Phase: **Action**

Decommissioning Process **"Contaminated Water Management"**
Investigation Subject **"Water treatment"**
Issue **"Efficient and effective water treatment"**

Needs

1. Cleaning up contaminated water

Contaminated Water Management：【Mid】

Desired state and reasons for it

- At present, contaminated water generated in the reactor building and the turbine building is cleaned up through the "cesium adsorption apparatus" to remove cesium and strontium, the "desalination apparatus" to separate salt, and the "multi-nuclide removal system (ALPS)" to remove nuclides other than tritium. It is desirable that this clean-up process can be carried out efficiently and effectively (economically).
- Since some of the ALPS treated water contains nuclides other than tritium that exceed the announcement density limit, it is also desirable to be able to remove such nuclides efficiently and effectively (economically).
- In investigating an efficient and effective (and economical) removal method, it is desirable to take into account the reduction of the amount of water treatment secondary waste generated and the ease of volume reduction and solidification treatment.
- It is also desirable to develop measures taking into consideration a debris retrieval and dismantling method to be used in the future. It is necessary to be noted that the properties of contaminated water may also change as the contamination source changes through debris retrieval.

Current state against ideal

- Except for the Unit 1-3 reactor buildings, the main process building, and the high-temperature incinerator building, the treatment of building retained water was completed in 2020. It is aimed to reduce the retained water level in the reactor building by half from the end of 2020 during the period from FY2022 to FY24. In the Unit 2 reactor building, the water level was carefully lowered while monitoring parameters such as PCV pressure and dust concentration, and reached the target water level of T.P.-2,800 in March 2022.
- The target nuclides to be measured and evaluated before ocean discharge of ALPS treated water are selected from 29 nuclides by combining inventory evaluation, actual measured data of nuclide concentrations in building retained water, etc., and consideration of physical and chemical properties of nuclides.
- On the other hand, the quality of contaminated water at the time of fuel debris removal, which will be in full swing in the future, will not be clear until the actual removal begins. It is necessary to set equipment specifications conservatively, including the presence of colloidal α-ray emitting nuclides, which are difficult to remove.
- Therefore, it is considered useful to continue testing with contaminated water that remains in existing buildings, expand knowledge of candidate removal methods, and continue to develop technologies

- Regarding secondary waste treatment technology, development of removal technology that can handle colloidal alpha-ray emitting nuclides in addition to soluble alpha-ray emitting nuclides, preparation for tests using contaminated water that remains in the buildings, and development of secondary waste treatment technology are being carried out.

Issues to be resolved

- The water treatment process generates water treatment secondary waste. It is necessary to develop a method to reduce the amount of such waste. In addition, it is necessary to develop a water treatment method that facilitates solidification process.
- The running cost of adsorbents has become an issue, and the development of better adsorbents is desired. In particular, at present the lifetime of adsorbents for iodine is three to four times shorter than that of adsorbents for other nuclides. Another problem is that it is difficult to select adsorbents for iodine because iodine takes various chemical forms.
- The plan is to reduce the amount of stagnant water in the reactor building between FY2022 and FY2024 to about half of what it was at the end of 2020, and to "lower the water level after confirming the properties of the stagnant water in the R／B", and "design and install equipment for removing alpha-nuclides contained in the stagnant water, after understanding their properties. The issue to be addressed is investigation of specific methods for separating and removing alpha-nuclides contained in stagnant water.
- Considering during debris retrieval (especially during processing), the nature of contaminated water (nuclides, chemical forms, etc.) is likely to change significantly from the current state, it is desirable to have a water treatment technology (soluble alpha-nuclides removing technology, etc.).
- In particular, it is desirable to investigate and develop a technology for removing radionuclides that exceed the treatment capacity of the ALPS.
- In investigating water treatment facilities for fuel debris retrieval, it is important to investigate an overall picture of how to share functions with the existing treatment facilities for building retained water (SARRY, ALPS, etc.) to create an appropriate configuration.
- During fuel debris retrieval, contaminated water containing a large amount of fine particles is generated due to cutting and other processing, and the α-nuclides contained in the fuel debris may exist in various forms, including fine particles, ions, and colloids. Since the water quality of such contaminated water depends on the method of cutting and other processing, it is difficult to estimate the water quality when the fuel debris retrieval method has not been determined. Thus, issue is created such as the water treatment system during fuel debris retrieval must have a complex equipment configuration to accommodate a wide range of water quality and various forms of α-nuclides.

2. Effectively treating contaminated water with high salinity

Contaminated Water Management： 【Short】

Desired state and reasons for it

- In the clean-up process of contaminated water, salt is separated in a "desalination plant", resulting in generation of high-salinity contaminated water. It is desirable to be able to treat it efficiently and effectively (economically).

Current state against ideal

- Since it is difficult to easily treat the untreated water in the tanks (concentrated liquid) with existing water treatment facilities, it is planned to investigate a treatment policy, etc., and then conduct treatment.

Issues to be resolved

- High-salinity contaminated water contains a large amount of Na and Cl ions, which reduce the adsorption performance of zeolites, etc. Therefore, it is necessary to develop an efficient adsorbent.

3. Optimizing the water treatment system for future improvement of the water treatment environment

Contaminated Water Management：【Mid】

Desired state and reasons for it

- It is desirable to establish an optimal water treatment system with an eye to the future(fuel debris retrieval process and long-term work).

Current state against ideal

- The situation will change drastically in the future such as SARRY, ALPS, and cooling water will no longer be needed, and the amount of groundwater inflow will be almost zero.

Issues to be resolved

- It is necessary to investigate the optimal water treatment system for such a situation. In this case, it is important to make the system optimal and efficient in view of safety improvement, cost reduction, and waste generation reduction, etc.

4. Efficiently collecting and treating sludge remaining in tanks and buildings with remote control technology

Contaminated Water Management：【Short】

Desired state and reasons for it

- Sludges, etc. remain at the bottom inside the tank and the building where are dried up, and should be collected quickly and efficiently.
- Quick collection will help prevent spills and dust scattering in the event of a tsunami.

Current state against ideal

- Currently, the basement floors of the main process building and the high-temperature incinerator building store building retained water, though TEPCO has set a goal of lowering the water level from FY2024 to expose the floor surface in the buildings. To achieve this, countermeasures against high-dose zeolite sandbags installed in the basement floors of the main process building and the high-temperature incinerator building, and the design of a temporary storage facility for stagnant water to replace storage in the basement floors, are underway.
- The temporary storage facility will take over the functions of receiving the retained water from the buildings, buffering the retained water for stable operation of the cesium adsorption equipment (KURION, SARRY, and SARRY II), averaging the concentration of the retained water in

each building, and settling and separating sludges. This facility will be installed on the fourth floor of the main process building.

- In the basement floors of both the main process building and the high-temperature incinerator building, zeolite sandbags that were installed soon after the accident exist in a high-dose state, and the maximum surface dose from the sandbags is approximately 4,400 mSv／h, an extremely high dose, and activated carbon sandbags are also known to exist.
- When the floor surface is exposed in these basement floors, it is anticipated that the loss of water shielding will result in a significant increase in radiation dose for the openings in the ground floor as well.
- Currently, a method of recovering these zeolite sandbags is being investigated.

Issues to be resolved

- It would be good to be able to not only efficiently collect but also decontaminate and incinerate the collected materials. For example, they could be achieved by remotely spreading resin or strippable paint, etc. on the floor and peeling off. In this case, the spraying agent such as resin needs to be radiation resistant. In addition, care must be taken to avoid collapsing waterways due to the spread of resin or other matter.
- Since the sludge contains high concentrations of Cs-137, a removal measure needs to be considered from the viewpoint of measures to reduce worker exposure doses, maintainability, and secondary waste.

Relevant Issues

- CWM-101 “Understanding current status of contamination source”
- CWM-102 “Understanding current status of underground and buildings”
- CWM-201 “Underground and buildings water level control”
- CWM-202 “Ensuring structural integrity”
- CWM-302 “Measuring alpha and difficult-to-measure nuclides”
- PDR-101 “Characterization”
- PDR-102 “Waste strategy”