The Outline of the Water Management and “The Subcommittee on Handling of ALPS Treated Water”

Agency for Natural Resources and Energy, METI
September, 2019
1. Generation of contaminated water, purification process and tank storage

◇ **Contaminated water in buildings** is generated by continuous water injection to fuel debris in reactors.

- **To Prevent leakage** of the contaminated water from the buildings:
  - The level of **groundwater outside is controlled to be higher** than that of contaminated water inside the buildings.
    - Groundwater keeps flowing into the buildings and mixes with contaminated water and the amount of contaminated water in the buildings keeps increasing.
      - Fuel debris retrieval is necessary to suppress the rate of arising contaminated water.

- **To Purify the contaminated water:** “**ALPS treated water**”
  - ALPS (Multi-nuclide retrieval equipment) and the other equipment have been used; and
  - Most of the radionuclides except tritium were removed.

At present, **ALPS treated water (≠contaminated water)** is being continuously stored on site.
2. Storage of ALPS treated water in tanks

- The rate of arising contaminated water has been reduced by effects of measures such as pumping up of groundwater by sub-drain and construction of frozen-soil wall.
  
  540m³/day (2014, May) → 170m³/day (average FY2018)

- The amount of the treated water stored exceeds 1.1 million m³ and is expected to keep increasing, with moderate rate of increase.

※The treated water means ALPS treated water and Sr treated water.
3. Examination status of handling of ALPS treated water

“The Tritiated Water Task Force (2013-2016)”
Technical feasibility (including monitoring to ensure safety), regulatory feasibility period and cost of five handling methods were examined;

- All cases were examined on the premise that there is no scientific impact on the human habitant.
- Verification project showed that the separation technology for tritium cannot yet put into use.

“The Subcommittee on Handling ALPS Treated Water (2016-)”
Handling of ALPS treated water has been continuously examined in a comprehensive manner, including from the perspective of countermeasure for reputational damage and of ensuring scientific safety.

All the measures, throughout their implementation, are subject to the approval of Nuclear Regulatory Authority in accordance with the Reactor Regulation Act.

<table>
<thead>
<tr>
<th>Method of disposal</th>
<th>(1) Example of geosphere injection</th>
<th>(2) Example of discharge to the sea</th>
<th>(3) Example of vapor release</th>
<th>(4) Example of hydrogen release</th>
<th>(5) Example of underground burial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
<td><img src="image5" alt="Image" /></td>
</tr>
<tr>
<td>Technical feasibility</td>
<td>- If proper stratum is not found, commencement of handling will be delayed. - There is no monitoring method established.</td>
<td>Examples) - Existing Nuclear facilities’ liquid radioactive waste discharge to the sea</td>
<td>Example) TMI-2 - water volume: 8,700 m³ - Tritium volume: 24 tri. Bq. Tritium conc.: 2.8mil. Bq/L - Total period: 2.8 years</td>
<td>To handle the ALPS treated water, R&amp;D for pre-treatment and scale expansion might be needed.</td>
<td>examples) - Concrete pit disposal site - Shut-off disposal site</td>
</tr>
<tr>
<td>Regulatory feasibility</td>
<td>Feasible</td>
<td>Feasible</td>
<td>Feasible</td>
<td>Feasible</td>
<td>New standards might be needed.</td>
</tr>
</tbody>
</table>
4. ALPS subcommittee: Status of Review

- Toward the decision on handling of ALPS treated water, “The Subcommittee on Handling ALPS Treated Water” has started its examination from November 2016
  - In a comprehensive manner, including the perspective of countermeasures for reputational damage.

- For the purpose of listening the concerns on handling methods and itself from the public widely, **public hearings** were held in Fukushima and in Tokyo in August 2018.
  - Issues raised at the public hearing have been examined at the subcommittee.

- **Examination status at the subcommittee will be shared** to the international society.
  - Example (METI website) [https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/index.html#cwi](https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/index.html#cwi)

### Issues raised at the public hearing

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment of radionuclides other than tritium</td>
<td>1 October, 2018</td>
</tr>
<tr>
<td>Biological effects of tritium</td>
<td>30 November, 2018</td>
</tr>
<tr>
<td>Continuation of storage</td>
<td>9 August and 27 September 2019</td>
</tr>
<tr>
<td>Handling method</td>
<td>9 August and 27 September 2019</td>
</tr>
<tr>
<td>Environmental monitoring</td>
<td>30 November, 2018 and 28 December, 2018</td>
</tr>
<tr>
<td>Countermeasures for reputational damage</td>
<td>28 December, 2018 and 27 September, 2019</td>
</tr>
<tr>
<td>Consensus building</td>
<td>27 September, 2019</td>
</tr>
</tbody>
</table>
5. Reviews at ALPS subcommittee (i. Treatment of radionuclides other than tritium)

◇ Two regulatory Standards:

1) **Applicable to storage**: to keep site boundary dose levels less than 1mSv/year **Current operational goal of ALPS**
2) **Applicable to release to the environment**: to keep radionuclides concentrations of treated water less than the regulatory limit.

◇ There are various concentration of ALPS treated water in the tanks, because:

- Concentration of ALPS treated water depends on the attributes of water to be treated and operation management of ALPS such as frequency of absorbent exchange; and
- Especially in early years, before improvement of ALPS performance, concentrations of ALPS treated water is relatively higher.

◇ **In case of releasing ALPS treated water to the environment, the water needs to satisfy standard 2).**

- TEPCO announced to re-purify ALPS treated water, to meet standard 2) for radionuclides other than tritium.

\[\begin{array}{cccc}
\text{Site Boundary dose levels} & \text{(assessed values)} & \\
\text{(mSv/year)} & 10 & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\
\text{End of FY2013} & 9.76 & & & & & & & & & & \\
\text{End of FY2014} & 1.44 & & & & & & & & & & \\
\text{End of FY2015} & 0.96 & & & & & & & & & & \\
\text{End of FY2016} & 0.92 & & & & & & & & & & \\
\text{End of FY2017} & 0.90 & & & & & & & & & & \\
\end{array}\]

\[\begin{array}{cccc}
\text{Sum of the ratios of actual concentrations to regulatory standards for 62 nuclides* (estimated)} & \text{Subject to re-purification} & \\
\text{out of 62 nuclides* (estimated)} & \text{Other than tritium} & \\
& \text{Water treated in early years of the treatment} & \text{Water treated in early years when crossflow filter permeate had trouble etc.} & \\
\text{~1} & \text{~5} & \text{5~10} & \text{10~100} & \text{100~} & \\
346,500m^3 & \text{(36%)} & 207,800m^3 & \text{(22%)} & 161,700m^3 & \text{(17%)} & 65,000m^3 & \text{(7%)} \end{array}\]

*These drawings are quoted from “Treated water portal site (TEPCO HP)”
Tritium is a relative of hydrogen that emits weak radiation.

Tritium exists naturally and is found in water such as water vapour in the atmosphere, rain, sea water, and tap-water.

- It has not been found that tritium concentrates in human beings and particular living organisms, as tritiated water has similar properties as water.
- Impact on health is very low, around $1/700$ of that of Cesium 137.
- The total annual amount of tritium, which is generated at domestic nuclear power plants (NPPs) and released to the sea, is around 1.7 times as much as that of tritium found in precipitation in Japan. (* 5 year average before 2011)
- NPPs in Japan have been discharging water containing tritium for more than 40 years in compliance with the standard limits based on the laws and regulations.
  - Concentration of tritium in sea water near NPPs are significantly lower than that of drinking water standards in the world.
  - It has not been found that tritium from NPPs have an impact on health.

*Overseas NPPs also discharge water containing tritium whose concentration is under standard limits.

**Comparison of impact of tritium and well-known radioactive nuclides on living organisms**

- Tritium (Water)
- Carbon 14
- Sodium 24
- Phosphorus 32
- Potassium 40
- Cobalt 60
- Iodine 131
- Cesium 137
- Iridium 192

$^3$H concentration in river water and tap water in Fukushima pref. and $^3$H concentration in precipitation at Chiba pref. (1978-2017)

<table>
<thead>
<tr>
<th>Year</th>
<th>Precipitation (Chiba)</th>
<th>Tap water (Fukushima)</th>
<th>River, lake and marsh water (Fukushima)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>1983</td>
<td>7</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>1988</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>1993</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>1998</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2003</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2013</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
5. Reviews at ALPS subcommittee (iii. Continuation of storage)

【Fukushima reconstruction and Decommissioning work】

- Decommissioning of TEPCO’s Fukushima Daiichi NPS is a continuous risk reduction activities to protect the people and the environment from the risks associated with radioactive substances by removing spent fuel and retrieving melted and solidified fuel debris from reactor buildings.

- There has been/will be no conflict between “Fukushima reconstruction” and “decommissioning and treatment of contaminated water”.
  - “Decommissioning” is a prerequisite for “reconstruction”.
  - “Reconstruction” efforts should not be undermined by rush “decommissioning”.

- Given the fact that all handling cases are examined on the premise that there is no scientific impact on the human habitant, handling of treated water in any way needs to be completed by the end of decommissioning.
  - To proceed decommissioning and reconstruction, considering reputational impact is a key issue.
  - Timeline of the handling options will be reviewed at the committee.

3 Basic Principles
(1) Isolating
(2) Preventing leakage
(3) Removing
5. Reviews at ALPS subcommittee (iii. Continuation of storage)

- Tank area occupies much of the southern half of the site. **Under current tank construction plan of 1.37 million m³ (by the end of 2020), the time to reach the full capacity is forecasted to be around summer of 2022.**
- **Site area which is available for building new tanks is approaching the limit,** considering the fact that northern half of the site is planned to be used for the solid radioactive waste storage.
- The whole premise should be effectively utilized, considering limitation of site use as well as the tanks and other facilities which will be needed for decommissioning.

【Facilities considered necessary for decommissioning work】

(1) **Tanks for storage ALPS treated water**

(2-1) **Temporary storage for Spent Fuel and Fuel Debris**
- Temporary storage for dry cask : About 21,000m²
  - For spent fuel pool from Unit 1-6 : About 5,000m²
  - For common pool : About 16,000m²
- Temporary storage for Fuel Debris : MAX About 60,000m²

(2 - 2) **Facilities to be considered in the future**
- Facilities for analyzing various samples
- Storage facility for fuel debris retrieval equipment
- Mock-up facilities for fuel debris retrieval
- Training facilities for fuel debris retrieval
- R&D facilities related to fuel debris and radioactive waste
- Waste recycle facilities
- Temporary storage area for waste
- Storage facilities for accident response equipment etc.
◇ Various concerns arising from the handling of ALPS treated water may induce reputational damage.
◇ Appropriate countermeasures for reputational damage should be examined for each layer, by analyzing the occurrence mechanism.
◇ It should be noted that influence of tsunami and Fukushima Daiichi accident damage on general perception is still remaining.
5. Reviews at ALPS subcommittee (vii. Consensus building)

- “engaging all stakeholders, to ensure the sustainability of the decommissioning activities and of the safe and effective implementation of other risk reduction measures.”

- Subcommittee reviewed the direction of engagement with people directly involved (e.g. Local community that might be suffered from reputational damage), and people that might have concern with insufficient information.

“The IAEA Review Team holds that a decision on the disposition path for the stored ALPS treated water containing tritium and other radionuclides, after further treatment as needed, must be taken urgently, engaging all stakeholders, to ensure the sustainability of the decommissioning activities and of the safe and effective implementation of other risk reduction measures.”

<direction of stakeholder engagement (outline)>

- “decision of basic policy for handling” will be made by GOJ
- After receiving the report from subcommittee, GOJ will communicate with broad range of people directly involved, such as local community people, and make a decision with transparency.
- After making the decision, GOJ will keep providing information and communicating interactively for the better understanding, on a long-term basis.
- In particular,
  - To people directly involved (e.g. local community that might be suffered from reputational damage): hear opinions before the decision-making and keep providing information
  - To people that might have concern with insufficient information: keep providing information inside/outside Japan
6. Examination Process ahead

- **Role of the subcommittee:**
  1) to examine in a comprehensive manner, such as countermeasures for reputational damage, and
  2) to compile report for the government

- **GOJ will decide basic policy**, after receiving report of subcommittee and having stakeholder discussion.
**Fukushima Daiichi Decommissioning is a continuous risk reduction activity** to protect the people and the environment from the risks associated with radioactive substances by:

- Removing spent fuel and fuel debris from the Reactor Building
- Reducing the risks associated with contaminated water and radioactive waste

**Safe and steady decommissioning is a prerequisite for reconstruction of Fukushima**

- Removing fuel from the Spent Fuel Pool
- Fuel Debris
- Contaminated Water Management
- Radioactive Solid Waste Management

**Current progress**

- Units 1 and 2: Rubble removal
- Unit 3: Installation of fuel removal equipment, Fuel removal
- Unit 4: Storage/Transportation
- Units 1-3: Ascertaining of the situation inside the PCV/ consideration of fuel debris retrieval etc.
- Fuel debris retrieval
- Storage/Transportation
- Disassembly of reactor facility, etc.
- Consideration of scenario and technologies
- Design and construction of equipment
- Dismantling and other tasks

Extended to 30-40 years
• The environmental impact on the site and surrounding area have been significantly reduced.
Regulatory Limit Specified by Reactor Regulation
- Cesium 137: 90Bq/L
- Cesium 134: 60Bq/L

① North side of units 5 and 6 discharge channel

② Real time monitoring

<TEPCO’s website>

③ Near South Discharge Channel
IAEA assessment (December 2013)

As the Government of Japan received IAEA’s assessment that reads “ongoing monitoring in the surrounding ocean area has detected no significant increase in radiation levels outside the port or in the open sea, and has shown that radiation levels in these areas remain within the standards of the WHO’s guidelines for drinking water,” and “the IAEA considers the public is safe”, there has been no leakage of contaminated groundwater at a level which has any impact on the public safety.


Seawater sampling points

～20Km from Fukushima Daiichi NPS

① Monitoring point: T-3 (S)

30～100Km from Fukushima Daiichi NPS

③ Monitoring point: T-M10 (S)

Decommissioning and Contaminated Water Management at TEPCO's Fukushima Daiichi NPS

Film, Fukushima Today 2018
- Efforts to Decommission and Reconstruction
  https://www.youtube.com/watch?v=TZV2HRKNvao

Film, Fukushima Today
- 8 years after the earthquake -
  https://www.youtube.com/watch?v=pKjsSAz5Kws

Treated Water Portal Site
http://www.tepco.co.jp/en/decommission/progress/watertreatment/index-e.html

Observation Data, Fukushima Daiichi NPS
https://www7.tepco.co.jp/responsibility/decommissioning/1f_newsroom/data/index-e.html
◆ Fukushima Daiichi Status Updates
https://www.iaea.org/newscenter/focus/fukushima/status-update

◆ IAEA Review mission reports (Press release)

IAEA Team Completes Fourth Review of Japan’s Plants to Decommission Fukushima Daiichi (November 13, 2018)


◆ UNSCEAR 2016 REPORT Annex C
- Biological effects of selected internal emitters-Tritium

**<Side event on Fukushima Daiichi Decommissioning & Food Safety>**

(i) TEPCO: the current status of Fukushima Daiichi Decommissioning
(ii) IAEA: “the Peer-review mission” held in November 2018
(iii) METI: treated water issue and Fukushima reconstruction
(iv) MAFF: Food safety management
(v) OECD/NEA: “Symposium on Decommissioning/Reconstruction and Food Safety” held in March 2019.

https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/index.html#iaea

**<Japan’s exhibition booth>**

- Screening the film on “Fukushima Daiichi decommissioning”
- Providing Japanese “Sake” from Fukushima at opening ceremony of Japan’s booth.

Participants: About 150 people

* Delegate Statement of Japan is available at https://www.iaea.org/sites/default/files/19/09/gc63-japan.pdf