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

Measures to control groundwater inflow

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

Figures by TEPCO
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

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

Remaining Issues

Treated water volume and tank storage capacity

Improvement of dike in tank area

Figures by TEPCO, edited by the NRA
Radioactive waste

Regulatory Perspectives

- Preventing scattering of radioactive waste during decommissioning processes

  ✓ Processing properly, ensuring adequate storage capacity

  ✓ Managing shielding etc. appropriately

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

<table>
<thead>
<tr>
<th>Unit</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tr>
<td>Capacity</td>
<td>900</td>
<td>1240</td>
<td>1220</td>
<td>1590</td>
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<tr>
<td>SFA</td>
<td>292</td>
<td>587</td>
<td>514</td>
<td>1334</td>
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<tr>
<td>FFA</td>
<td>100</td>
<td>28</td>
<td>52</td>
<td>204</td>
</tr>
<tr>
<td>Total</td>
<td>392</td>
<td>615</td>
<td>566</td>
<td>1535</td>
</tr>
</tbody>
</table>

Step of installing Unit 3 fuel removal cover etc.

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.

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

Remaining Issues

- Stabilizing sludge generated from decontamination device

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

Figures by TEPCO, edited by the NRA
Effective dose at the site boundary

Managing off-site effective dose during decommissioning processes

- Dose due to solid waste etc.
- Dose due to sprinkling water
- Dose due to liquid waste
- Dose due to gas waste

Figures by TEPCO

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

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

**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

**2015**
- Completing removal of tanks lacking concrete foundations and/or dikes (Dec. 2014; H3 Area)
- Removing high-radioactive contaminated water from the sea-side pipe trenches (Units 2-4) (June. 2015; Unit 2, July. 2015; Unit 3, Dec. 2015; Unit 4)
- Completing construction of Unit 3 R/B cover and completing fuel removal facility
- Completing construction of Unit 3 R/B cover and completing fuel removal facility

**2016**
- Completing construction of Unit 3 R/B cover and completing fuel removal facility
- Completing construction of Unit 3 R/B cover and completing fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility

**2017**
- Completing construction of Unit 3 R/B cover and completed fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility

**2018**
- Completing construction of Unit 3 R/B cover and completed fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility
- Completing construction of Unit 3 R/B cover and completed fuel removal facility

**2020**
- Completing treatment of contaminated water in R/Bs and T/Bs
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- Completing treatment of contaminated water in R/Bs and T/Bs

**Effective dose at the site boundary (estimated value)**
- 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

**Preventing scattering of radioactive dusts during decommissioning processes**
- Implementing the countermeasures against scattering of dusts, in light of the scattering incident from Unit 1 (optimization of dispersion of scattering countermeasures against scattering of dusts) (2011-2016)
- Completing rubble removal operation at Unit 3 SFP (2011-2016)
- Completing on-site decontamination excluding the vicinity of R/Bs etc. (May. 2015)
- Managing the work environment for decommissioning

**Managing off-site effective dose during decommissioning processes**
- Managing the additional effective dose to 1mSv/year* or less (Mar. 2016) *Estimated value

**Building the internal situation of the damaged facilities**
- Managing a work environment not requiring full-face mask respirators excluding the vicinity of R/Bs etc. (May. 2015)
- Implementing and monitoring of enhanced countermeasures against scattering of dusts
- Completing rubble removal operation at Unit 1 operating rooms and SFP (2016-2018)
- Examining the process of accumulation of contaminated water in R/Bs, etc.

**Building the food-service center (Mar. 2015)**
- Implementing and monitoring of enhanced countermeasures against scattering of dusts
- Completing rubble removal operation at Unit 1 operating rooms and SFP (2016-2018)
- Examining the process of accumulation of contaminated water in R/Bs, etc.
- Analyzing the contaminated water of the inside of R/Bs, etc.

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

**Understanding the internal situation of the damaged facilities**
- Implementing and monitoring of enhanced countermeasures against scattering of dusts
- Completing rubble removal operation at Unit 1 operating rooms and SFP (2016-2018)
- Examining the process of accumulation of contaminated water in R/Bs, etc.
- Analyzing the contaminated water of the inside of R/Bs, etc.
- Directly observing inside of Primary Containment Vessels(PCVs) and Reactor Pressure Vessels(RPVs)

**Enabling a sustainable work environment for decommissioning**
- Managing the work environment for decommissioning
- Completing rubble removal operation at Unit 1 operating rooms and SFP (2016-2018)
- Examining the process of accumulation of contaminated water in R/Bs, etc.
- Analyzing the contaminated water of the inside of R/Bs, etc.
- Directly observing inside of Primary Containment Vessels(PCVs) and Reactor Pressure Vessels(RPVs)

**Preventing scattering of dusts**
- Implementing the countermeasures against scattering of dusts
- Completing rubble removal operation at Unit 3 SFP (2011-2016)
- Completing on-site decontamination excluding the vicinity of R/Bs etc. (May. 2015)
- Examining the process of accumulation of contaminated water in R/Bs, etc.

[2011 Tsunami]
- 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, HT)
- 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, HT)

[Transportation]
- Stabilizing sludge generated from decontamination device
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
- Mock-up test
- Detailed Design

- Equipment Development

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

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.