Phase: **Design**

Decommissioning Process **"Transport/Storing/Storage (including Wastes containing Alpha Nuclides originating from Fuels)"**
Investigation Subject **"Maintaining stabilized condition"**
Issue **"Design of canister specifications"**

Needs

1. Understanding water contamination by materials dissolved from debris and its impact on storage canisters

Transport/Storing/Storage：【Mid】

Desired state and reasons for it

- Regarding the influential substances that are assumed to be contained in fuel debris, it is desirable to have data and evaluation methods on factors that affect safety during storing.
- It is desirable to organize the fundamental information to investigate on the feasibility of storing of fuel debris (e.g., parameters related to nuclide behavior in safety assessment).

Current state against ideal

- R&D is being conducted to grasp the properties of fuel debris. In addition, data on the properties of the fuel debris is expected to be expanded in the future, as test retrieval of the fuel debris began in September 2024.
- Although not fuel debris, the feasibility of treatment of ALPS slurry dehydrate on a real scale and the corrosion resistance of candidate storage canister materials are being investigated.

Issues to be resolved

- It is necessary to obtain knowledge of the chemical substances contained in fuel debris and to expand the data.
- In order to evaluate the degradation of the storage canisters, it is necessary to evaluate the impact of degradation, corrosion, etc. on the storage canisters in the transfer and storage environment.

2. Establishing an evaluation method necessary for safety assessment of the transfer and storing system

Transport/Storing/Storage：【Long 1】

Desired state and reasons for it

- In the previous technology development, verification was conducted mainly by elemental tests from the viewpoint of summarizing the basic design of the storage canister and the transfer and storing system, but verification as a system is necessary.
- In the design of a transfer and storing system, it is necessary to clarify the division of safety functions and their requirements.

- In order to conduct safe and rational operations from packaging to storing, it is necessary to analyze and evaluate the throughput, risk, and facility rationality of each process and optimize them.
- Planning, conducting, and evaluating a storage canister structural verification test should be proceeded, resulting in reflecting in the storage canister design.

Current state against ideal

- The flow of waste from generation through storage, sorting, volume reduction, stabilization, and other treatment to long-term storage or disposal is organized, and the concepts and decision indicators that serve as criteria for selecting and narrowing down options are investigated.

Issues to be resolved

- With regard to the storage canister design specifications obtained from elemental tests for each part, it is necessary to verify the feasibility of the storage canister as a whole, taking into account its operability and other factors.
- Since a variety of information is required to select and narrow down the options, it is necessary, by utilizing the results of the organization of such information, to proceed with the organization of the information in cross-sectoral manner.

3. Providing shielding, heat removal, sealing, and criticality prevention, for storage canisters

Transport/Storing/Storage：【Mid】

Desired state and reasons for it

- If the storage canister is made lighter, it is necessary to shield it not only with the shielding function of the storage canister, but also with peripheral equipment and facilities.
- In addition to the natural heat dissipation from the storage canister, by the baskets such as transfer cask, etc., air conditioning in the facility, and other means, the ambient temperature environment should be ensured.
- From the viewpoint of the increase in internal pressure due to hydrogen generation, etc., it is necessary to use the air sealing function of the transfer cask, instead of sealing the storage canister, only to prevent excessive environmental release of fuel debris.
- It is desirable to keep the storage canister subcritical on its own and maximize the size of its body as large as possible from the viewpoint of containing.
- It is necessary to be designed considering the different sizes and properties of the fuel debris to be stored (lump, granular, powder, sludge／sludge).

Current state against ideal

- By FY2022, as the basic specifications of the storage canister, the overall length in consideration of ease of handling, inner diameter, material, and lid structure in consideration of work efficiency and subcriticality maintenance, were established, and the demonstration of the integrity was conducted through tests.
- By FY2022 a realistic and reasonable prediction method for the amount of hydrogen generated from fuel debris stored in the unit canister was investigated, and a venting mechanism for hydrogen release installed on the lid of the storage canister was investigated using that prediction method.

- In addition, an efficient drying system and conditions for fuel debris packaged in the unit can were investigated, and preparations for tests to investigate and verify the behavior of powdered fuel debris in the storage canister were carried out by FY2023.
- With reference to the results of the above investigations, the following issues are also being investigated: the specifics of the storage canisters for storing and the first storing facility that will be required for the gradual expansion of the scale of retrieval, the investigation of the transfer and storing process for further expansion of the scale of retrieval, the survey of storing technologies and formats and narrowing down the candidates, the treatment required before storing fuel debris, the transfer method and route to the storing site.

Issues to be resolved

- Since it is necessary to carry out the handling of unit and storage canisters safely and reliably and continuously using remote equipment, a mock-up of the anticipated work should be made at early stage of the detailed design process.
- It is also important to utilize data such as the amount of hydrogen generation collected and accumulated during the test retrieval and the retrieval on a gradually expanded scale, as well as knowledge and experience on the handling of fuel debris from transfer to storing.

4. Developing a method for transferring and storing fuel debris using storage canister

Transport/Storing/Storage：【Mid】

Desired state and reasons for it

- Dry storing, which can reduce the amount of water causing hydrogen generation and corrosion, is rational, and therefore it is required to establish a fuel debris drying technology.
- It is required to reflect allocation of added building, etc. where the handling equipment is installed and the operability of the actual equipment.
- It is necessary to safely store fuel debris under the environment such as the temperature and chloride ion concentration assumed for the storage canister.

Current state against ideal

- By FY2022, safe transfer conditions were established, considering the accumulation of hydrogen gas in the transfer container.
- By FY2022, development of applicable and efficient drying technology for fuel debris stored in unit canister, and investigation of drying systems using that technology were conducted.
- In addition to granular and lumpy fuel debris, which had been the subject of previous investigation, investigation on safe, reliable, and rational methods for storing powdered and sludge fuel debris, which is investigated to be recovered in gas management systems and cooling water circulation systems, as well as on the necessary equipment and facilities, is initiated.

Issues to be resolved

- Since the knowledge on the properties of fuel debris is limited, equipment and facilities are designed conservatively assuming the properties of fuel debris, and therefore, it is necessary to proceed with rationalization by utilizing various measurement data such as the amount of hydrogen generation and fuel debris properties as well as the knowledge and experience on the handling of fuel debris in the operations from the acceptance to the storage of the on-site transfer container during the test retrieval and the retrieval gradually expanded its scale in

designing equipment and facilities for storage, transfer, and storage at the time of further expansion of the scale of retrieval.

Relevant Issues

- TSR-101 “Characterization”
- TSR-201 “Technology development to assess and manage storage container integrity”
- TSR-202 “Understanding hydrogen generation behavior”
- TSR-205 “Criticality control”
- TSR-301 “Transport/storing/storage method investigation”