end of Feb. 2018.

【Employees' activities】

■ Outdoor Cleaning & Clearing



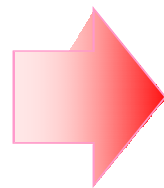
■ Weed Removal



■ Contribution to Local Festivals



■ Before and After: Making a Difference
(Weed and Mud removal for Restoration of Agriculture Business)



Venue arrangement for "Daruma-ichi" held by Futaba Town (Jan. 2018)

- **TEPCO announced “Action Plan against Harmful Rumor” in Jan. 2018. The idea is to be more proactive in and responsible for dispelling harmful rumor as the inflictor.**
- **TEPCO supports sales promotion such as increase in purchase by TEPCO Group employees, events by “O-EN Network” (established in Nov. 2014) and increase in sales at retail shops and mass merchandise markets.**

“O-EN Network”: 118 Companies included

Sales Event at TEPCO HQ on Mar. 16

Activities

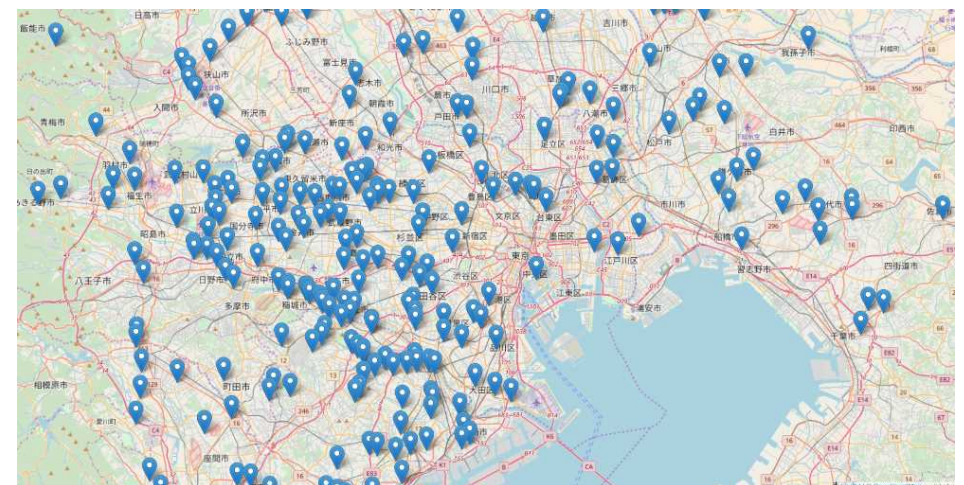
- ◆ Promotion of Fukushima Produce at member company cafeterias
- ◆ Marche held by member companies
- ◆ Using Fukushima products and produce as congratulation gifts and commemorative gifts



Map of Fukushima Rice Retail Shops



Marche held by the member company



Open to TEPCO employees via its intranet



In Conclusion

- **TEPCO is committed to decommissioning work**
- **TEPCO will share the information with the international society proactively and resolve their concerns in a respectful manner**



Thank you for your kind attention

TEPCO

