Phase: **Design**

Decommissioning Process **"Contaminated Water Management"**
Investigation Subject **"Ground water and contaminated water management"**
Issue **"Controlling water level of underground and buildings"**

Needs

1. Implementing water stoppage of the building

Contaminated Water Management：【Mid】

Desired state and reasons for it

- At present, contaminated water is increasing due to the fact that groundwater flowing from the mountain side to the sea side flows into the reactor building, etc. and mixes with water containing radioactive material remaining in the building, etc. In order to prevent and control the increase of contaminated water, it is desirable to stop the water flow into the building (to block the groundwater inflowing parts).
- To prevent the increase of contaminated water, the ultimate goal is to stop all water flowing into the building.
- It is desirable to maintain a constant environment in the building over the long term by controlling the underground and building water levels.
- It is assumed that water splays will be used to prevent the scattering of crushed fragments, fumes, etc. during debris retrieval. For this reason, it is desirable to prevent the outflow from the building in order to avoid secondary leakage and prevent the contaminated area from expanding.

Current state against ideal

- The area around the building has high radiation dose and the location of groundwater inflow has not been identified.
- Water stoppage work inside the torus room will be done remotely, but robots are unable to enter narrow spaces such as penetrations where inflow is expected and cannot be seen clearly even by using light.
- In addition to rainwater inflow countermeasures by facing around Units 1-4, it is being investigated on water stoppage measures (filling, ground improvement, etc.) for building penetrations (piping, etc.) and gap ends between buildings as local water stoppage measure for Unit 3.

Issues to be resolved

- Assuming information on the location, size, shape, and characteristics of the surrounding area of inflow and so on is obtained, it is necessary to have technologies that can appropriately stop the water based on the information.
- On the other hand, since there is a possibility that sufficient information on the inflow location cannot be obtained, it is also necessary to develop a water stoppage technology that can be applied even when the inflow location and its characteristics cannot be identified.
- As for water stoppage work inside the torus room, even if an inflow location is found and blocked, the same water stoppage work will be required permanently because the water will flow in from another hole. On the other hand, as for water stoppage work outside the building, it can

be an option to enclose the entire building, but it has difficulty to stop the water flow even into the bottom of the reactor building.

2. Implementing water stoppage of the inter-building gap

Contaminated Water Management：【Mid】

Desired state and reasons for it

- An inter-building gap is a gap between the outer walls created when buildings around the reactor building are constructed adjacent to each other. and penetrations such as piping are present (see Figure).
- The inflow of contaminated water is also assumed to occur between the reactor building and the turbine building. This penetration of the gap between buildings is considered to be one of the main causes of groundwater inflow into the buildings. It is desirable to be able to implement local water sealing measures.

Current state against ideal

- The inside of the building has a high radiation dose rate, and the inflow point has not been identified.
- In addition to rainwater inflow countermeasures by facing around Units 1-4, it is being investigated on water stoppage measures (filling, ground improvement, etc.) for building penetrations (piping, etc.) and gap ends between buildings as local water stoppage measure for Unit 3.
- Specifically, a measure is being considered to construct a watertight section by drilling a borehole at the edge of the gap and filling it with mortar or other materials. A plan is being developed to test the construction method and materials in Units 5 and 6, and then expand to Units 3 and others while coordinating with other decommissioning work.

Issues to be resolved

- Assuming information on the location, size, shape, and characteristics of the surrounding area of inflow and so on is obtained, it is necessary to have technologies that can appropriately stop the water based on the information.
- On the other hand, since there is a possibility that sufficient information on the inflow location cannot be obtained, it is also necessary to develop a water stoppage technology that can be applied even when the inflow location and its characteristics cannot be identified.

3. Reducing the increase of contaminated water

Contaminated Water Management：【Mid】

Desired state and reasons for it

- In the current decommissioning process, contaminated water treatment accounts for most of the cost. In order to reduce this cost, it is desirable to minimize the increasing amount of contaminated water.
- In addition, if the area for placing contaminated water storage tanks and treated water storage tanks can be reduced, it will be easier to secure more work space for future fuel debris retrieval.

Current state against ideal

- The multilayered contaminated water countermeasures, such as the land-side impermeable wall and sub-drainage system, have made it possible to stably manage the groundwater level around the reactor buildings at a low level. In addition, repair of damaged parts of the building roofs and facing of the premises have suppressed the increase in the amount of contaminated water generated during rainfall. As a result, the amount of contaminated water generated has been reduced from approximately 490 m3／day (FY 2015) before the measures were taken to approximately 130 m3／day (FY 2021) and to about 90 m3／day (FY2022). *However, the amount of rainfall in FY2022 was lower than in previous years.

- In order to reduce the emissions to less than 100 m3／day by the end of 2025 and further to approximately 50-70 m3／day by the end of FY2028, roof repairs and expansion of the facing area are underway while coordinating interference with other decommissioning work and other activities.
- It is possible to reduce the inflow amount by reducing the difference between the stagnant water level and the groundwater level. It should be noted, however, that reducing the difference in water levels increases the risk of contaminated water outflowing to the surrounding are of the building.
- The outflow of contaminated water is an event that must be avoided. Currently, the water level of the sub-drain is currently maintained at about 800mm above the water level in the building, while allowing for some inflow.
- In the future, it is planned to “continue maintenance and management operations of the groundwater bypass／sub-drainage／land-side impermeable wall to stably manage groundwater around the buildings at low levels,” and “pave the site inside the land-side impermeable wall (mountain side) and repair the damaged roof of the buildings, as a measure to prevent rainwater infiltration.

Issues to be resolved

- It is necessary to establish a system that can cope with a sudden increase in groundwater level during heavy rain.
- It is necessary to investigate an aging management and maintenance system for frozen soil walls and an alternative measure to frozen soil walls. In particular, it is necessary to investigate cost effective alternatives to frozen soil walls. In addition, to maintain the effectiveness of contaminated water countermeasures over the medium to long term, it is necessary to ensure periodic inspection and renewal of each facility, including sub-drainage facilities and existing water treatment facilities (SARRY, ALPS, etc.). To this end, it is necessary to strengthen the system for monitoring and early restoration measures, organize procurement arrangements for spare and alternative equipment for stable operation, and proceed with maintenance and management, and facility renewal in planned manner, while assuming various risks such as deterioration of equipment functions with aging, metal fatigue caused by traffic loads, and damage to piping caused by natural disasters.
- In view of the fact that it is almost impossible to achieve “complete water stoppage” meaning “a zero increase in contaminated water”, the description here aims to “reduce the increase in contaminated water to the extent possible”, rather than complete water stoppage.
- Issues in actual work are “constraints in paving the site (including radiation environment in the work area and removal of existing equipment)” and “constraints in rain water control work of the building (including removing existing equipment and closing method of contaminated pipes, etc.)”.

4. Managing contaminated water migration into groundwater

Contaminated Water Management：【Mid】

Desired state and reasons for it

- While the concentrations in the stagnant water decreased, the concentrations of Sr-90 and H-3 in the groundwater did not decrease much and sometimes exceeded the concentrations in the stagnant water. Since it is important to reduce the risk of leaking to the environment, it is desirable to understand the dynamics of radionuclides in groundwater in shallow ground and to develop diffusion control technology.
- It is also desirable to establish measures considering future debris retrieval and dismantling methods. It should be noted that as the contamination source changes through debris retrieval, the properties of the contaminated water may also change.

Current state against ideal

- Groundwater monitoring has been conducted, but the precise distribution of groundwater levels and radioactive material concentrations have not yet been understood.

Issues to be resolved

- In order to deal with groundwater and contaminated water in a rational and systematic manner, it is necessary to understand their behaviors as a whole.
- In order to evaluate the migration of radionuclides contained in the soil around the building, it is necessary to understand the groundwater behavior around the building.
- Then, it is desirable to have a technology that can manage groundwater behavior.

Relevant Issues

- CWM-102 “Understanding current status of underground and buildings”
- CWM-301 “Efficient and effective water treatment”