Phase: **Design**

Decommissioning Process **"Transport/Storing/Storage (including Wastes containing Alpha Nuclides originating from Fuels)"**
Investigation Subject **"Maintaining stabilized condition"**
Issue **"Understanding the behavior of hydrogen generation"**

Needs

1. Managing hydrogen gas generated in the fuel debris storage canisters and controlling the corrosion resistance

Desired state and reasons for it

- It is desirable to understand what physical phenomena (e.g., radiolysis of coolant) produce hydrogen in the storage canister. In addition, under complex conditions (reaction field, irradiation field) that are scientifically unexplained, a deeper scientific elucidation of the mechanism is desirable for regulatory compliance.
- It is desirable that event progression scenarios from hydrogen generation to combustion are comprehensively investigated, and management policies and facilities based on these scenarios are defined. In addition, it is desirable to have an evaluation model or experimental findings that can evaluate the effectiveness of the management policies and facilities investigated in preventing hydrogen combustion.
- In order to achieve enclosure and stable storing, measures against hydrogen generation and corrosion inside the container (canisters, etc. for storing) should be investigated to minimize the management burden and cost during storing, while eliminating venting mechanisms, etc. as much as possible.

Current state against ideal

- For mass and granular fuel debris, in the Government-led R&D Program on Decommissioning, Contaminated Water and Treated Water Management up to FY2023, a realistic and rational hydrogen generation prediction method from fuel debris in storage canister has been investigated, and using this predicted hydrogen generation, the vent mechanism for hydrogen gas release installed in the canister lid has been investigated and safe transferring conditions have been established by considering hydrogen gas accumulation in the transferring containers.
- For fuel debris in the form of slurry／sludge, in the Government-led R&D Program on Decommissioning, Contaminated Water and Treated Water Management from FY2021, the drying method and hydrogen gas generation amount evaluation method, hydrogen gas release characteristics, and the hydrogen gas behavior from transferring to storing have been investigated and evaluated through desktop studies. In addition, from FY2023, considering the investigations in the Government-led R&D Program on Decommissioning, Contaminated Water and Treated Water Management as well as in the TEPCO and knowledge, etc. of fuel debris characteristics and PCV inside conditions, the evaluation method for hydrogen generation amount and the desktop study results of hydrogen gas release characteristics are being confirmed through element tests, etc. Parallel to this, the filter lifespan installed in storage canister has also been confirmed through element tests, etc.

- In addition, it was launched to estimate the environment inside storing containers during fuel debris storing, and to investigate corrosion generation and progression models that take into account the types of steel used in the storing containers, the characteristics of the fuel debris, and the radiation conditions..

Issues to be resolved

- Since information on fuel debris (properties, source strength, etc.) is limited at this time, it is necessary to constantly incorporate the latest information on fuel debris and review hydrogen gas management and corrosion resistance management methods as necessary.
- In order to realize stable storing, technologies are required to take measures against corrosion and hydrogen generation (e.g., drying of fuel debris, recombination and absorption of hydrogen, confirmation and evaluation that hydrogen concentration can be kept below the flammable limit concentration of 4 vol%, etc.).

2. Advancing the radiolysis behavior evaluation

Desired state and reasons for it

- It is desirable that the phenomena model and parameters with large uncertainties are clarified in order to determine the priority of the advancing target. In addition, it is desirable that a deeper scientific mechanism is clarified for regulatory compliance under complex conditions (reaction field, irradiation field) that are scientifically unexplained.

Current state against ideal

- At this stage, it is clarified which parameters affect hydrogen generation by radiolysis.
- The G-values used for the PCV and other facilities on the 1F are different from those of general wastes, and are forced to be evaluated conservatively.
- Since the test retrieval of the fuel debris began in September 2024 and the retrieval of fuel debris samples was successful in November 2024 and April 2025. It is necessary to investigate obtaining data related to treatment and disposal, such as thermal properties and hydrogen generation from radiolysis of water, using the retrieved fuel debris.

Issues to be resolved

- It is desirable to properly evaluate G-values that are set excessively conservatively. In particular, the effects of the material and nuclide composition of the object, trace constituents in water, and water content on G-values should be developed, including basic data, to lead to appropriate G-value evaluation.

Relevant Issues

- TSR-101 “Characterization”
- TSR-201 “Technology development to assess and manage storage container integrity”
- TSR-204 “Design of canister specifications”
- TSR-301 “Transport/storing/storage method investigation”