

## 2-1 R&D Supporting the Technology and Reliability of Geological Disposal in Japan

Radioactive waste occurs when we utilize nuclear power. In Japan, reprocessing is done to recover uranium and plutonium remaining in spent fuel from power generating reactors for recycling into useful fuel. The liquid remaining after such retrieval is vitrified to produce a chemically and physically stable glass monolith, which is high-level radioactive waste (hereafter, HLW). Radioactivity of HLW is high initially and lasts a long time. Therefore, HLW should be isolated from human environments for a long term. International consensus has been developed that HLW can be disposed of in stable deep geological environments (geological disposal). Waste glass inserted in an overpack (e.g. carbon steel) will be emplaced with a bentonite buffer at below 300m depth in the Japanese concepts (Fig.2-1).

To ensure safe implementation of geological disposal, R&D should be carried out in various fields, i.e. geoscientific research, engineering development and study of performance assessment (PA) of the geological disposal system. JAEA and its predecessor have conducted comprehensive R&D on geological disposal technology since the 1970's. In November 1999, we compiled its R&D achievements up to

that time into the second progress report (referred to "H12") and submitted it to the government. H12 presented the technical feasibility of geological disposal in Japan. The Specified Radioactive Waste Final Disposal Act (the "Act"), based on the technical achievements documented in H12, came into force in June 2000. Pursuant to the Act, the Nuclear Waste Management Organization of Japan (NUMO), with responsibility for implementing geological disposal of HLW, was established in October 2000 and the Japanese program of geological disposal moved into the implementation phase (Fig.2-1).

NUMO has defined a stepwise site selection procedure as required by the Act, and adopted a novel "volunteering" approach to siting. The stepwise site selection procedure starts with literature surveys of volunteer community areas to identify suitable Preliminary Investigation Areas (PIAs). PIAs will be investigated using surface-based techniques, including deep boreholes. Thereafter, Detailed Investigation Areas (DIAs) will be selected for more intensive characterization including studies by an underground research facility. This leads to selection of the repository site.

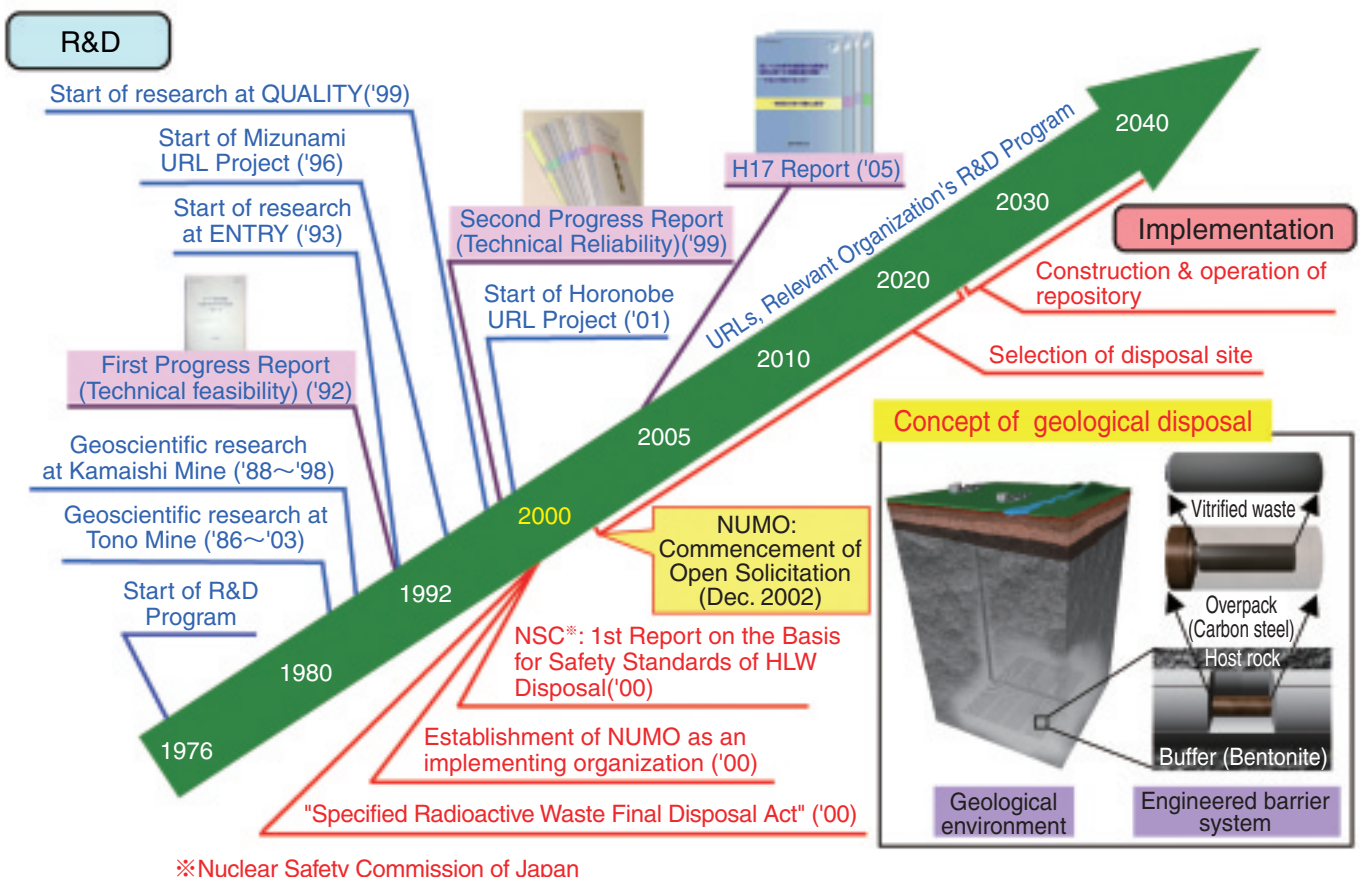


Fig.2-1 Milestones of HLW disposal program in Japan

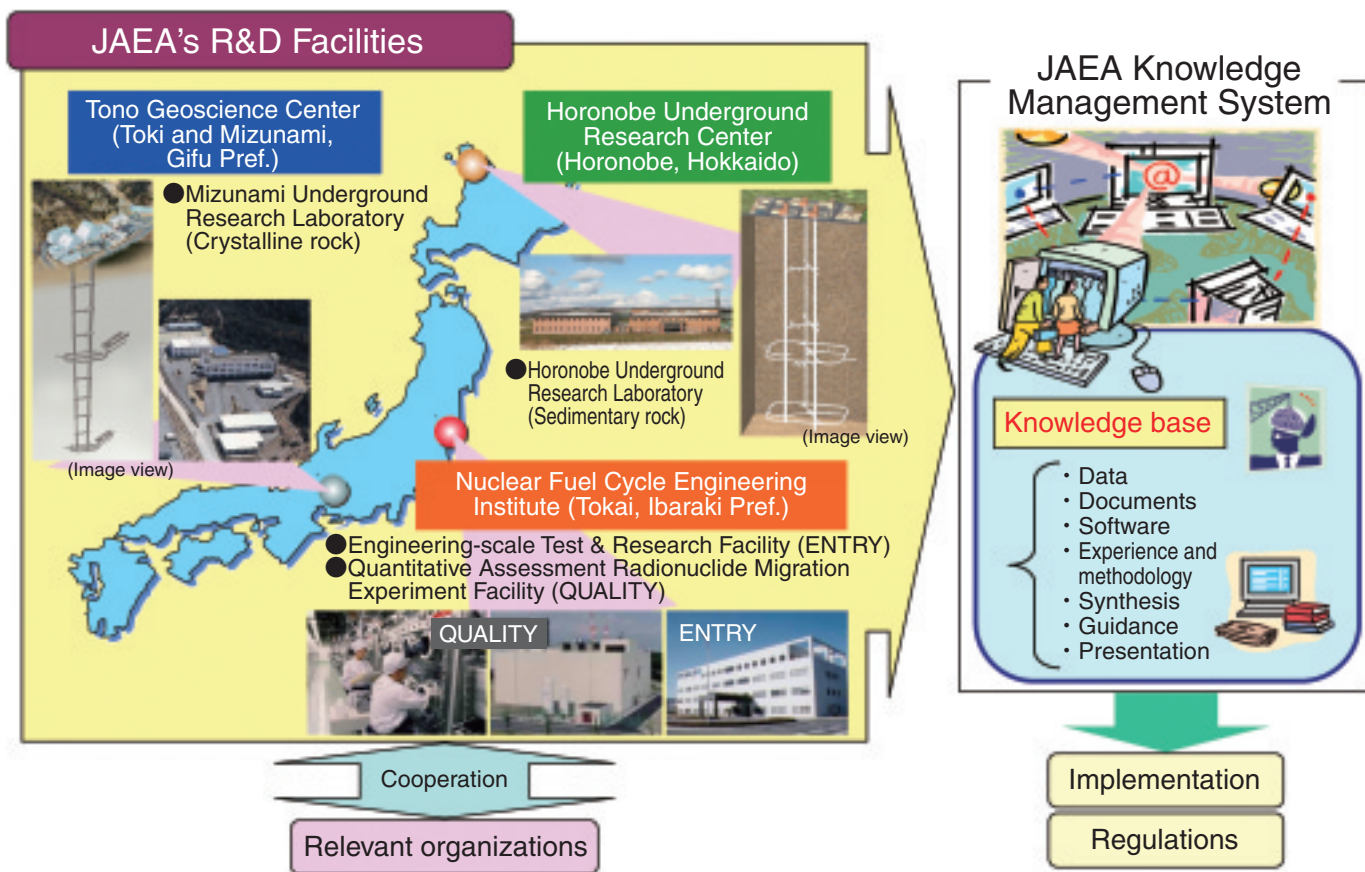


Fig.2-2 JAEA's R&D activities on geological disposal technology

The role of our R&D is to develop the technical basis for such implementation activities as well as the safety regulations with lead time. A particular our R&D activity in this implementation phase is to promote the projects of two Underground Research Laboratories (URLs): one at Mizunami city in crystalline rock and the other at Horonobe town in sedimentary rock (Fig.2-2). The URL programs are being conducted in three phases planned over a period of 20 years, i.e. investigations from the surface (Phase I; already finished), excavation of shafts and drifts (Phase II) and detailed investigations in the underground facility (Phase III). In each phase, the investigation and evaluation methodologies used will be iteratively improved and integrated as necessary, and the applicability of engineering technologies for the design and construction of an underground facility will be verified.

At the same time, we are conducting laboratory experimental studies at our Engineering-scale Test and Research Facility (ENTRY) and Quantitative Assessment Radionuclide Migration Experimental Facility (QUALITY) at Tokai village. ENTRY was designed for performing a series of relatively large-scale and non-radioactive experiments and PA of the multibarrier system supported by

extensive computer analysis. QUALITY was designed to obtain basic data concerning the chemical properties and migration behavior of radionuclides under geological disposal conditions. These studies are linked with the geological environment data obtained from the URLs.

Geological disposal of HLW will be a long term project of more than one hundred years. It is supported by vast quantities of information, data, experience, understanding, etc. – which can be defined broadly as “knowledge”. Management of knowledge is a very important issue for this long-term disposal program. We have initiated a project to develop the next generation of novel knowledge management tools utilizing advanced electronic information management technology.

In July 2005, a “Coordination Council for R&D on geological disposal” was established to develop wide ranging R&D which is being carried out by JAEA and ANRE (Agency for Natural Resources and Energy). In this council, JAEA and related R&D organizations have discussed their respective roles, and also a co-operation framework to integrate R&D results into knowledge base and have prepared a roadmap of R&D for the implementation of geological disposal.