

## Toward Decommissioning Nuclear Facilities and Managing Radioactive Waste

To maintain and develop its research and development (R&D) capabilities by strengthening the safety of its nuclear facilities and to ensure the steady implementation of back-end measures, the JAEA issues the “Medium- and Long-Term Management Plan of our Facilities” (issued on April 1, 2017, amended on April 1, 2022) as a comprehensive plan detailing the following three points:

- the selection and consolidation of facilities,
- safety measures, and
- the management of back-end issues.

In the plan, 89 nuclear facilities were chosen for decommissioning.

Among the large facilities, the JAEA applied for permission to proceed with the decommissioning of MONJU and the Tokai Reprocessing Plant (TRP) to the Nuclear Regulation Authority (NRA). The NRA granted permission for the decommissioning of MONJU on March 28, 2018, and for the decommissioning of TRP on June 13, 2018. The application to the NRA for permission of the decommissioning of the Uranium Enrichment Demonstration Plant is under process.

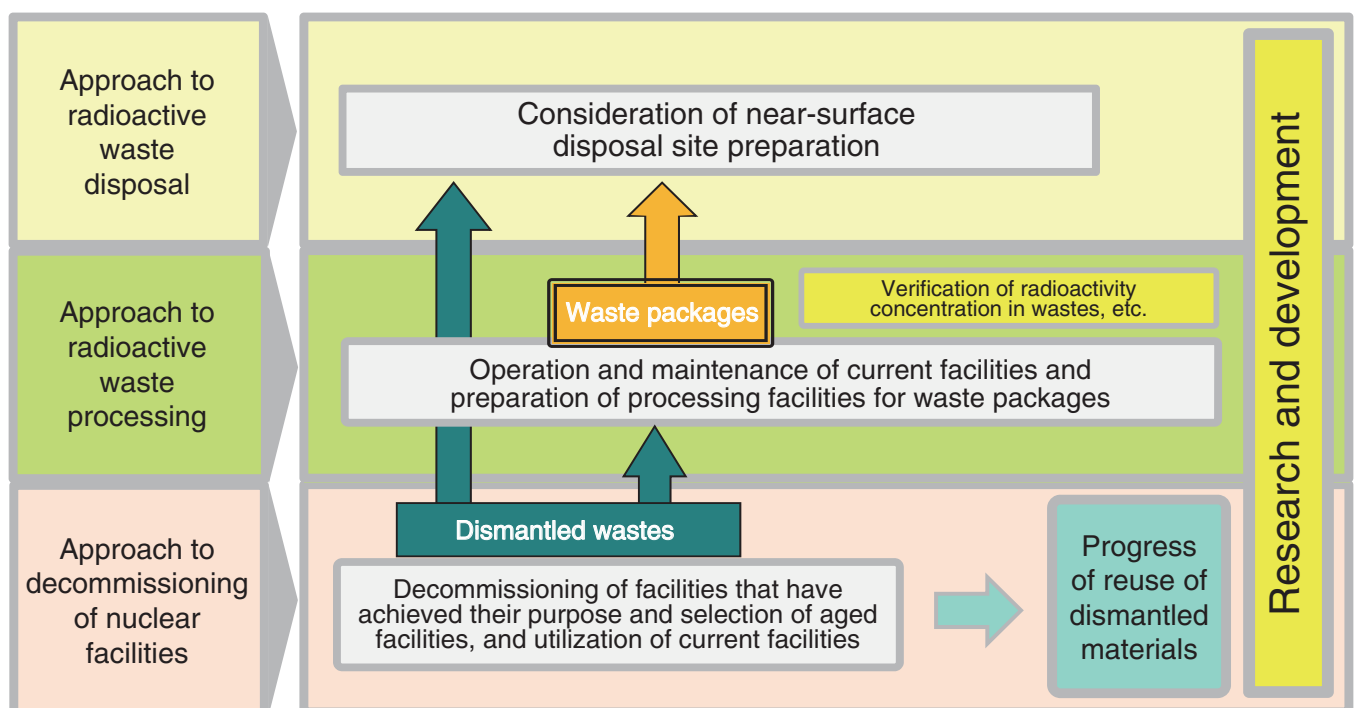
The implementation of back-end measures requires long-term prospects and policies, including those regarding the processing and disposal of radioactive waste; the decommissioning of TRP is expected to take approximately 70 years to complete. The JAEA, therefore, published a long-term prospect and policy for back-end measures, the “Back-end Roadmap”, on December 26, 2018.

To ensure the safe and appropriate nuclear facility decommissioning and radioactive waste management, it is

necessary to introduce new technologies and knowledge and to promote the development of technologies for advanced safety and cost reduction. Technologies for the safe and effective dismantling of nuclear facilities, minimization and stabilization of radioactive wastes, and disposal of radioactive wastes are under development (Fig.8-1). The proposed disposal project applies to low-level radioactive wastes from research facilities of universities, private organizations, and the JAEA facilities.

The TRP was approved for the decommissioning plan on June 13, 2018, and it has entered the decommissioning stage. In the TRP, as an effort to reduce the risk of facilities, the vitrification of the high-level liquid waste is being promoted with the primary focus on safety. The JAEA produced 13 vitrified bodies in FY2021 and also developed advanced vitrification techniques.

This chapter discusses the technical development results in the relevant fields: Research that contributes to the design study of trench disposal facilities for radioactive waste containing uranium (Topic 8-1), development of a stabilization treatment method for nuclear fuel material containing organic compounds (Topic 8-2), characterization of lead stabilized with alkali-activated material for developing a stable solidification technology for radioactive waste containing environmentally hazardous substances (Topic 8-3), and the development of a surface contamination removal technology using laser cleaning technology (Topic 8-4). It also introduces the decommissioning of a facility with a history of contamination due to a fire disaster in the controlled area (Topic 8-5) and the dismantling of a tank containing liquid with  $\alpha$  nuclides (Topic 8-6) as efforts for decommissioning nuclear facilities.



**Fig.8-1 Outline of low-level radioactive waste management**

R&D of the decommissioning of nuclear facilities and processing of radioactive wastes, including waste treatment and waste characterization, has been promoted.

## R&D to Improve the Reliability of Geological Disposal Technologies in Japan

Geological disposal is internationally recognized as the most practical method currently available for the long-term isolation of HLW, which is produced during the generation of nuclear power, from human environments. This critical issue must be approached sensibly by the present generation, and it will remain crucial regardless of any revision of the national nuclear energy policy.

In Japan, the spent fuel discharged from a nuclear reactor is reprocessed to extract reusable uranium and plutonium for power generation. The liquids separated from the spent fuel during chemical reprocessing are consolidated into a stable glass form. In accordance with the Japanese disposal policy, the vitrified waste is then encapsulated in a thick steel overpack, surrounded by highly compacted bentonite, and emplaced in a stable geological environment at a depth greater than 300 m below the surface (Fig.8-2).

R&D in relevant fields such as geoscience, repository engineering, and safety assessments of the disposal system are ongoing, as summarized in Fig.8-3, and these efforts are vital for improving their sound technical basis and get reflected in the implementation and regulatory activities.

The Horonobe Underground Research Center for sedimentary rock conducts R&D, including study on near-field system performance in geological environments (Topics 8-7 and 8-8).

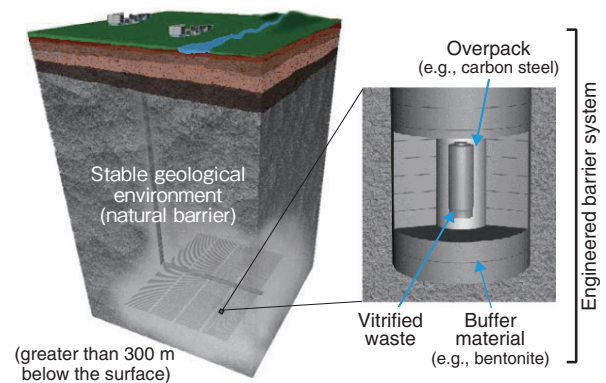
At the Tono Geoscience Center, the Toki Research Institute of Isotope Geology and Geochronology is engaged in a study on the long-term stability of the geological environment (Topic 8-9), while at the Mizunami Underground Research Laboratory, the underground facilities were backfilled and

surface facilities removed by January 16, 2022.

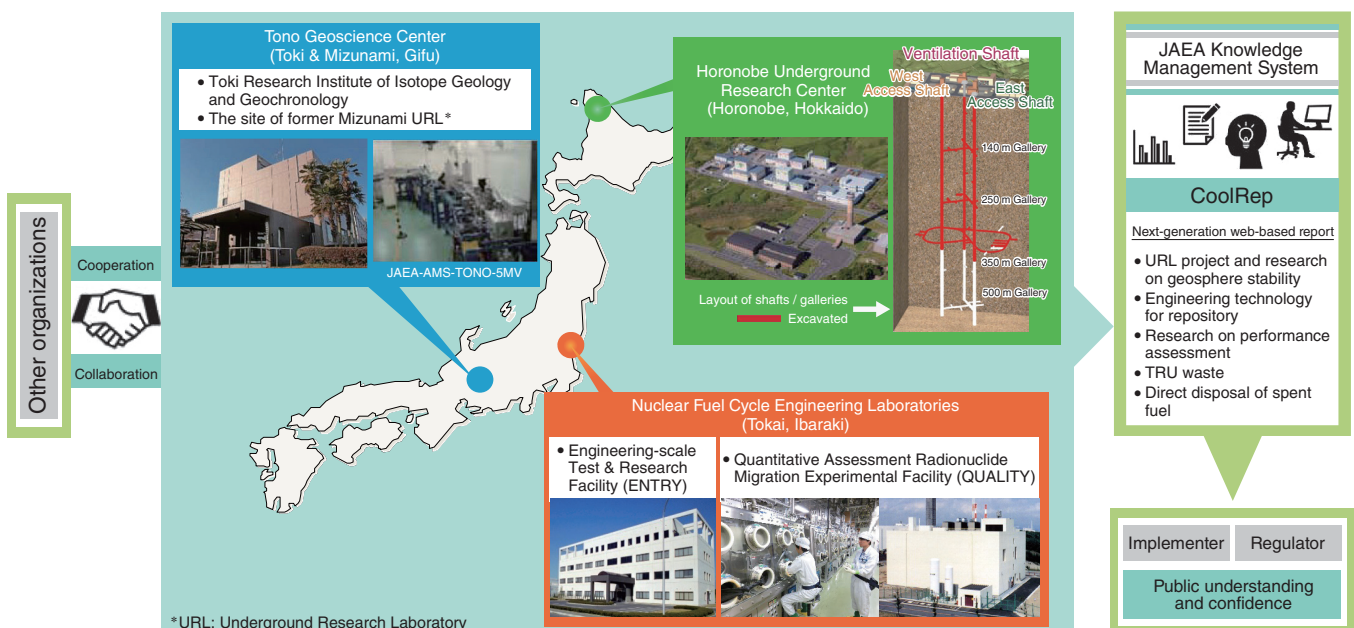
To expand further the knowledge on geological disposal, extensive studies are being conducted to assess the behavior of the engineered barrier system and the key processes constraining the release and migration of radionuclides (Topics 8-10 and 8-11). These studies use the data on long-term stability of geological environments and the data on geological environments obtained through geoscientific research at underground research laboratories.

Results of the R&D activities during Third Medium-/Long-Term Objectives period (FY2015–FY2021) have been summarized as a next-generation web-based report (CoolRep), which has been made available on the public website of the JAEA:

CoolRep: <https://kms1.jaea.go.jp/CoolRep/index.html> (Japanese site).



**Fig.8-2 Schematic view of the basic concept of the geological disposal of high-level waste**



**Fig.8-3 Structure of the JAEA R&D activities**