Regulatory Perspectives on Decommissioning of TEPCO Fukushima Daiichi Nuclear Power Station

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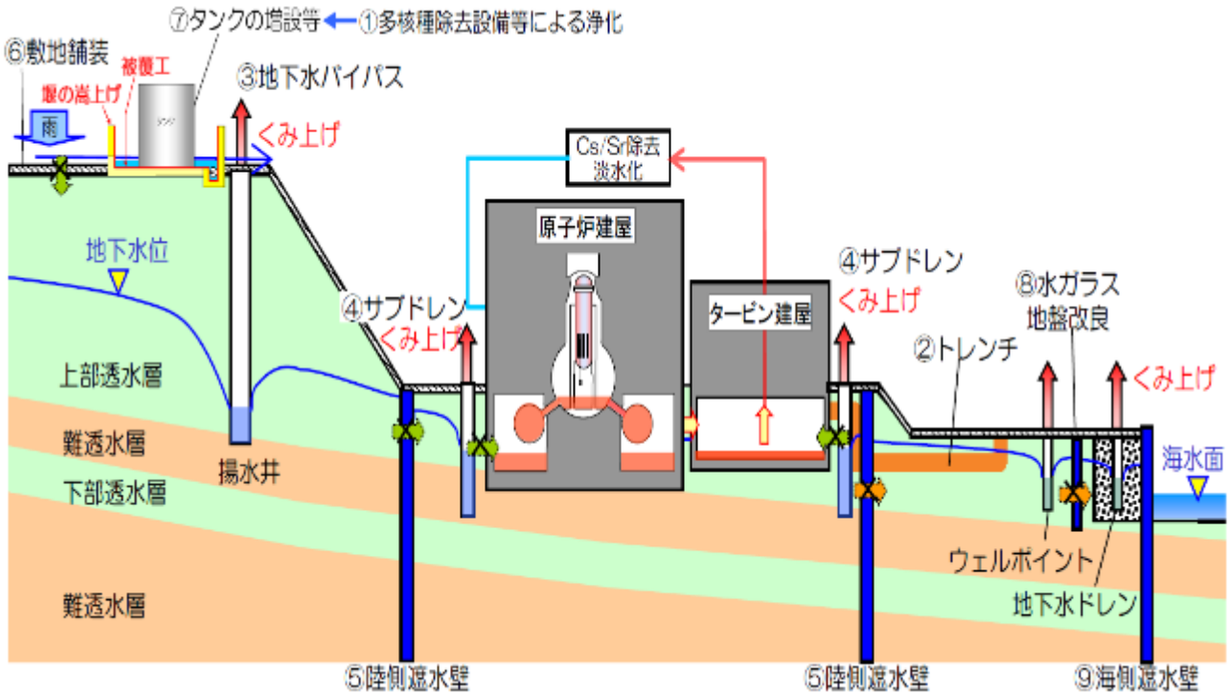
Contaminated water(1/2)

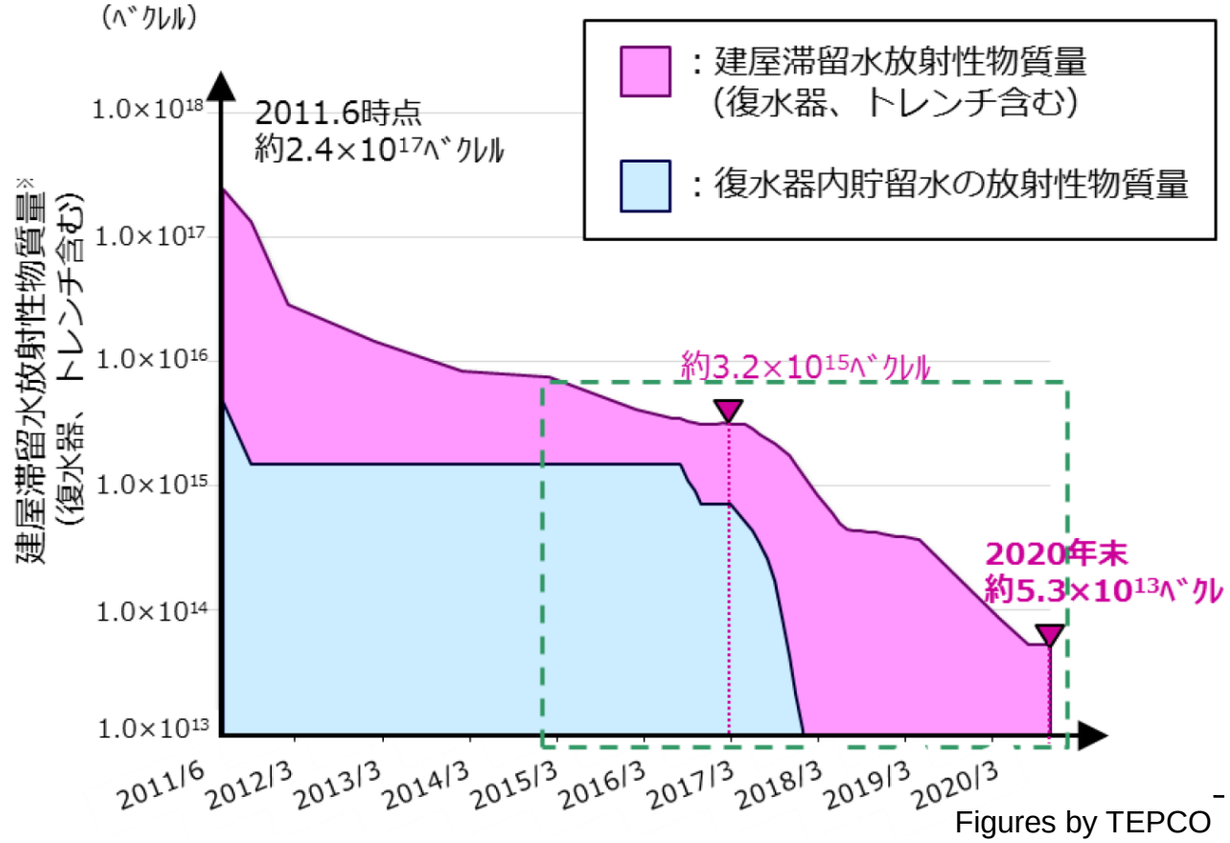
Regulatory Perspectives

- Reduction of leakage risk of liquid radioactive waste accumulated in R/Bs and T/Bs
  - ✓Removing high-radioactive contaminated water from the sea-side pipe trenches
  - ✓Restraining the inflow of ground water into R/Bs and T/Bs
  - ✓Treating contaminated water in R/Bs and T/Bs



Figures by TEPCO

Measures to control groundwater inflow



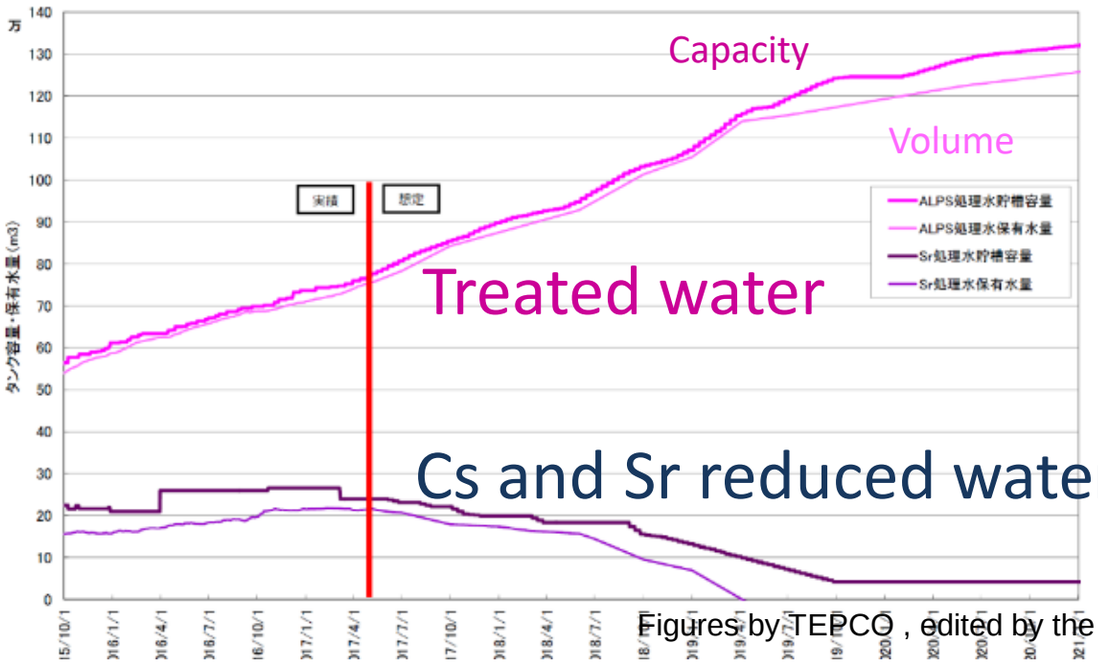
Figures by TEPCO

Trend of Inventory of contaminated water in R/Bs and T/Bs

Contaminated water(2/2)

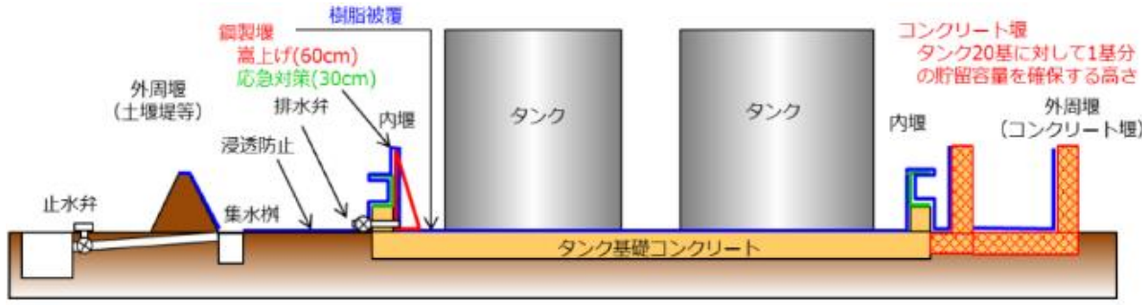
Regulatory Perspectives

- Avoiding leakage of contaminated water from tanks etc.
  - ✓Treating radioactive contaminated water in tanks
  - ✓Avoiding leakage and preventing contamination from spreading

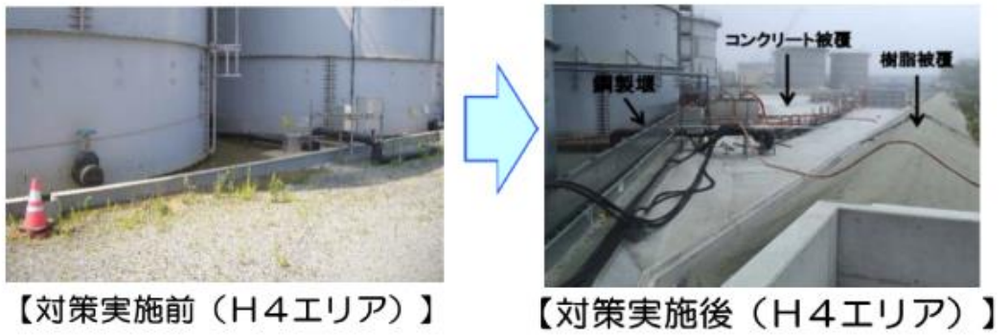


Figures by TEPCO , edited by the NRA

Treated water volume and tank storage capacity



【堰対策概略図】



【対策実施前（H４エリア）】　【対策実施後（H４エリア）】

Improvement of dike in tank area

Figures by TEPCO , edited by the NRA

Remaining Issues

- ✓ Discharging the water after necessary treatment to the sea in accordance with the regulatory requirements, etc.

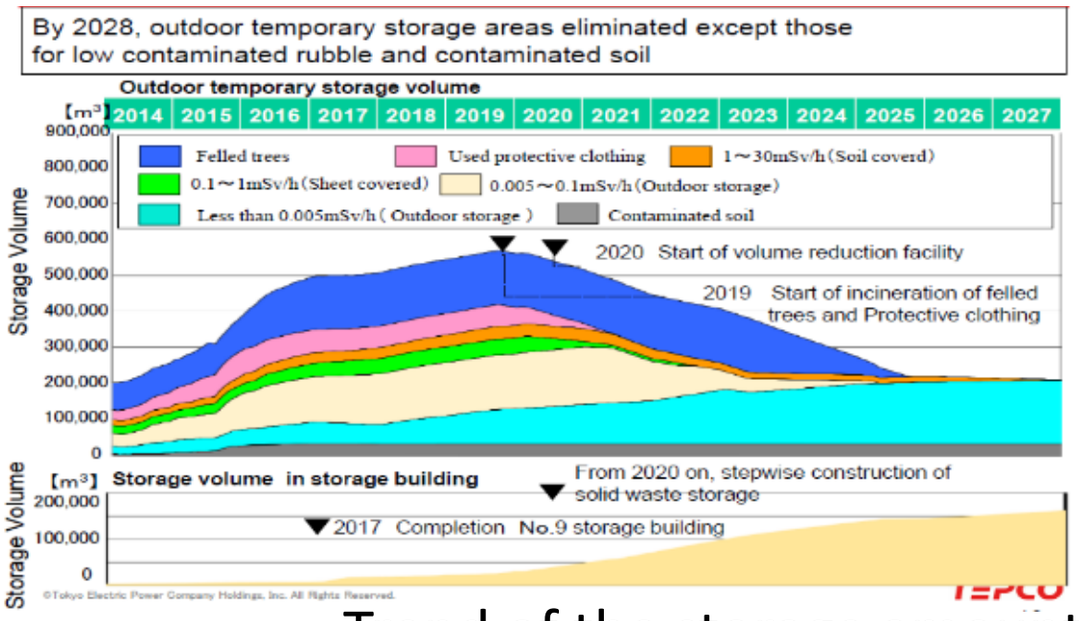
Radioactive waste

Regulatory Perspectives

- Preventing scattering of radioactive waste during decommissioning processes

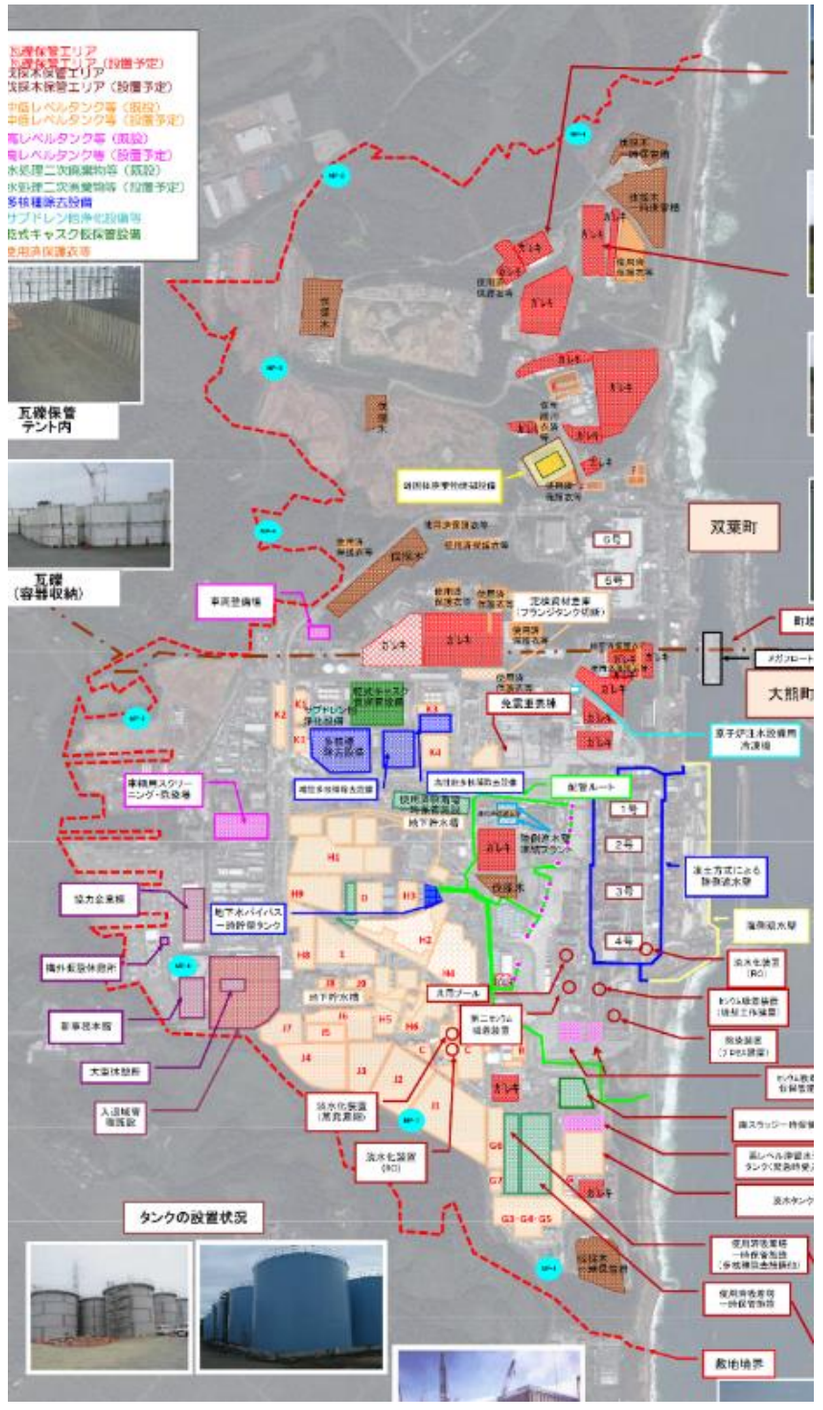
  ✓Processing properly, ensuring adequate storage capacity

  ✓Managing shielding etc. appropriately



Figures by TEPCO

Trend of the storage amount of rubble etc. (if measures were taken)



Placement map

Figures by TEPCO

Remaining Issues

✓ Planning a storage management including the solid radioactive waste that is expected to occur and ensuring storage capacity

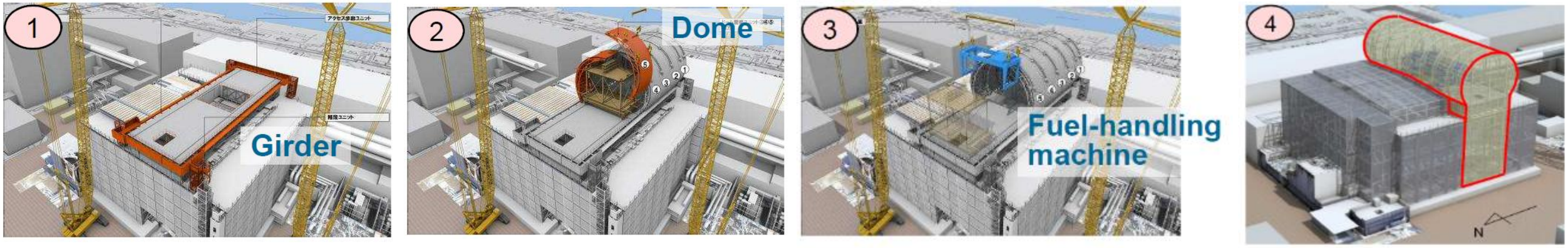
Spent fuel

Regulatory Perspectives

- Removing risk of Spent Fuel Pools
  - ✓Taking fuel out as soon as possible
  - ✓Preventing fuel from falling and shielding
  - ✓Preventing scattering of radioactive dust

Storage status of spent fuel pool

Unit	1	2	3	4
Capacity	900	1240	1220	1590
SFA	**292**	**587**	**514**	~~1331~~
FFA	100	28	52	~~204~~
Total	392	615	566	~~1535~~



Step of installing Unit 3 fuel removal cover etc.

Figures by TEPCO , edited by the NRA

Remaining Issues

- ✓ Removing spent fuel from Unit 3 steadily
- ✓ Making plan of removal method of spent fuel from Unit 2 and Unit 1

Earthquake / Tsunami(1/2)

Regulatory Perspectives

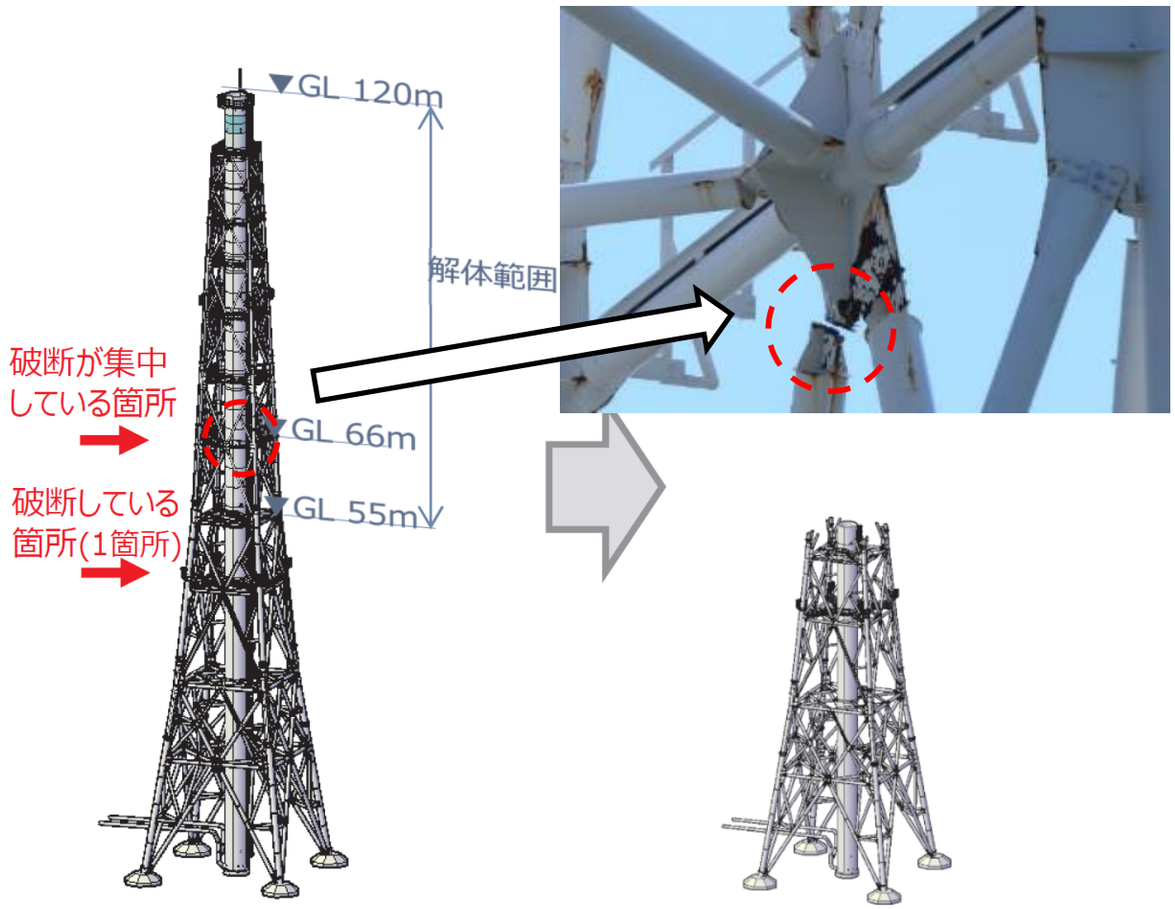
- Site and environmental protection from Earthquake / Tsunami

  ✓Preventing the outflow of contaminated water in the basement floor

  ✓Preventing collapse of building etc.

Figures by TEPCO

Block of Unit1 T/Bs staircase



Figures by TEPCO , edited by the NRA

Disassembly policy of Unit 1 and 2 common stack

Remaining Issues

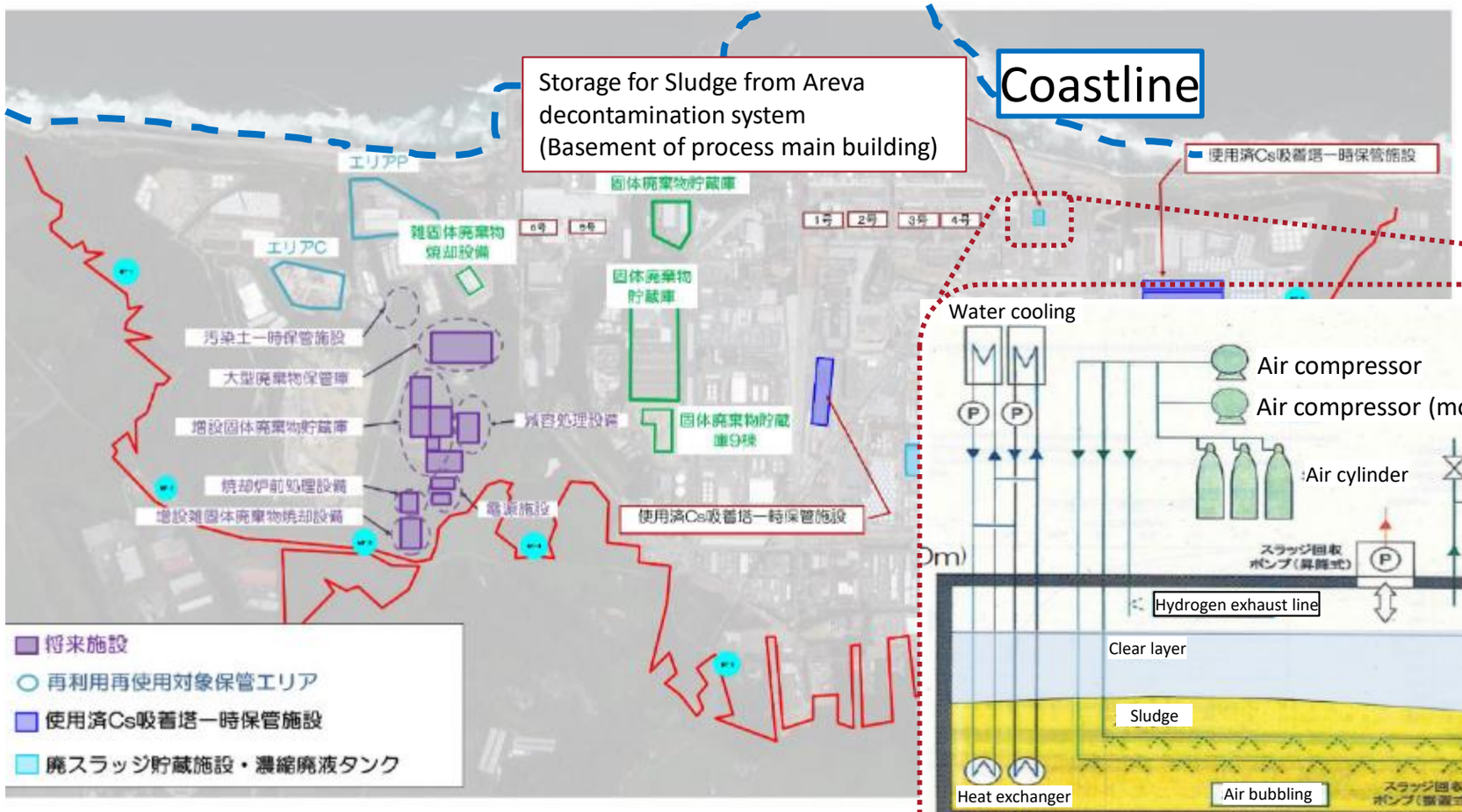
✓ Blocking the openings (Unit 3 T/B, Process main building)

Earthquake / Tsunami(2/2)

Regulatory Perspectives

- Site and environmental protection from Earthquake / Tsunami

  ✓Preventing leakage of radioactive material



「瓦礫等」及び「水処理二次廃棄物」の保管の将来像

（Reference）
Total of ^{90}Sr 2×10^{17} Bq
Storage amount $597m^3$

Schematic diagram of granulated and solidified storage

Figures by TEPCO , edited by the NRA

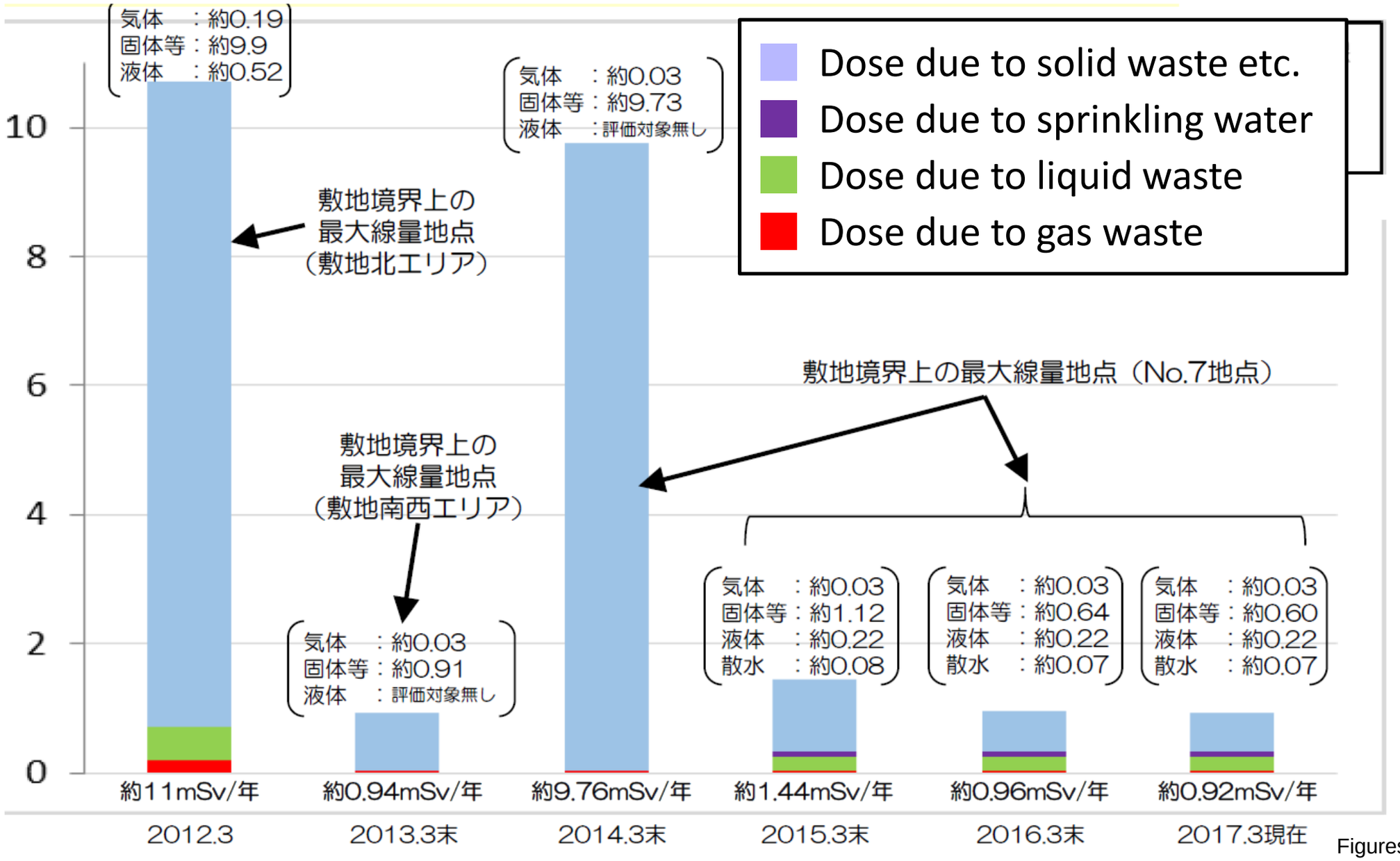
Remaining Issues

- ✓ Stabilizing sludge generated from decontamination device

Effective dose at the site boundary

Regulatory Perspectives

- Managing off-site effective dose during decommissioning processes



Figures by TEPCO

Trend of the site boundary effective dose
(Evaluation value; excluding the background inside and outside of the site)

(Provisional Translation)

14 December, 2016

Measures for Mid-term Risk Reduction at TEPCO's Fukushima Daiichi NPS (as of December 2016)

Issue	Contaminated water	Radioactive waste	Spent fuel	Earthquake / Tsunami	Effective dose at the site boundary (estimated value)	Preventing scattering of dusts	Work environment	Examining the inside of the facilities
Objective	Avoiding leakage of contaminated water from tanks etc.	Preventing scattering and leakage of radioactive waste during decommissioning processes	Removing fuel from Spent Fuel Pools (SFPs)	Site and environmental protection from Earthquake / Tsunami	Managing off-site effective dose during decommissioning processes	Preventing scattering of radioactive dusts during decommissioning processes	Enabling a sustainable work environment for decommissioning	Understanding the internal situation of the damaged facilities

2015

- Removing high-radioactive contaminated water from the sea-side pipe trenches (Units 2-4) (June. 2015; Unit 2, July. 2015; Unit 3, Dec. 2015; Unit4))
- Treating high-radioactive contaminated water in tanks (May. 2015)
- Completing fuel removal operation at Unit 4 SFP (Dec. 2014)
- Construction of temporary seawall (June 2011)
- Preventing the outflow of contaminated water anticipating the recurrence of the 2011 Tsunami (max 15.5m)

  Blocking the openings (Sep.2013; Common Pool, Oct.2014; Unit 1 T/B, Unit 2 T/B, HTI)
- Scientifically providing the greater earthquake/tsunami model (900 gal, 26.3m),and establishing the basic protection plan that corresponds to this model (Dec. 2015)
- Managing the additional effective dose to 2mSv/year* or less by continuous radiation monitoring and by treating high-radioactive contaminated water etc. (Mar. 2015)

  *Estimated value
- Implementing the countermeasures against scattering of dusts, in light of the scattering incident from Unit 3 (optimization of dispersion of scattering prevention chemicals and installing more dust monitors) (2013)
- Implementing and monitoring of enhanced countermeasures against scattering of dusts

  Completing rubble removal operation at Unit 3 SFP (2011-2016)
- Managing a work environment not requiring full-face mask respirators excluding the vicinity of R/Bs etc. (May. 2015)
- Building the food-service center (Mar. 2015)
- Building the large resting facility (May. 2015)

2016

- Completing removal of tanks lacking concrete foundations and/or dikes (Dec. 2014;H1 Area)
- Preventing the outflow of contaminated groundwater into the sea by completing the sea-side underground impermeable wall including sub-drain control systems (Oct. 2015)
- Starting operation of incineration plants for miscellaneous radioactive waste e.g. protective clothing (Mar. 2016)
- Removing high-radioactive contaminated water from bolt-joint tanks (May.2015)
- Preventing the outflow of contaminated water in R/Bs and T/Bs. Accurately controlling the levels of groundwater and contaminated water in R/Bs and T/Bs (Oct. 2015)
- Managing the additional effective dose to 1mSv/year* or less (Mar. 2016)

  *Estimated value
- Completing on-site decontamination excluding the vicinity of R/Bs etc. (Sep. 2016)
- Facilitating administration of the workers by completing the new main office building .
- Examining the process of accumulation of contaminated water in R/Bs, etc.

2017

- Managing the increase of the total capacity of water in tanks by restraining the inflow of groundwater into Reactor Buildings(R/Bs) and Turbine Buildings(T/Bs)
- Reducing the volume of contaminated water in tanks by discharging the water after necessary treatment to the sea in accordance with the regulatory requirements, etc.
- Completing construction of Unit 3 R/B cover and completing fuel removal facility
- Preventing the outflow of contaminated water anticipating the recurrence of the 2011 Tsunami (max 15.5m)

  Blocking the openings (Unit 3 T/B, Process main building (planned))
- Implementing and monitoring of enhanced countermeasures against scattering of dusts

  Dismantling of the covering of Unit 2 (2016-2018)

  Completing rubble removal operation at Unit 1 operating rooms and SFP (2016-2018)
- Characterizing nuclides in water passing through the reactors

2018

- Removing (treated) contaminated water from bolt-joint tanks
- Treating contaminated water in R/Bs and T/Bs . To reduce the amount of radioactive material to less than half.
- Starting operation of the 9th storage facility for radioactive waste
- Starting operation of temporary storage facilities for contaminated soil
- Starting operation of Radioactive Material Analysis and Research Facility-1
- Completing fuel removal operation at Unit 3 SFP
- Completing construction of Unit 2 R/B cover and completing fuel removal facility
- Implementing the site protection measures for Mega-Float (Tanker) following the established plan
- Dismantling of the upper part of stack for Units 1 and 2
- Analyzing the contaminated water of the inside of R/Bs, etc.

2020

- Completing treatment of contaminated water in R/Bs and T/Bs.
- Transferring3 to the stable management of secondary waste from treatment of contaminated water e.g. sledges in the High Integrity Container(HIC)s, etc.
- Starting operation of large storage plants
- Starting operation of incineration plants for felled trees, flammables in rubble, etc.
- Stopping of outside storage (used protective clothing)
- Starting operation of volume reduction plants (metal, concrete)
- Completing construction of Unit 1 R/B cover and completing fuel removal facility
- Stabilizing sludge generated from decontamination device
- Directly observing inside of Primary Containment Vessels(PCVs) and Reactor Pressure Vessels(RPVs)

(year)

[Note]
- Completed measures:
- Measures in progress or in preparation:
- Measures (Timing TBD):

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Mid-term Risk Reduction Map

- ✓ In order to communicate existing mid-term risks at TEPCO Fukushima Daiichi Nuclear Power Station to the public, the NRA published “Mid-term Risk Reduction Map” in February 2015, which has been periodically revised to reflect progress of decommissioning work and emerging issues.

- ✓ Tasks to be addressed for the moment are

  - Discharging the water after necessary treatment to the sea in accordance with the regulatory requirements, etc.

  - Reducing the inventory of radioactive materials in contaminated water in the turbine buildings and the reactor buildings, which could be swept away by severe tsunami

  - Taking protecting measures against earthquake and tsunami, such as dismantling of unit 1/2 stack

  - Securing sufficient room of storage capacity for solid radioactive waste and stabilizing radioactive waste from water treatment (eg .sludge from AREVA decontamination system)

Preparation for Decommissioning work

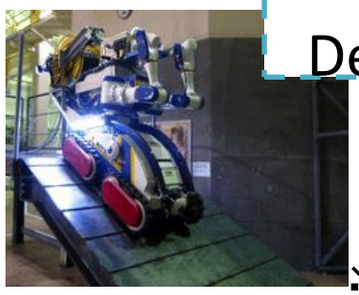
Investigation

- Position and properties of debris
- Soundness of buildings, piping, etc.
- Dose map etc.

（Design Process）

Setting of Design Policy

Equipment Development



※1

Mock-up test

Detailed Design

Feedback to the design

Safety Assessment

Implementing of Decommissioning work

（Source）

※1 http://www.mhi.co.jp/news/story/1402205498.html

Conclusion

- ✓ TEPCO Fukushima Daiichi site has shifted from “Emergency Response Stage” to “Planned Action Stage”.
- ✓ But, still there are so many tasks to be accomplished regarding contaminated water, radioactive waste and so on.
- ✓ Field survey inside and outside the PCVs is vitally important for TEPCO and NRA to get information for planning and safety evaluation of retrieval activities of fuel debris and for analysis of the accident.