

**Technical Strategic Plan 2023
for Decommissioning of the Fukushima
Daiichi Nuclear Power Station of
Tokyo Electric Power Company Holdings, Inc.
(Explanatory Material)**

October 18, 2023

**Nuclear Damage Compensation and
Decommissioning Facilitation Corporation**

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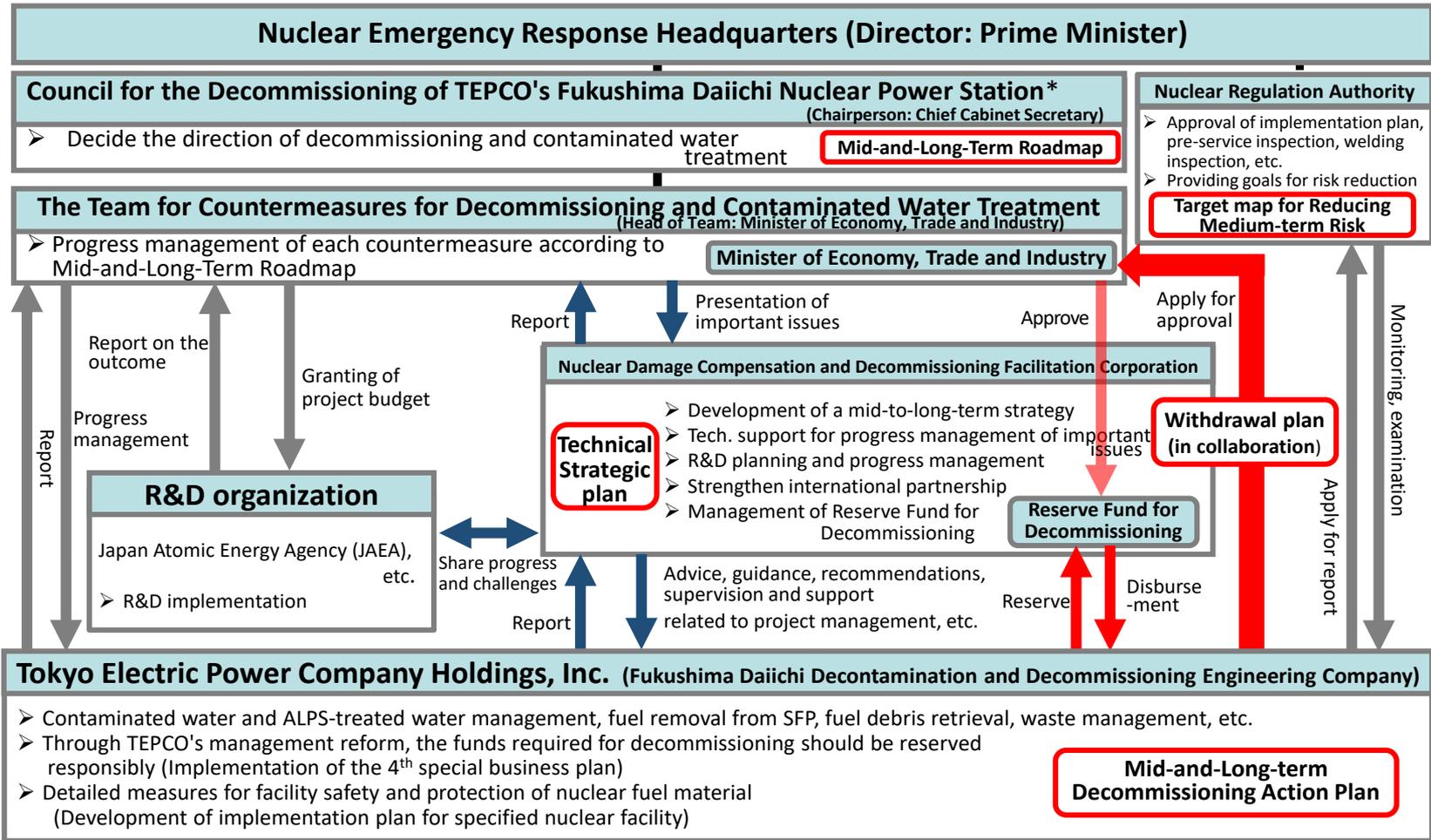
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Division of roles of related organizations responsible for decommissioning of the Fukushima Daiichi NPS

Local residents and communities

Bidirectional dialogue

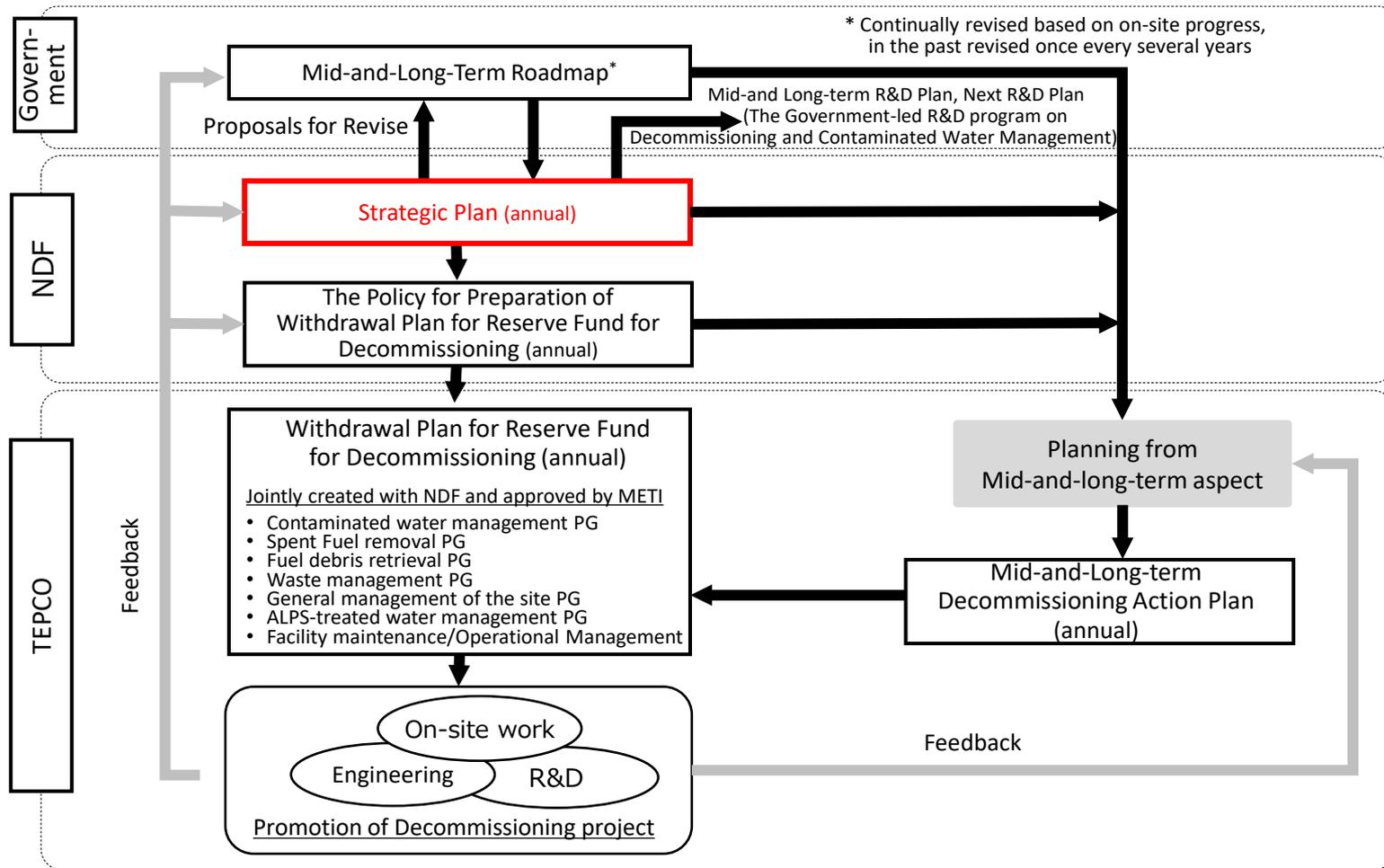
Organizations related to decommissioning



* In response to the ALPS-treated water disposal policy decided on April 13, 2021, "Council for the Decommissioning of TEPCO's Fukushima Daiichi NPS toward steady implementation of basic policy on ALPS-treated water disposal" was founded.



Positioning of the Technical Strategic Plan



Concept on risk reduction

Target

Bringing the risk levels into the “Sufficiently stable management region” (the pale blue area)

Red arrows present major changes from the Technical Strategic Plan 2022.

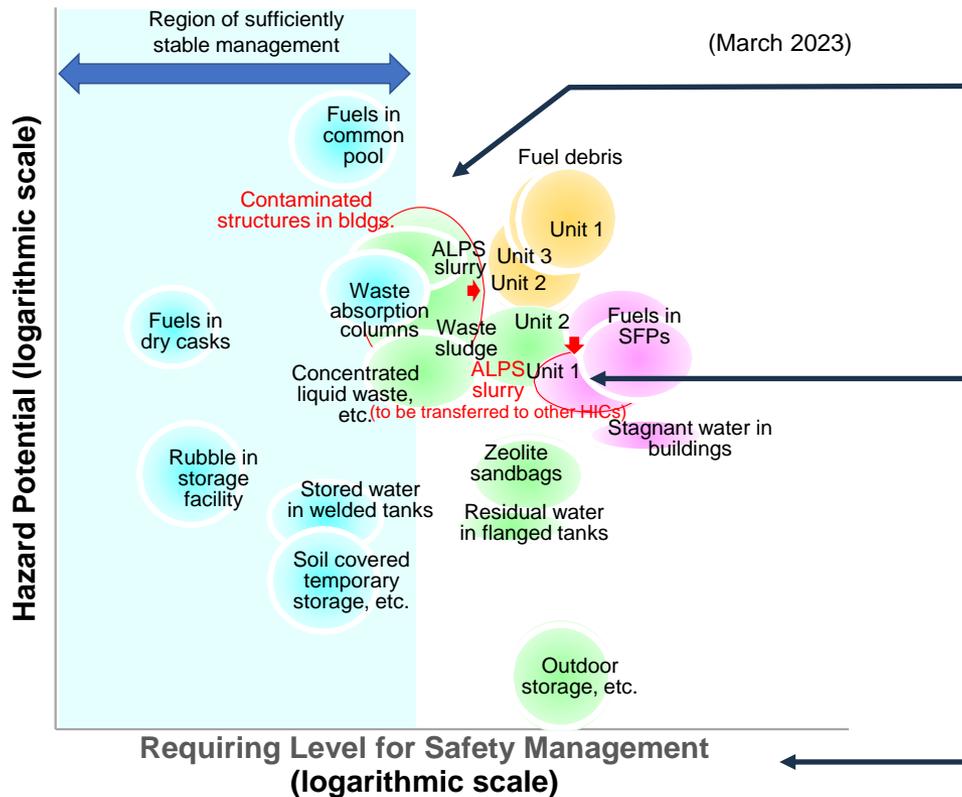


Fig. Risk levels posed by major risk sources at the Fukushima Daiichi NPS

Major changes ① Contaminated structures in buildings

Increased “Requiring Level for Safety Management”

Reflects the retention of hydrogen flowing into the system connected to the PCV during the accident.

Major changes ② ALPS slurry (to be transferred to other HICs)

Reduced “Hazard Potential”

As the transfer has progressed, the hazard potential of the ALPS slurry (to be transferred to other HICs), which was shifted to ALPS slurry, has been reduced and moved downward.

Renamed the horizontal axis label

Changed from “Safety Management” to “Requiring Level for Safety Management”

Indicates that a higher level of safety management is otherwise required, e.g. where facility integrity is insufficient.

Approach to ensuring safety during decommissioning

Issue

The peculiarities of Fukushima Daiichi should be fully recognized to ensure safety.

As for decommissioning of the Fukushima Daiichi NPS containing the reactors involved in the accident, safety perspective and operator's perspective should be reflected to address safety peculiarities.

Peculiarities of Fukushima Daiichi NPS

Atypical & unsealed

A large amount of radioactive material is in an unsealed state, and in unusual and various (atypical) forms

Incomplete barriers

Barriers for containing radioactive materials are incomplete

Large uncertainty

Significant uncertainties exist on the state of radioactive materials and containment barriers

Difficult to measure

Difficulty in accessing the site and installing instrumentation devices to obtain on-site information, due to constraints such as high radiation levels

Need to be aware of timeframes

Further degradation of containment barriers is a concern

Major targets and progress for fuel debris retrieval

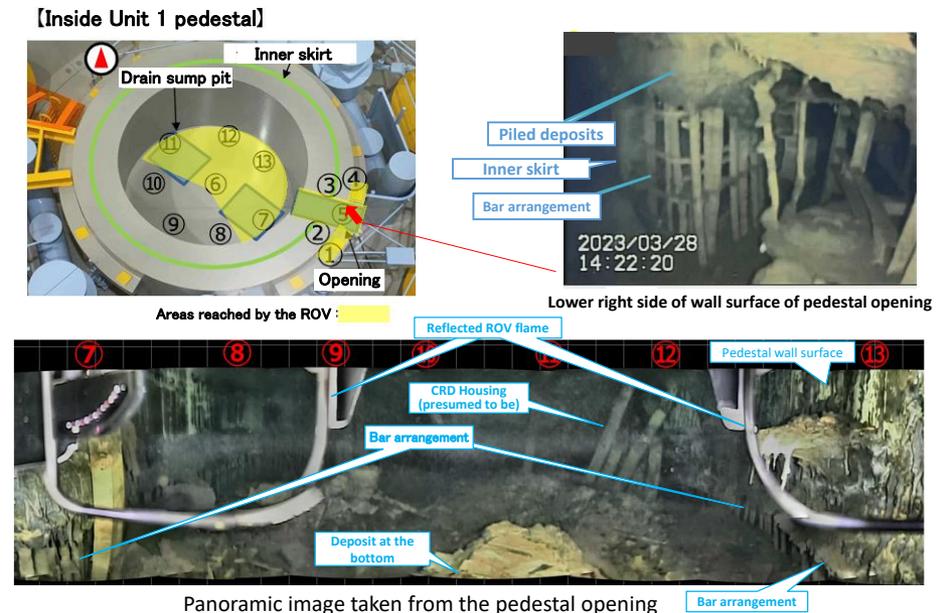
Major Targets

- Trial retrieval in Unit 2 is expected to start in late FY2023.
- For further expansion of fuel debris retrieval in scale, consideration will be given to the methods including those for containing, transferring, and storing of fuel debris, by assessing fuel debris retrieval in Unit 2, internal investigations, research and development, etc.

Progress

Unit 1 Internal investigation

- It was observed that the entire circumference of concrete was missing at the pedestal opening and on the inside wall surface.
- The evaluation showed that even the loss of the pedestal's support function would not pose a significant risk of external radiation exposure.
- On the other hand, strengthening the containment function and deploying mobile equipment are under consideration in the event of an emergency.



(Source : , Team Meeting/Secretariat Meeting of the Decommissioning, Contaminated Water/Treated Water Management, April 27, 2023)

Fig. Results of the internal investigation for PCV

Issues and technical strategies for trial retrieval from Unit 2 (internal investigation and fuel debris sampling)

Significance

This is the first attempt at fuel debris retrieval at the Fukushima Daiichi NPS.

- Expanding the containment barriers to the outside of the PCV is a basic on-site configuration for planned retrieval operations.
- Future decommissioning efforts will make use of this experience and information from the retrieved samples.

Issues and technical strategies

The issue is to carry out a series of operations step by step amid uncertainties about the internal condition of the PCV.

Ensure that required performance is met

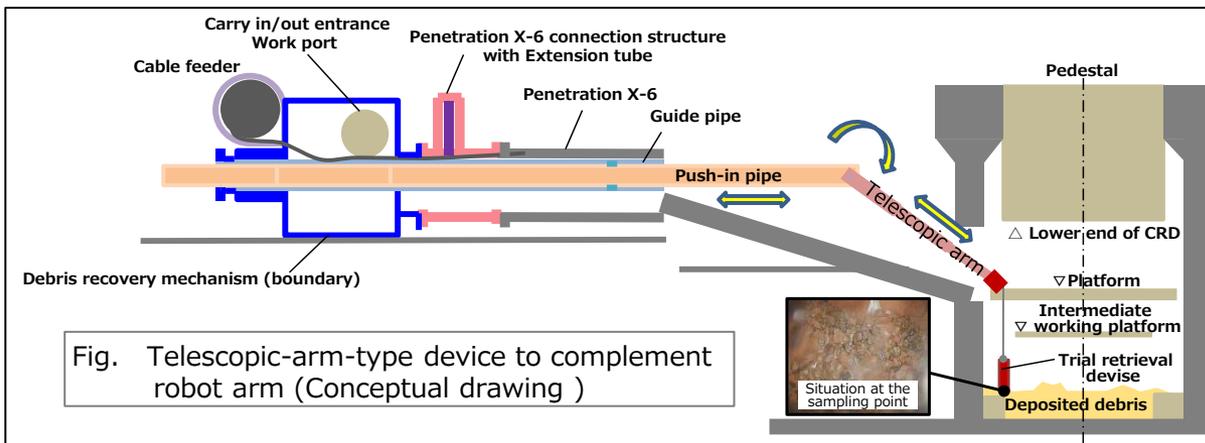
- ✓ Functional verification in various conditions in mock-up tests.

Careful planning

- ✓ Proceed safely and carefully, keeping in mind the experience of defects during operation.

Work step for trial retrieval

01. Preparations (completed)
02. Install the isolation chamber (completed) 
- 03. Open the hatch of the penetration X-6
↑ being implemented**
04. Remove deposits inside the penetration X-6
05. Install the robot-arm
06. Enter the robot-arm
07. Internal investigation/fuel debris sampling
08. Collect from fuel debris retrieval equipment to transport container/measure dose
09. Accept into glove box/measure
10. Remove container/store in canister and carry out
11. Off-site transport and off-site analysis



Further expansion of fuel debris retrieval in Unit 3 (1)

Significance

Further expansion of fuel debris retrieval in scale is an important process in decommissioning, and its reliable implementation will determine the success or failure of the decommissioning project.



The selection of the retrieval method is an extremely important decision.

- Before the selection, not only TEPCO but the government and NDF should cooperate in a comprehensive review and evaluation.*

*The Sub-Committee for the Evaluation of Fuel Debris Retrieval Methods, established in February 2023, has started the examination and evaluation.

Issue

After fully recognizing the factors that make fuel debris retrieval difficult and appropriate retrieval methods should be examined.

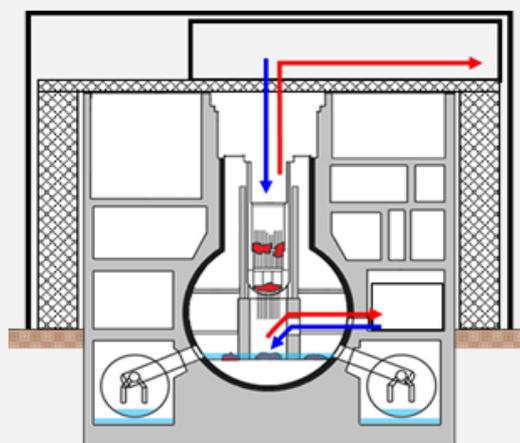
Factors that make fuel debris retrieval difficult

- ① **Extremely high radiation dose in PCVs and RPVs**
- ② **High-radiation dose in reactor buildings**
- ③ **Lack of on-site information**
- ④ **Building containment barriers**
- ⑤ **Criticality control**
- ⑥ **Waste management**

Further expansion of fuel debris retrieval in Unit 3 (2)

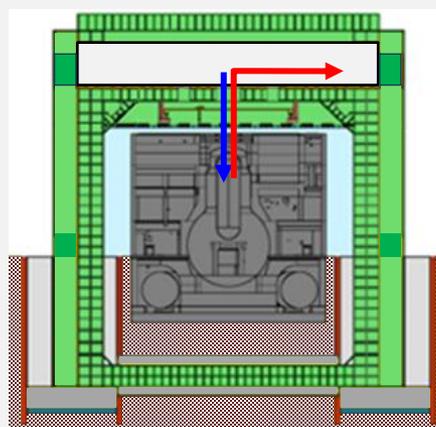
- Access direction of the devices
- Transfer direction of fuel debris and waste
- Filler material

Partial submersion method (Water injection into RPV)



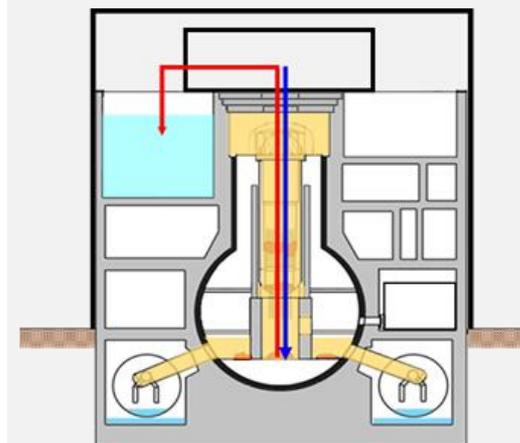
A method to retrieve the fuel debris exposed to the air or immersed at a low water level while pouring water into the RPV.

Submersion method (shell structure)



A method to enclose the entire reactor building with a new structure, called a shell structure, and then flood the reactor building and retrieve fuel debris.

Partial submersion method (RPV solidification)



A method to solidify the pedestal bottom, the RPV, and the reactor well with fillers, and then excavate and retrieve fuel debris together with the fillers.

Major targets for waste management

Major Targets

- Based on the prospects of processing/disposal methods and technology related to their safety presented in FY 2021, appropriate measures should be studied as management approaches for overall solid waste to establish waste streams*.
- * A series of handling procedure from its generation, storage to processing/disposal according to the characteristics of solid waste
- Develop and update the analysis plan necessary to advance the consideration of storage/management and processing/disposal, and proceed steadily with analysis based on it.

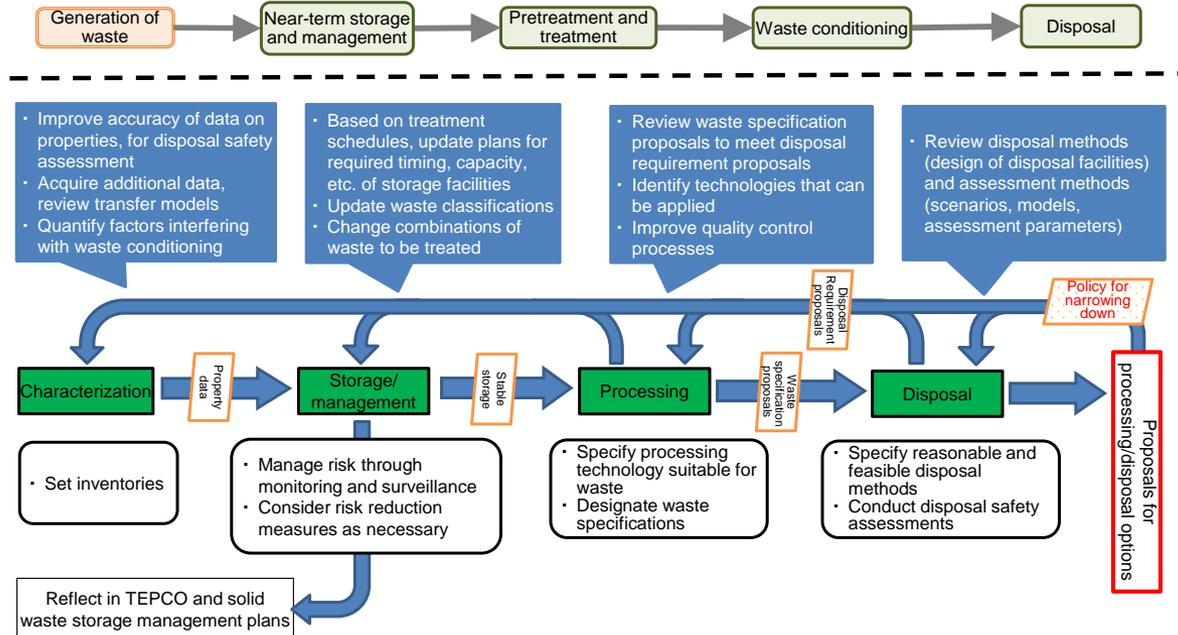


Fig. Procedure to reasonably select safe processing/disposal methods of solid waste

Major issues and technical strategies for waste management

Issues and technical strategies

Characterization

For a variety of solid waste, it is needed to develop a medium-to-long-term analysis strategy that defines its priority, the objective of the analysis, and quantitative targets, etc., and to proceed with analysis/evaluation accordingly.



Accumulate trial results and verify their validity to establish a development flow of the medium-to-long-term analysis plan with an analysis project approach using statistical methods

Storage/management

Storage/management of solid waste according to the progress of decommissioning work in the future should be advanced in a safe and reasonable manner



Transit from classification based on the surface dose rate to manage based on radioactivity concentration and examine rational waste classification and on-site reuse in preparation for the expected increase of solid waste generation.

Processing/disposal

The Mid-and-Long-term Roadmap stated that the specifications of waste form and their production methods will be determined in Phase 3, the study on appropriate overall measures should be initiated for specific management for solid waste.



Create processing/disposal options for solid waste by examining pending issues related to processing technology and disposal options.
Compare and evaluate options using the characteristic data that are becoming clear, and examine to establish a waste stream that is suitable for the feature of solid waste.

Major targets and technical strategies for contaminated water and treated water management

Major Targets

- To suppress the amount of contaminated water generated to 100 m³/day or less within 2025 and to approximately 50 to 70 m³/day around the end of FY2028.
- To discharge ALPS-treated water safely and reliably in order to secure the site and other resources and to facilitate the entire decommissioning process.

Issues and technical strategies

Contaminated water management

Contaminated water generation is expected to be reduced to 100 m³/day or less, and the issue is to reduce it further.

In addition to selecting methods for debris retrieval in progress, it is also necessary to consider measures over the medium to long term.



Proceed with local watertight work in the building, in addition to the ongoing lowering of the water level of sub-drains and work on facings.



Since each fuel debris retrieval method requires different purification systems and watertight measures for buildings, establish contaminated water management measures according to the method, considering interference with retrieval operation.

Efforts toward discharging ALPS-treated water into the sea

Issues and technical strategies

It is essential to operate the facilities as planned and in a reliable manner and to communicate the status promptly with high transparency, including analysis and monitoring results of relevant organizations.

Treated water management

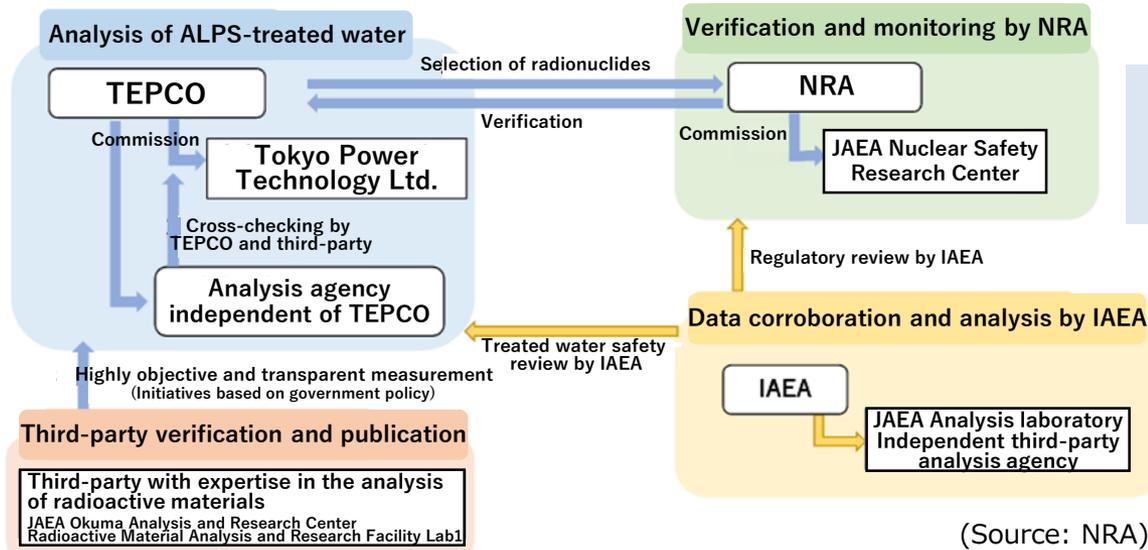
After confirming that the concentration of radionuclides other than tritium in ALPS-treated water before dilution is definitely below the regulatory limit*, dilute and discharge the ALPS-treated water.

- ✓ Conducted by TEPCO and third-party organizations with expertise in analyzing radioactive materials.

*The sum of the ratios against the regulatory concentrations limits is less than 1.

Several organizations provide marine monitoring, including TEPCO, the Ministry of the Environment, the Nuclear Regulation Authority, and Fukushima Prefecture.

Disclose analysis and monitoring results, and the operation status of facilities for discharge into the sea through the Treated Water Portal Website, etc.



Reviews by IAEA continue even after the start of discharge.

Fig. ALPS-treated water analysis and evaluation structure

Major targets and technical strategies for fuel removal from spent fuel pools

Major Targets

The aim is to complete fuel removal from all spent fuel pools of Units 1 to 6 by the end of 2031.

- Retrieval from Unit 1 started in FY 2027 to FY 2028
- Retrieval from Unit 2 started in FY 2024 to FY 2026

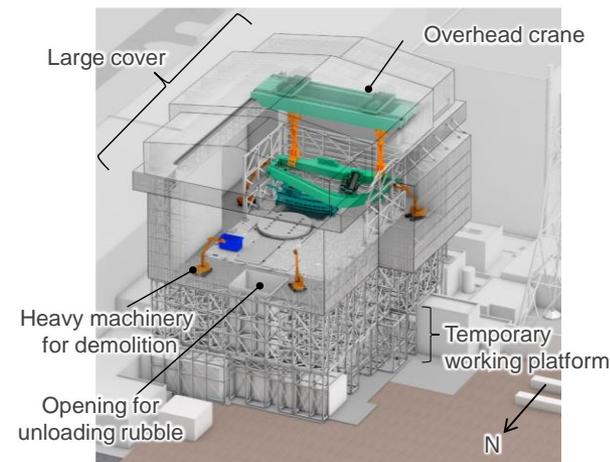


Fig. During rubble removal from Unit 1 (Conceptual drawing)

Issues and technical strategies

Unit 1 In order to remove the overhead crane in an unstable state, a thorough investigation is needed.

Unit 2 The issue is to ensure that a fuel handling machine with a boom-type crane, which has not been used for nuclear facilities in Japan, is operated remotely.

Promptly investigate it as soon as investigation becomes possible and incorporate into safety assessment and rubble removal plans.

To be sufficiently familiar with the operation and functionality of systems beforehand.

Significance of analysis for decommissioning

Significance

Analysis with a diverse variety of analysis targets, objectives, and radiation dose rates is essential to the decommissioning the Fukushima Daiichi NPS.

- If the range of uncertainty about fuel debris is reduced, there will be no need to include excessive margins, improving the promptness and rationality of decommissioning.
- Analysis to obtain property data is essential in examining processing/disposal methods of solid waste.

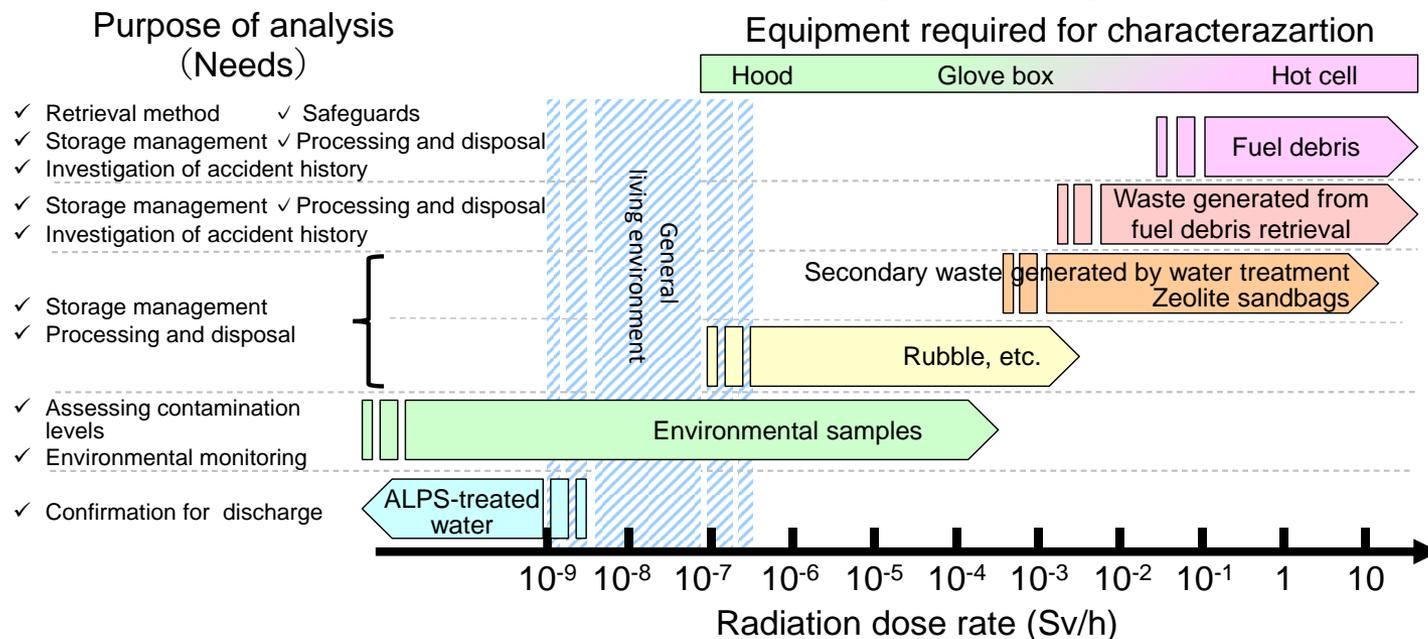


Fig. Relationship between the purpose of the analysis, equipment required for characterization, and radiation dose rates of the analysis targets

Issues and strategies

Strengthening analysis methods and structures

To prevent decommissioning work from stagnating, the issue is to analyze according to the plan, considering the future expansion of the demand for analysis.

It is necessary to have a high level of ability to develop analysis plans that anticipate in advance how the analysis results are utilized. (This is not feasible for a single individual.)



Identify types of waste with a high priority for analysis and consider policies for characterization and analysis plans based on the characteristics of each type.

Integrate and coordinate these analysis plans, formulate the annual development of the analysis capabilities, and incorporate them into personnel plans.



Organize an Analysis Coordinating Committee and an Analysis Support Team to confirm analysis plans and provide advice on problem-solving.

Diversification of analytical techniques to increase sample size and volume

Although sample analysis can measure many analysis items, the issue is that each analysis takes a long time, and the amount analyzed each time is small.



Compared with sample analysis, it is important to study the application method of non-destructive measurement, which can measure large amounts in a short time.

5. Efforts to facilitate research and development for decommissioning of the Fukushima Daiichi NPS

Significance

The steady promotion of decommissioning requires research and development to solve many challenging and technical issues.

Current status

- As the investigation inside the reactor progresses, the need for decommissioning has been clarified and full-scale engineering by TEPCO has started.
- The implementation structure of the Project of Decommissioning, Contaminated Water and Treated Water Management has shifted from an IRID-led project structure to a new structure led by researching institutions and manufacturers based on TEPCO's needs.

Strategies

Introduction of two initiatives (RFI and project review) for the Project of Decommissioning, Contaminated Water and Treated Water Management

- ✓ Further strengthen functions related to planning proposals for R&D and ensure actual site applicability of research results.

Request for Information (RFI)

Widely solicit for topics for R&D to undertake and explore new seeds for development.

Project review

Provide guidance and advice on activities such as planning, testing, design, and manufacturing of subsidized operators from the viewpoint of actual site applicability.

Capabilities, organization, and personnel to proceed with decommissioning

Significance

To achieve goals in project-based operations such as the decommissioning of Fukushima Daiichi NPS, it is **essential to clarify the objectives, means, resources required, schedules, and risks and to manage project execution.**

Strategies

Abilities required of owners

- ✓ Engineering capabilities based on safety and operator's perspectives that is grounded on the peculiarities and actual on-site situations.
- ✓ Ability to examine/review the upstream of a project to better clarify the significance and goals of the project

Organization-related initiatives

- ✓ Consider integrating and reorganizing the headquarters functions at Fukushima Daiichi and Fukushima Daini.

Initiatives to recruit and develop personnel

- ✓ In addition to recruiting proactively, promote multi-skill development and performance improvement for current human resources.
- ✓ Determine what human resources will be needed and when in the medium to long term and secure a wide range of internal and external human resources.
- ✓ Develop leaders responsible for decommissioning in a planned and systematic manner.

Strengthening international cooperation

Significance

- Learn lessons from precedent overseas cases, and **utilize the world's highest level of technology and human resources**
- **Sharing our decommissioning experience in Fukushima Daiich with the international community** is Japan's responsibility.
- **Gain international understanding and interest** in the decommissioning efforts of Fukushima Daiichi

Strategies

Integrate the wisdom and knowledge from around the world and give back

- ✓ Collect information from a wide range of countries to apply general-purpose technologies to decommissioning.

Maintain cooperative relationships with the international community and maintain its understanding of and interest in decommissioning

- ✓ Dialogue and exchange for experts in each country to expand a science-based and accurate understanding.
- ✓ As there are some gaps in the knowledge and amount of information that are foundational to understanding, distribute information that is detailed and easy for the target audience to understand.



The 7th International Forum on Decommissioning of the Fukushima Daiichi (August,2023)

Local community engagement

Significance

In achieving “Coexistence of reconstruction and decommissioning”, **revitalizing decommissioning-related industries is an important pillar of TEPCO’s contribution to the reconstruction of Fukushima.**

Current status

- As of the end of July 2023, **there were 706 matches related to decommissioning** through decommissioning-related industrial exchange meetings.
- **Establishing joint ventures for accumulating decommissioning industries in the Hamadori region.**
 - ✓ Toso Mirai Technology Company (In collaboration with IHI Corporation)
 - ✓ Toso Mirai Manufacturing (In collaboration with Hitachi Zosen Corporation)

Strategies

Initiatives to enable local companies to receive constant and a certain scale of orders

- ✓ To encourage local business participation, more specific tasks have been specified in the "Medium- to-Long-Term Outlook in the Decommissioning" from FY2022.

Strengthen cooperation and collaboration with the community and relevant institutions

- ✓ Further strengthening of cooperation and collaboration with local governments, including Fukushima Prefecture, and local related organizations, such as the Fukushima Innovation Coast Framework Promotion Organization and the Fukushima Soso Recovery Promotion Organization.