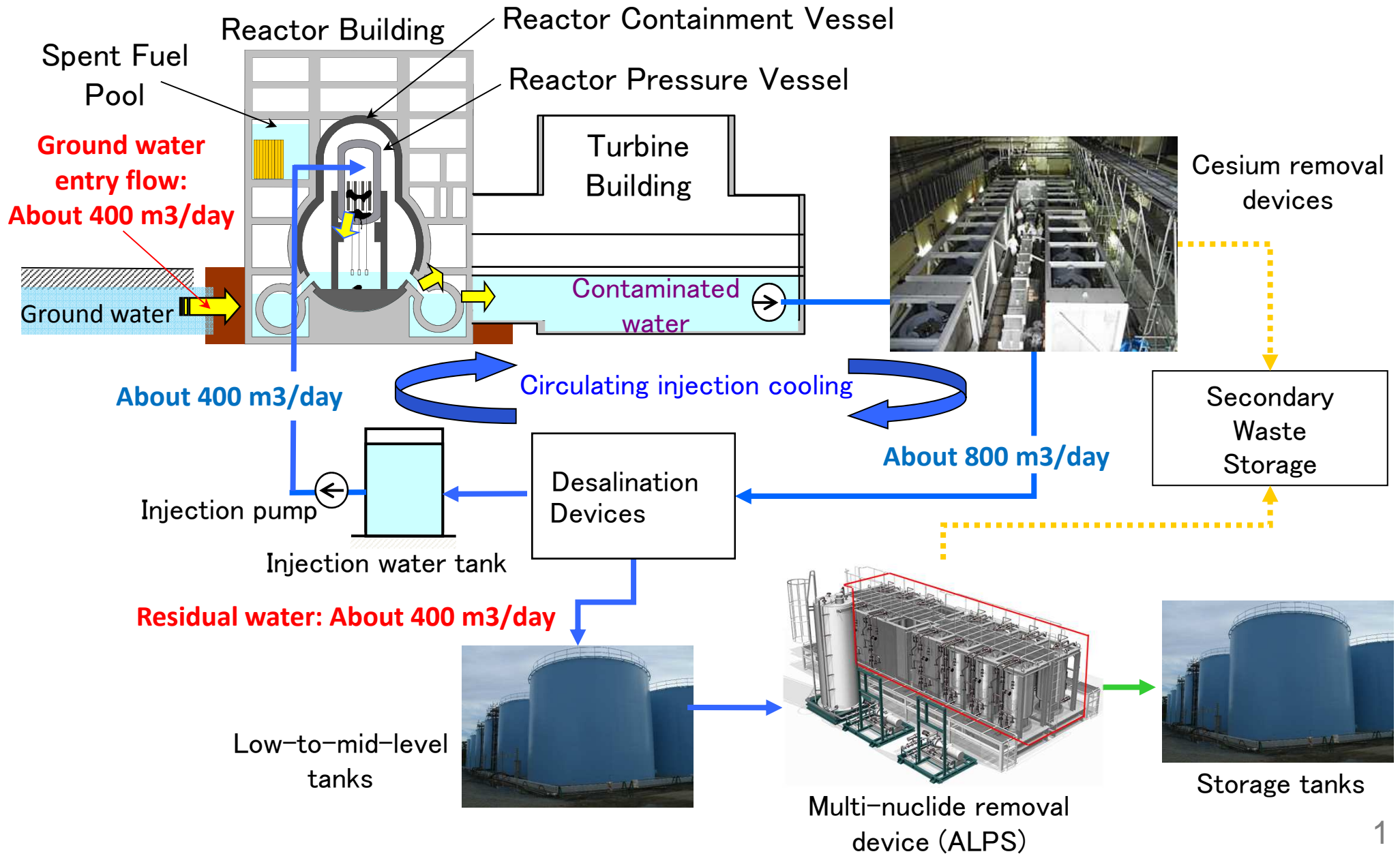


Background Information of the Contaminated Water Management at TEPCO's Fukushima Daiichi NPS

June 3, 2014

Ministry of Economy, Trade and Industry
Agency for Natural Resources and Energy
(Cabinet Office, Management Office of the Team for
Decommissioning and Contaminated Water Countermeasures)

Contaminated Water Treatment System



1. Three Principles for Contaminated Water Issue

Fundamental countermeasures will be taken in several phases in addition to the immediate countermeasures, based on the following principles:

- (1) Removing the contamination source, (2) Isolating water from the contamination source, (3) Preventing leakage of contaminated water

2. Invitation of technical proposals (Request for Information, RFI)

On Sep. 20, 2013, a team of professionals was launched to gather domestic and overseas knowledge by receiving technical proposals, centering around the International Research Institute for Nuclear Decommissioning (IRID). (IRID was selected as the RFI secretariat)

1. Contaminated water storage (Storage tanks, micro-leakage detection techniques, etc.)
2. Contaminated water treatment (Tritium separation techniques, long-term stable tritium storage methods, etc.)
3. Purification of sea water in the harbor (Techniques to eliminate radioactive Cs and Sr in sea water, etc.)
4. Contaminated water control in the building (Building internal water leakage prevention techniques, ground improvement techniques, etc.)
5. Site management for inhibiting inflow of underground water (Water-shielding wall construction techniques, pavement techniques, etc.)
6. Understanding of underground water behavior, etc. (Geological condition and underground water data measuring systems, water quality analytical techniques, etc.)

Gathering domestic and overseas wisdom on solutions to contaminated water issues

■ Inviting technical proposals

- ◇ A team consisting of experts, such as members of the International Research Institute for Nuclear Decommissioning (IRID), was set up to collect wisdom from both home and abroad and accepted technical proposals (period: September 25 to October 23, 2013).
- ◇ The collected proposals were closely examined by the “Committee on countermeasures for contaminated water treatment,” to reflect the overall image of the preventive and multi-layered contaminated water measures.

■ Status of collection

- ◇ A total of 780 proposals were submitted. The details are as follows:

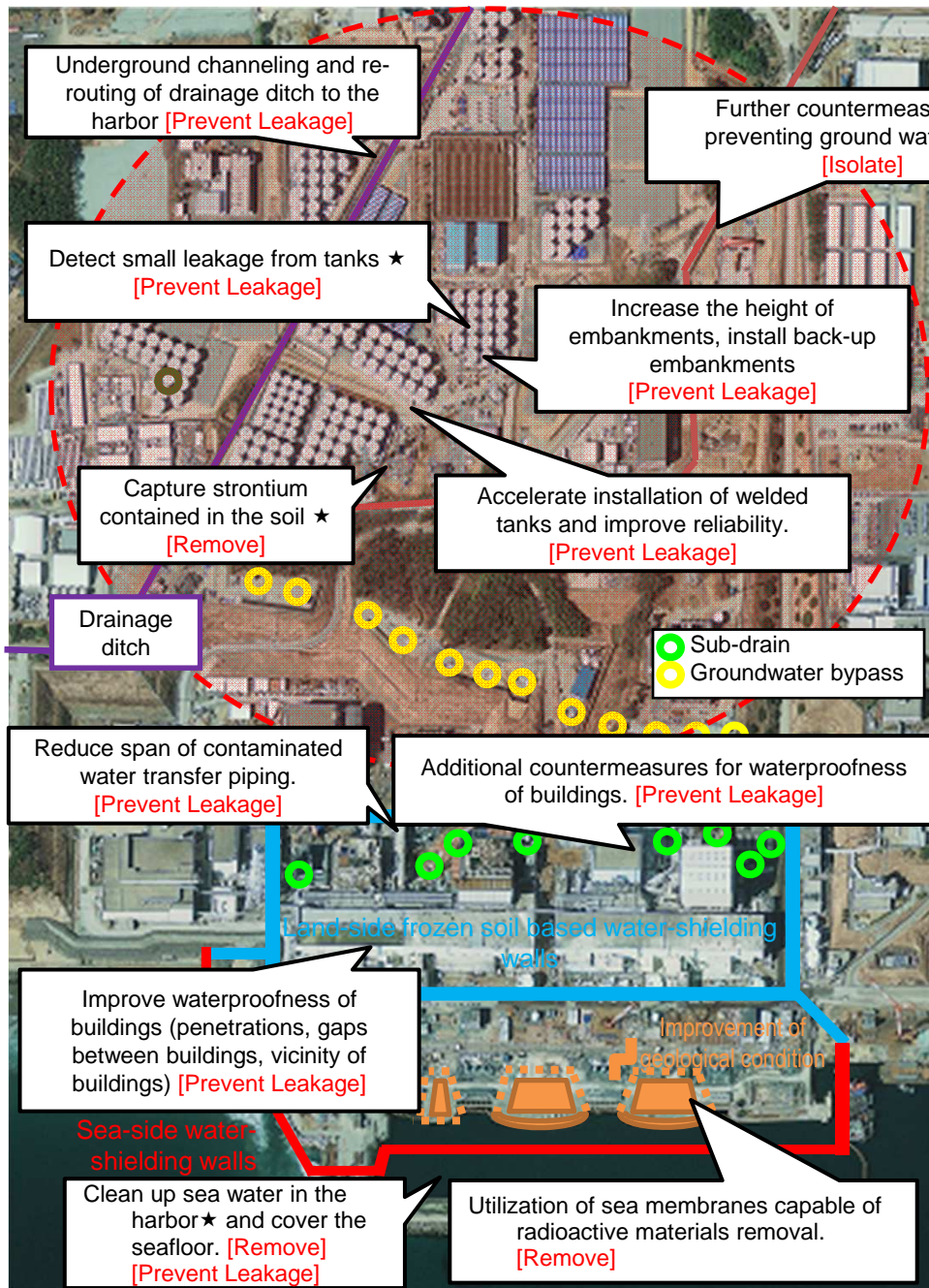
| Field of information gathered | Number of proposals submitted |
|--|-------------------------------|
| (1) Contaminated water storage (Storage tanks, small leakage detection technology, etc.) | 206 |
| (2) Contaminated water treatment (Tritium separation technology, long-term, stable tritium storage methods, etc.) | 182 |
| (3) Clean-up of seawater in port (Technology to eliminate radioactive Cs and Sr in seawater, etc.) | 151 |
| (4) Controlling contaminated water in buildings (Technologies to stop water in buildings and for soil improvement work, etc.) | 107 |
| (5) Management of premises to suppress groundwater inflow (Technologies to construct impermeable walls and conduct pavement, etc.) | 174 |
| (6) Understanding behavior of groundwater (Geological/groundwater data measurement systems, water quality analysis technology, etc.) | 115 |
| Others (Those that do not fall under (1) to (6)) | 34 |

(Note 1) The fields are those identified in the proposer’s application.
 (Note 2) Some proposals were related to two or more fields.

- ◇ Technical proposals presented from both inside and outside of Japan are precious data that provide a complete picture of technologies for contaminated water treatment.
- ◇ Taking into consideration the maturity of technologies, the urgency of response, and adaptability of technologies to the site, the following technologies were selected:

- (1) Technologies that should be adopted after confirming their adaptability to the site:
 - High-reliability, large-size tanks such as double-shell steel tanks
 - Lightweight shielding sheet that does not use lead
 - Contamination prevention membrane (silt fence, etc.)
 - Water stopping technology (stopping water in and around buildings)
 - Geological/groundwater survey, preparing observation network etc.
- (2) Technologies to be used by selecting an execution method based on workability and cost effectiveness
 - Water shut-off technologies (pavement, water shut-off, etc.)
- (3) Technologies that are expected to be effective but need to be checked and verified before being used
 - Small leakage detection technology (including dyes)
 - Tank decontaminating technology without using water
 - Tritiated water storage and separation technologies
 - Technology for cleaning up seawater in port
 - Technology for capturing strontium in soil
 - Automated boring technology etc.
- (4) Technologies to be pushed forward based on study by the Committee on countermeasures for contaminated water treatment
 - General assessment of handling of tritiated water
 - Study on issues related to tankers and underground storage, etc.

Overview of preventive & multi-layered contaminated water treatment



Three principles

1. Remove sources of contamination
2. Isolate water from contamination
3. Prevent leakage of contaminated water

- | Immediate measures | Fundamental measures |
|---|--|
| 1. Remove highly-contaminated water in the trenches [Remove] | 1. Pump up groundwater from sub-drains near buildings [Isolate] |
| 2. Soil improvement with sodium silicate (liquid glass), rainproof pavement, and pumping out [Isolate] [Prevent leakage] | 2. Install sea-side impermeable walls [Prevent leakage] |
| 3. Pump up groundwater for bypassing [Isolate] | 3. Install land-side frozen soil impermeable walls [Isolate] |
| | 4. Install more efficient water treatment equipment [Remove] |
| | etc. |

- Preventive and Multi-layered Measures**
 (★:measure to be studied on its feasibility)
1. Further countermeasures for preventing ground water inflow **[Isolate]**
 2. Increase height of embankments, install back-up embankments **[Prevent leakage]**
 3. Accelerate installation of welded tanks and improve reliability **[Prevent leakage]**
 4. Underground channeling and re-routing of drainage ditch to the plant port **[Prevent leakage]**
 5. Detect small leakage from tanks. ★ **[Prevent leakage]**
 6. Capture strontium in contained water in soil. ★ **[Remove]**
 7. Reduce span of contaminated water transfer piping. **[Prevent Leakage]**
 8. Improve waterproofness of buildings (penetrations, gaps between buildings, vicinity of buildings), etc. **[Prevent Leakage]**
 9. Countermeasures for great tsunami (consideration of additional countermeasures for waterproofness of buildings, wave breakers, etc.) **[Prevent Leakage]**
 10. Clean up sea water in the harbor ★ and cover the seafloor. **[Remove] [Prevent Leakage]**
 11. Utilization of sea membranes capable of radioactive materials removal. **[Remove]**

Main measures taken or to be taken after decision of basic policy on Sep. 3, 2013

1. Preventive and Multi-layered Measures against Contaminated Water Issue

1) **Remove** sources of contamination

key measures already being implemented or decided:

- Remove contaminated water in the trenches and isolate the trenches
- Treat contaminated water with multi-nuclide removal equipment (ALPS)
- Install high-performance multi-nuclide removal equipment at government expense

Key additional measures:

- Install more multi-nuclide removal equipment
- Take measures to prevent water leakage from tanks (capturing strontium contained in the soil)
- Clean up sea water in the harbor

2) **Isolate** water from contamination

key measures already being implemented or decided:

- Pump up groundwater for by-passing
- Pump up ground water from sub-drains near buildings
- Install land-side frozen soil impermeable walls at government expense
- Pave the area between building and sea

Key additional measures:

- Implement “broader area pavement (surface waterproofing) in the site” or “limited area pavement with an impermeable enclosure,” also consider dose-reduction measures (e.g. decontamination of land surface)
- Install gutters on top of tanks

3) **Prevent leakage** of contaminated water

key measures already being implemented or decided:

- Improve soil with sodium silicate
- Install sea-side impermeable walls
- Install further tanks (replace bolted-joint tanks with welded-joint tanks)

Key additional measures:

- Accelerate installation of welded-joint tanks
- Prepare countermeasures against large tsunami (e.g. install watertight doors on buildings)
- Prevent contaminated water leakage from buildings
- Reduce length of contaminated water transfer piping

- **Need to accelerate installation of further tanks to the extent possible with combined efforts of public- and private-sectors**, such as encouraging cooperation of relevant business operators, together with acceleration of installing welded-joint tanks, in order to secure enough storage capacity of tanks in preparation for waves on the surface of the liquid caused by earthquake.
- Press forward the **efforts such as verification of technology with Fiscal Year 2013 Supplementary Budget** for the additional **measures with high technical difficulty** such as the measures to clean up the sea water in the harbor and to remove radioactive materials in the soil.
- Make **a comprehensive evaluation of all options** for **tritiated water**, which still has remaining risks, as soon as possible and consider appropriate measures.

2. Enhanced Communication as a Measure to Prevent Damage to Reputation

- Provide evidence-based information in an internationally open manner. Under the cooperation of relevant ministries, enhance the integrated communication of the Team for Decommissioning and Contaminated Water Countermeasures.

Process from RFI to RFP

| Time | Contents | Organization |
|-------------------------------|--|---|
| Sep. 25, 2013 – Oct. 23, 2013 | Implementation of the Request for Information (RFI) for addressing the Contaminated Water Issue | The Agency for Natural Resources and Energy (ANRE, METI) <International Research Institute for Nuclear Decommissioning (IRID) was selected as the RFI secretariat> |
| Nov. 15, 2013 | IRID reported information which was submitted through the RFI process to the Committee on Countermeasures for Contaminated Water Treatment (CCCWT) | The same as above |
| Dec. 10, 2013 | CCCWT released “Preventative and Multi-layered Measures for Contaminated Water Treatment at the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company” | CCCWT |
| Dec. 20, 2013 | Nuclear Emergency Response Headquarters released “Additional Measures for Decommissioning and Contaminated Water Issues at TEPCO’s Fukushima Daiichi NPS” | Government of Japan (Nuclear Emergency Response Headquarters) |
| Feb. 25, 2014 | Selection of the project management office for the “Project of Decommissioning and Contaminated Water Management ” in the FY2013 Supplementary Budget | The Agency for Natural Resources and Energy (ANRE, METI) <Mitsubishi Research Institute was selected for the tasks of the project management office.> |
| Mar. 24, 2014 | Start of the solicitation for Entities to Implement the Subsidy Program “Validation of technologies for contaminated water management project” in the FY2013 Supplementary Budget (The solicitation was closed on May 19, now under review.) | The same as above |
| Jun. 3, 2014 | Holding of the Information Session for RFP for Entities to Implement the Subsidy Program “Validation of Technologies for Contaminated Water Management Project (Demonstration Project for Verification | The same as above |