Status of the Undertakings of the regulatory body for 1F Decommissioning

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Today's Topic

1. Medium-term risk reduction target roadmap for Fukushima Daiichi Nuclear Power Station
2. Current Status of Radioactive Waste at Fukushima Daiichi Nuclear Power Station
3. Latest status of Fukushima Daiichi Nuclear Power Station Unit 1
4. Research and Development of the Nuclear Regulation Authority on Fuel Debris

1. Medium-term risk reduction target roadmap for Fukushima Daiichi Nuclear Power Station

- The medium-term risk reduction target roadmap for TEPCO's Fukushima Daiichi Nuclear Power Station (hereafter referred to as the "Risk Map") aims to reduce and optimize the risk of the entire facility and also expedite the necessary measures to ensure safety inside and outside the site. **It was formulated with the aim of clarifying the goals related to measures for decommissioning that should be prioritized by the Nuclear Regulation Authority.**
- The first risk map was created in 2015. Since then, it has been constantly reviewed based on the progress of work and the latest risk assessment (revised annually).
- Points from the latest version (March 2023 version)
  - **Priority is given to fields related to solid radioactive materials.**
  - In addition to subdividing the relevant fields and setting targets according to radioactivity concentration and properties etc., targets were set for **improving the analysis system** which is necessary to get a better understanding.

Measures for Mid-term Risk Reduction at TEPCO's Fukushima Daiichi NPS (as of March 2023)

Solid Radioactive Materials: Prioritized Area for Risk Reduction (excluding Nuclear Fuel Debris)

(FY)	Waste from Water Treatment Process (unstable)	Demolition Waste (generated in the future)	Rubbles (generated up to now)	Nuclide Analysis
2023	Complete basic design of slurry dehydration facility Start salvage of zeolite etc. in main process building Start construction of large waste storage facility inside Establish design concept for storage facilities of dehydrated material, salvaged material, adsorbed material and HIC Select candidates and determine requirements for solidification of dehydrated material, salvaged material and adsorbed material	Identify materials and volume to be generated in the near term Establish storage and management concept according to radioactivity concentration and characteristics	Start operation of volume reduction treatment facility	Start enhancement of analytical capability Analyze radioactivity concentration and characteristics Revise analytical plan
2024	Increase temporary capacity of HIC Complete detailed design and start construction of slurry dehydration facility Start storage of adsorption columns at large waste storage facility Complete basic design of storage facility of dehydrated material, salvaged material, adsorbed material and HIC Assess technical feasibility of solidification method of dehydrated material, salvaged material, adsorbed material	Establish storage and management plan according to radioactivity concentration and characteristics	Start operation of solid waste storage facility - 10 (First half of 2024FY)	
2025	Start salvage of sludge from main process building Complete seismic reinforcement of large waste storage facility Complete detailed design of storage facility of dehydrated material, salvaged material, adsorbed material and HIC and start construction Establish concept for solidification of dehydrated material, salvaged material and adsorbed material	Start storage and management according to radioactivity concentration and characteristics	Start operation of a pre-incineration processing facility	Strengthen in-house analytical capabilities
Future Target 2026～2034	Start dehydration of slurry (FY2026) Establish concept for solidification of dehydrated material, salvaged material, adsorbed material and start solidification **【Goals】** Stabilization of high dose waste (dehydration or solidification, and storage in facility with appropriate earthquake resistance)	Enlarge storage according to radioactivity concentration and characteristics **【Goals】** Classification of waste according to radioactivity concentration and characteristics for proper storage and management	Resolve outside storage of rubbles (FY2028) Install a melting facility Start operation of solid waste storage facility (after first 11 buildings) (FY2031) Resolve temporary storage in solid waste storage facility – 10 (Fy2033) Transition to appropriate storage according to radioactivity concentration and characteristics	Install a comprehensive analytical facility **【Goals】** Installation of analytical facilities and strengthening of analytical capabilities for steadfast advancement of decommissioning
Long-term Target	Transition to final waste form according to classification			

Measures of special attention needed to surrounding areas and sea area

Measures of comparatively low risk to surrounding areas and sea area

2. Current Status of Radioactive Waste at Fukushima Daiichi Nuclear Power Station

Among the goals of the risk map, the following issues require further consideration:

① How to store and manage low-level waste such as concrete

② Analytical needs for waste storage

2-1. How to store and manage low-level waste such as concrete

- Low-level radioactive waste is a notable issue in terms due to sheer quantity within the activities of decommissioning 1F. A notable challenge is the storage and management of waste such as low-level concrete; it has already been generated in large quantities and will continue to be generated in large quantities as part of the demolition of buildings in the future. This is an unavoidable important issue.

2-1. How to store and manage low-level waste such as concrete

- In order to store the large amount of rubble indoors, it is desirable to carry out “volume reduction treatment”.

A. Example of waste (without volume reduction)


B. Example of waste (after volume reduction)

- However, the rubble radiation level varies and it is difficult to reduce the volume immediately. Is it realistic and rational to store all of it indoors?

- It is necessary to consider how to store and manage existing debris, including outdoor storage within the premises of the Fukushima Daiichi Nuclear Power Station, this may include storing low-level debris outdoors without carrying out volume reduction.

The 12th Technical Meeting on the Review of Implementation Plans for Specified Nuclear Facilities
Excerpt from article 1-1 (11th July 2023, Tokyo Electric Power Company Holdings, Inc.)

2-2. Characteristics of waste and analysis needs for storage

- 1F waste → diverse, high dose, large amount, obscure... and still some unidentified waste
- Although the waste has a wide spread of characteristics, it is necessary to search for commonalities and use standard units such as ‘Sv’ so that it can be quantified (surface dose, radioactivity concentration etc.)
- The requirements associated with the analytical methods and results are addressed (technical, resource, efficiency, accuracy, applicability, timing etc.)
- Understand the properties through analysis done before any handling takes place, manage the results for activities involving handling
- Flexible thinking is necessary when considering how to classify objects and how to store them accordingly

Building a system to meet diverse and large-scale analysis needs

- Domestic analytical capacity is insufficient!
- Will TEPCO's proactive efforts and support from analysis institutions be able to meet future needs?

1 Enhancement of the analysis system is a priority issue in promoting the decommissioning of 1F

2 Efforts to enhance resources related to analysis are necessary

At this time,

1. Continuously over a long period of time,
2. High quality,
3. Large-volume

For the analysis system,

a. Human Resources,
b. Facilities & Equipment,
c. Operational Resourced

are required as well as the environment and mechanisms

3. Latest status of Fukushima Daiichi Nuclear Power Station Unit 1

① Current status of the reactor core of Fukushima Daiichi Nuclear Power Station Unit 1

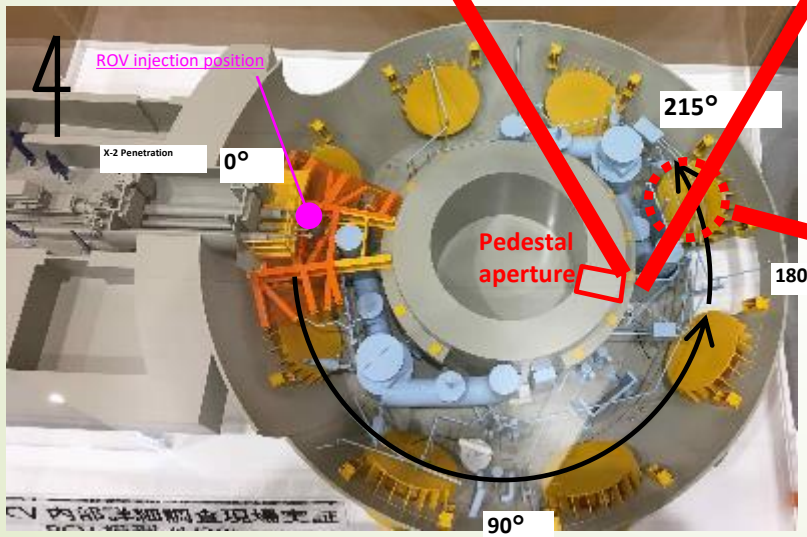
② State of the pedestal at Fukushima Daiichi Nuclear Power Station Unit 1

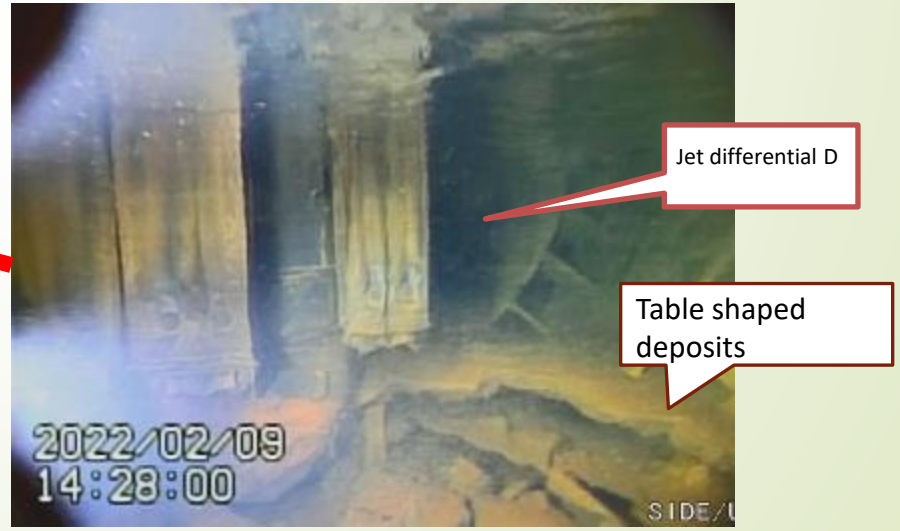
③ NRA response to pedestal damage

3-1. Situation around Unit 1 core

A. Pedestal opening Table-shaped deposits

B. Inside the pedestal opening Lumpy deposits





C. Near the east-northeast of the PCV Table-shaped deposits

The 30th Study Group on Accident Analysis at Tokyo Electric Power Company Fukushima Daiichi Nuclear Power Station
Excerpt from Supplementary Explanatory Material 1 (30th June 2022, Tokyo Electric Power Company Holdings, Inc.), partially edited

Materials provided by: International Research Institute for Nuclear Decommissioning (IRID), Hitachi-GE Nuclear Energy

3-2. Condition of Unit 1 pedestal

Panoramic photo taken from the pedestal opening

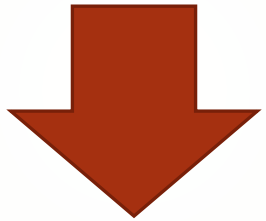
Remaining portion of the pedestal wall on the right side of the opening

- Concrete damage was observed all around the pedestal as indicated in red
- The steel frame from the reinforced concrete foundation has visibly melted and is exposed

From TEPCO HD website
https://photo.tepco.co.jp/date/2023/202304-j/230414-01j.html

3-3. NRA response to pedestal damage

- After the damage to the Unit 1 pedestal was discovered, the Nuclear Regulation Authority ordered TEPCO to quickly look into the following two matters to confirm safety.



(1) Assessment of the impact of the release of radioactive materials on the surrounding environment

(2) Based on (1), measures to control the release of radioactive materials

3-3-1. Results of the evaluation of the impact on the surrounding environment from the release of radioactive materials

- The evaluation was conducted **assuming the worst case scenario** considering that the pedestal support function is lost and a large opening is present in the containment vessel.

- As a result, even considering this worst case scenario, as well as assuming that contaminants on the outer surface of the pressure vessel or debris inside the pressure vessel are scattered, **it was found that the maximum effective dose at the site boundary due to the scattering of radioactive materials generated by the nuclear reactor would be 0.04mSv. This is well below the accident standard of 5mSv in the safety assessment of ordinary commercial power reactors.**

3-3-2. Based on (3-3-1), measures to control the release of radioactive materials

- In the case that a large opening forms in the containment vessel as in the worst case scenario (3-3-1), **an effective course of action would be to stop filling the containment vessel with nitrogen, thereby suppressing the extrusion of radioactive materials.**
- However, since it is difficult to directly observe the deterioration of the support function of the pedestal and the existence of any openings, it was decided that **the procedure for stopping the nitrogen filling would be proactively established in the operation management document based on the implementation plan**, and any future measures would be taken based on this.
- In particular, if an earthquake with a seismic intensity of shindo 6- or more occurs, or if the dust concentration in the containment vessel increases, nitrogen filling will be stopped. After that, nitrogen filling will only resume once it is confirmed that the dust concentration in the containment vessel is the same as before the event.

The above results of TEPCO's consideration are evaluated as valid by the Nuclear Regulation Authority.

4. Research and development of the Nuclear Regulation Authority on fuel debris

① Domestic research

(1) Safety research project related to decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station

- Research evaluating the criticality control and dose when criticality is exceeded in order to confirm safety during fuel debris removal work
- Development of a code that can evaluate the formation of fuel debris

(2) Research project for advanced regulations related to the release of radioactive materials in the event of a severe accident

- Investigation and research on safety concerns related to hydrogen leakage behavior, core dropping, sedimentation, loss of reinforced concrete frame structure, chemical reaction between gaseous organic matter and iodine, etc.

② Joint research with OECD/NEA (FACE project)

- Research on the progression of the Fukushima Daiichi Nuclear Power Station accident and the behavior of the related nuclear fission products as well as the explosive behavior of hydrogen
- Research on characterization of particles containing uranium and future fuel debris analysis technology for decontamination and decommissioning