R&D Supporting the Technology and Reliability of Geological Disposal in Japan

High-level radioactive waste (hereafter, HLW) is generated 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 finished is vitrified to produce a chemically and physically stable glass, which is HLW. International consensus has been reached that HLW can be disposed of in stable deep geological strata (geological disposal) so as to be isolated from human environments for a long term. Waste glass inserted in an over pack (e.g. carbon steel) with a bentonite buffer around that will be placed at a depth below 300 m in the Japanese proposal (Fig.2-1).

To initiate repository operation in the late 2030s, the Nuclear Waste Management Organization of Japan (NUMO), which has the responsibility for geological disposal of HLW, is now calling for municipalities to volunteer as candidate site areas and be surveyed, which is the first stage in the final disposal project.

Geological disposal of HLW will be a long term project of more than one hundred years from siting to construction, operation and closing. Therefore, continuous strengthening of the technical foundations of these activities is very important. To support such a national project technically, we have conducted research and development in various fields, e.g. geoscientific research, engineering development, and performance assessment (PA) of the geological disposal system.

A particular focus of our research and development activity at present involves projects at two Underground Research Laboratories (URLs) to establish techniques for characterizing the geological environment: one at Mizunami city in crystalline rock and the other at Horonobe town in sedimentary rock (Fig.2-2). The investigations from the surface (phase1) have been completed. The results from this phase of both URL projects were reported at an open symposium in September 2007. The research of the excavation phase is ongoing currently to verify and refine the results of phase1 such as methodology of investigation and modelling of geological environments. Research on geological phenomena such as faults and volcanic activities in order to evaluate the long-term stability of deep geological environments also has progressed (Topic 2-7, Topic 2-8).

At the same time, we are conducting laboratory experimental studies at the Tokai research center. Relatively large-scale and non-radioactive experiments, performance assessment of the multibarrier system supported by extensive computer analysis, and research to obtain basic data concerning the chemical properties and migration behavior of radionuclides under geological disposal conditions has been carried out. These studies are linked with the geological environment data obtained from URLs. In 2007, the data for long-term stability of overpack were complied (Topic 2-3) and "FepMatrix" was released on the Web to serve as an important supporting tool for scenario development in safety assessment (Topic 2-4).

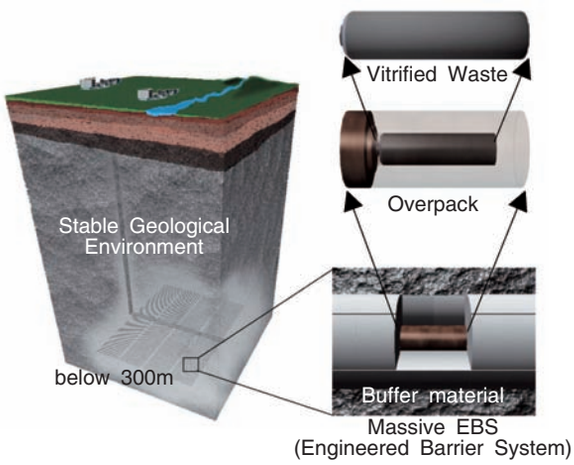

Fig.2-1 Basic Concept of HLW Disposal in Japan

Based on such research and development activities, we have conducted a project to develop the next generation novel knowledge management system (KMS) to systematically manage multiple lines of evidence and scientific results relevant to safety in the form of a knowledge base. The design of KMS was completed in March 2008. System integration is underway at present (Topic 2-1).

In April 2008, the basic policy and plan for implementation of geological disposal of HLW were revised by government. It was apparent that research and development organizations should contribute to understanding by the nation of these efforts through publicity on their research and development facilities by means such as URL. In this revision, the implementation schedule was also changed. We will make steady progress in improving technology and reliability of geological disposal in Japan, taking advantage of trends in business and planning our R&D to be optimally effective.

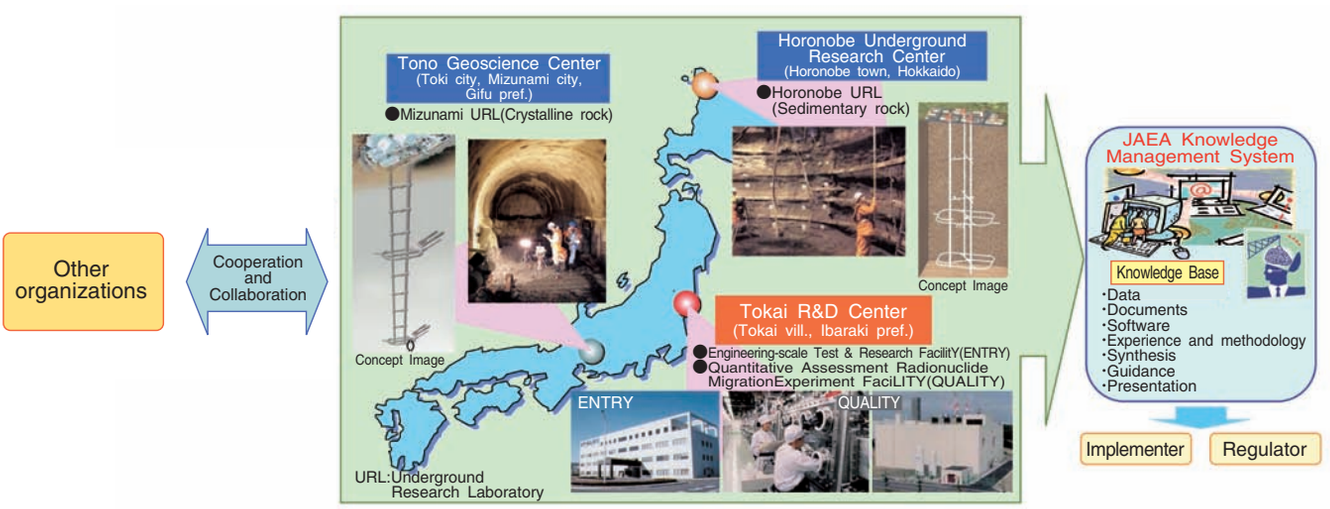

Fig.2-2 R&D Facilities