Current Status of R&D Activities and Future Plan and Role of JAEA's Two Generic URLs - 15356

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ABSTRACT

The Japan Atomic Energy Agency (JAEA) has promoted R&D on geological disposal technology contribute to the implementation and safety regulation for high-level radioactive waste (HLW) disposal. JAEA launched two purpose-built generic URL projects to cover the diversity of geological environments in Japan, in accordance with "Long-Term Program for Development and Utilization of Nuclear Energy" published in 1994 by the Japan Atomic Energy Commission. One is the Mizunami URL Project started in 1996. The Mizunami URL Project is a comprehensive geoscientific research project investigating the deep underground environment within crystalline rock at Mizunami City in Gifu Prefecture, central Japan. The other one is the Horonobe URL Project started in 2001. The Horonobe URL Project consists of two major research areas, geoscientific studies and R&D on geological disposal technology in the sedimentary rock environment at Horonobe Town in Hokkaido Prefecture, northern Japan. Both of the URL projects have been planned to proceed in three overlapping phases, "Phase I: Surface-based investigation", "Phase II: Construction" and "Phase III: Operation", with a total duration of about 20 years. Currently, the construction of research galleries in both of the Mizunami and the Horonobe URLs has been completed to 500 m and 350 m depths, respectively. R&D activities in Phase III are being conducted at both URLs. According to the latest five-year plan, announced in September 2014, JAEA will promote R&D activities in Phase III including study of the effects of long-term evolution of the geological environment on geological characteristics such as groundwater flow and chemistry for reducing the uncertainty inherent in the evaluation of the long-term stability of the geological environment. This has been a very critical issue for HLW geological disposal in Japan after the Great East Japan Earthquake in 2011. Furthermore, JAEA will contribute to international cooperation especially with countries having a similar geological environment such as those in the Circum-Pacific area, development of human resources and communication amongst stakeholders through the generic URL projects.

INTRODUCTION

Most North American and European countries promoting geological disposal program of high-level radioactive waste (HLW) are located in stable continental regions, whereas Japan is located in a tectonically active mobile belt and its geology and tectonics are very dynamic and complicated [1]. Furthermore, the Japanese public, in general, because of negative experiences engendered by Hiroshima and Nagasaki, have a more complex perception of nuclear power than the public in other countries. Moreover, the Fukushima Nuclear Power Plant (NPP) accident has increased the difficulty of acquiring public acceptance for siting of radioactive waste disposal facilities [2]. In this context, finding a way to attain an acceptance of the HLW geological disposal is probably a socio-political challenge. Therefore, technological and socio-political efforts to realize geological disposal in Japan can provide a lot of lessons

Fig. 1. Mizunami (left) and Horonobe (right) URL Sites.

and options to evaluate the geological environment and to examine siting processes or decision-making rules for countries planning HLW geological disposal in the future.

As mentioned above, Japan is located in the tectonically active Circum-Pacific mobile belt. The nature of this belt is evident in the topography and the geology of the Japanese Islands; the topography is mountainous and rugged, the islands are seismically active and volcanoes are numerous and volcanic rocks are widely distributed. The geological environment consists of many different rock types and geological structures and the geographic position of the islands plays an important role in controlling the movement of groundwater and other related phenomena [1]. Taking into consideration the complicated geological setting of Japan, in 1994, the Japan Atomic Energy Commission (JAEC) recommended that underground research laboratories (URLs) should be constructed at several places considering the characteristics and features of Japanese geology and other relevant factors in the "Long-term Program on Research, Development and Utilization on Nuclear Energy" (LTP)[3]. Based on this recommendation, the Japan Atomic Energy Agency (JAEA) launched two URL projects, the Mizunami URL project for investigating crystalline rock was launched in 1996 and, in 2001, the Horonobe URL project for investigating sedimentary rock was launched (Fig. 1).

This paper describes the current status of R&D activities, the future plans and expected roles of JAEA's two generic URLs to enhance confidence of geological disposal technology of HLW and to contribute to public understanding of geological disposal in Japan.

JAPANESE HLW DISPOSAL PROGRAM

In the Japanese program for nuclear power generation, the safe management of the resulting radioactive waste, particularly vitrified HLW arising from fuel reprocessing, has been a major concern and a focus of R&D since the late 1970s. According to the LTP published in 1994 [3], high-level radioactive liquid waste separated from spent nuclear fuel during chemical reprocessing will be solidified into a stable glass HLW form. The immobilized HLW is then stored for 30 to 50 years for cooling in an engineered facility at the surface and finally disposed of in a stable geological environment deep underground.

The Second Progress Report on R&D for the geological disposal of HLW (H12 report) [4] was published by Japan Nuclear Cycle Development Institute (JNC: now, JAEA) after two decades of R&D activities and concluded that HLW geological disposal in Japan is feasible and can be practically implemented at sites meeting certain geological stability requirements. The H12 Report technically supported the government decisions that formed the basis of "the Act on Final Disposal of Specified Radioactive

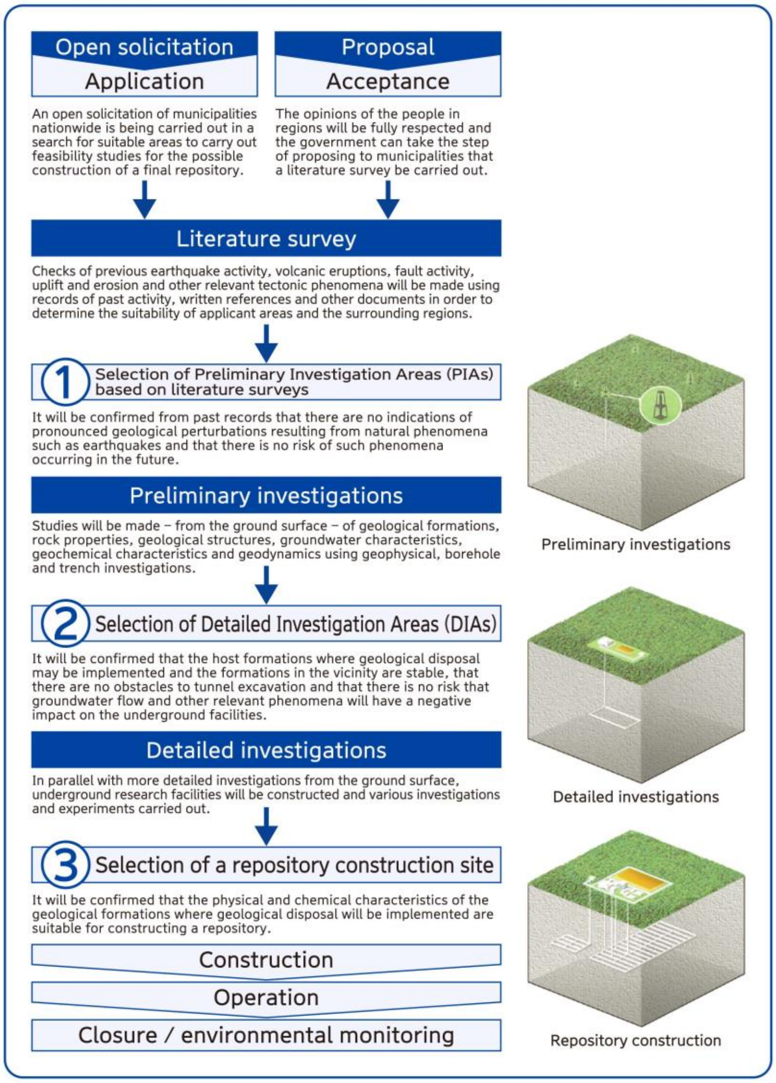

Fig. 2. Siting process for HLW geological disposal in Japan. [5]

Waste" (Final Disposal Act), which came into force in 2000. The Final Disposal Act specifies deep geological disposal of HLW at depths greater than 300 m from the surface, together with a stepwise site selection process in three stages. The Nuclear Waste Management Organization of Japan (NUMO) was established in October 2000, as an implementing organization authorized by the Final Disposal Act, with the mandate to conduct the project for the HLW geological disposal, and also to make a collection of the disposal fund from owners of nuclear power reactors. NUMO has been conducting open solicitation of municipalities nationwide since October 2002, seeking areas to carry out feasibility studies on the possible location of a final repository. After confirming that volcanic activity, active faults or other geological phenomena at the locations obtained through this solicitation process do not make them clearly unsuitable as sites for constructing a repository, site investigation and selection will then proceed following the three-stage process, the selection of Preliminary Investigation Areas (PIAs), the selection of Detailed Investigation Areas (DIAs) and the selection of a repository construction site [5] (Fig. 2).

The Final Disposal Act was revised in 2007 to include TRU waste for geological disposal: some types of long-lived, low heat-generating waste from fuel reprocessing and other processes in the nuclear fuel cycle. It is destined for geological disposal and thus fell within NUMO's mandate.

According to the currently “Specified Radioactive Waste Final Disposal Plan”, NUMO will start repository operation in late 2030s after the three step procedure of site selection. In January 2007, Toyo Town in Kochi Prefecture became the first municipality to officially make an application to the literature survey as a volunteer area. However, in April 2007, Toyo Town withdrew their application as a volunteer. Since then, no other volunteer municipality comes forward. In May 2013, the government of Japan started reviewing the siting process to ameliorate such a situation [6] and approved the new “strategic energy plan” in order to show to the public the basic direction of Japan’s energy policy after the Fukushima NPP accident under the Basic Act on Energy Policy in a Cabinet meeting in April 2014 [7]. In this plan, the government announced its intention to take more of the initiative in explaining the selection of candidate favorable disposal sites from a scientific viewpoint and to develop a mechanism for building public consensus.

OVERVIEW OF JAEA’S PURPOSE-BUILT GENERIC URL PROJECTS

The JAEC proposals for the LTP, published in 1994 and 2000, recommended that two or more URLs should be constructed, based on consideration of the range in characteristics of the geology of Japan. Furthermore, the URLs should serve not only as a place for scientific investigation, but also as a place for deepening public understanding of R&D activities related to the HLW geological disposal [3, 8]. On this basis, JAEA has initiated two purpose-built generic URL projects, the Mizunami URL Project for investigating crystalline rock and fresh groundwater conditions and the Horonobe URL Project for investigating sedimentary rock and saline groundwater conditions. Locations of the Mizunami and the Horonobe URLs are shown in Fig. 3.

These URL Projects were planned based on knowledge and experience obtained from early generic URL projects utilizing two pre-existing mines, the Tono Uranium Mine in sedimentary rock and the Kamaishi Iron Mine in crystalline rock. Both URLs are classified as purpose-built generic URLs, as described in the OECD/NEA report [9]. These URLs are distinct from any actual disposal facility, which will be selected by NUMO [3]. Furthermore, JAEA has promised not to transport any radioactive wastes into the URLs and not to use those in R&D activities in the URL Projects under agreements signed between the local governments and JAEA.

These URLs have the primary goals of applying and demonstrating geoscientific investigation methods, the disposal technology and the safety assessment methodology described in the H12 Report [5], in order to confirm their applicability to specific geological environments. Furthermore, the technology and methodology should be optimized through the actual application and the evaluation of the applicability for deep geological disposal on the basis of stepwise R&D activities carried out in the URLs and R&D activities in other JAEA facilities, *i.e.* the Engineering Scale Test and Research Facility (ENTRY) and the Quantitative Assessment Radionuclide Migration Experimental Facility (QUALITY) in the Nuclear Fuel Cycle Engineering Laboratories at Tokai (Fig. 3).

MIZUNAMI URL PROJECT

Overview and Progress to Date

The Mizunami URL (MIU) Project is a comprehensive research project investigating the deep underground environment within crystalline rock in Mizunami City, Gifu Prefecture, central Japan. The MIU Project consists of three overlapping phases: Surface-based Investigation phase (Phase I), Construction phase (Phase II), and Operation phase (Phase III), with a total duration of about 20 years. The overall project goals are to establish techniques for investigation, analysis and assessment of the deep geological environment, and to develop a range of engineering technologies for deep underground application [10].

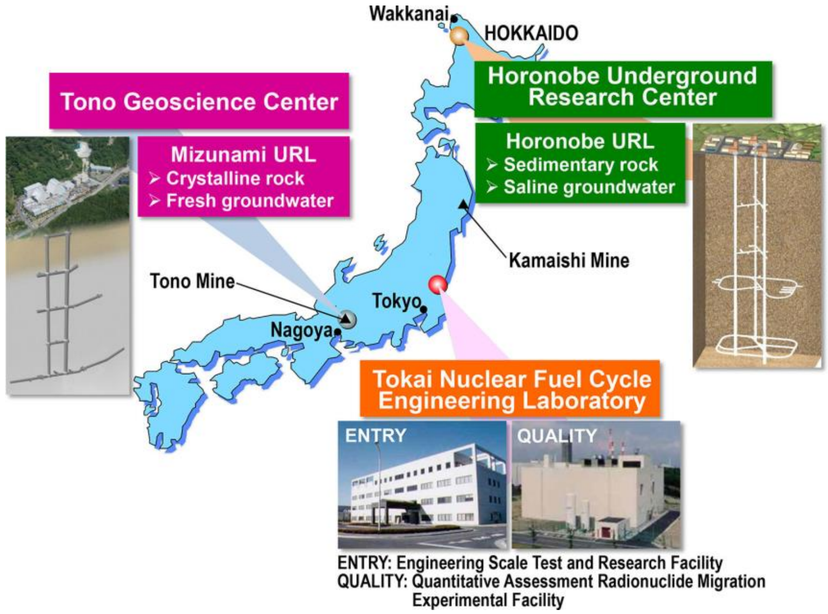

Fig.3. Locations of JAEA's research facilities for R&D on HLW geological disposal.

The MIU Site is located at 200 m above sea-level in a hilly area adjacent to the urban area of Mizunami City. Around the site, Tertiary sedimentary rocks are common and unconformably overlie the Cretaceous Toki Granite dated at 60-70 Ma (Fig. 4) [11]. The Tertiary sedimentary rocks are lithologically divided into the Mizunami Group (15-20 Ma) and the Seto Group (1.5-12 Ma). The Mizunami Group is further sub-divided into the Toki Lignite-bearing Formation, the Akeyo/Hongo Formation and the Oidawara Formation, in ascending order. The maximum thickness of the Mizunami Group at the MIU Site is about 170 m. The Toki Granite is a granite stock, ca. 14 × 12 km in areal extent, intruding the Jurassic sedimentary rocks of the Mino Terrane as well as into the Nohi Rhyolite (85 ± 5 Ma). The Toki Granite, a zoned pluton, has three mineralogical facies grading from muscovite-biotite granite at the margin through hornblende-biotite granite to biotite granite [12]. The most significant structure in the area is the Tsukiyoshi Fault, which has an E-W trend and a dip of 70-80° to the south. The Toki Granite and the Mizunami Group are both cut by the fault, with approximately 30 m of vertical displacement [13]. The underground facilities of the MIU have been constructed mainly in the Toki Granite basement on the hanging wall side.

This project was initiated in 1996 with a focus only on geoscientific research at the JAEA-owned Shobasama Site in Mizunami City, under an agreement signed in December 1995 between the local governments of Gifu Prefecture, Mizunami City, Toki City and the PNC: Power Reactor and Nuclear Fuel Development Corporation (now, JAEA). However, JAEA was not able to start construction of the URL in the Shobasama Site for social reasons. In January 2002, JAEA and Mizunami City concluded a lease contract for the city-owned land located about 1.5 km southeast of the Shobasama Site, finalizing the decision to construct the URL facilities at this location. Preparation of the land began in July 2002, with excavation for the shaft collar in July 2003, followed by initiating full excavation work for the shafts in 2004. The Phase I investigations at the MIU Site extended over three years from FY 2002 to 2004. With the initiation of full excavation work, the Phase II investigations started in FY 2004. The Phase III investigations have been underway since FY 2010 with completion of the -300 m Access/Research Gallery. By 2012, excavation of the Main and Ventilation Shafts reached 500 m depth. By February 2014, construction of the -500 m Access/Research Gallery had been completed and the Phase II investigations finished. Currently, the Phase III investigations are being conducted mainly in the -300 m and -500 m Access/Research Galleries. The present layout of the MIU is shown in Fig. 5.

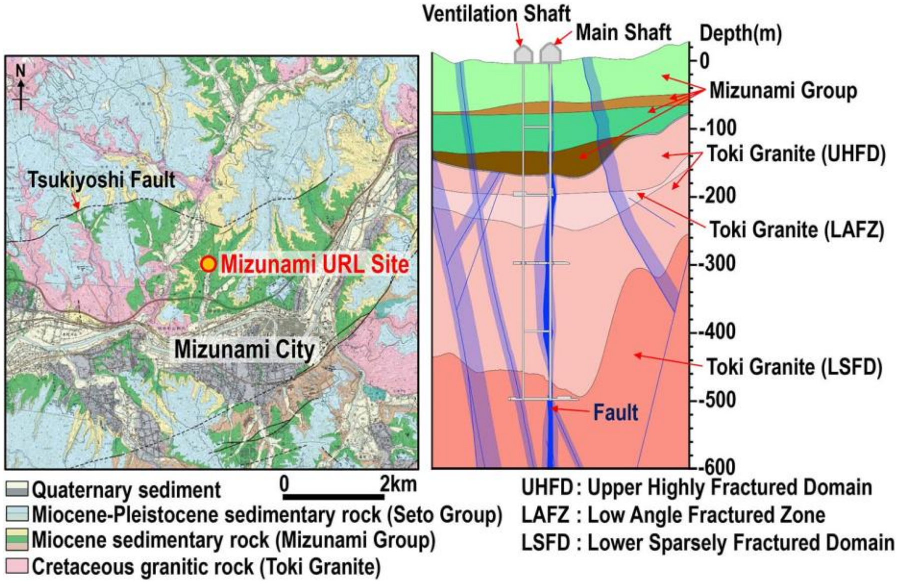

Fig. 4. Geological setting of Mizunami URL Site.

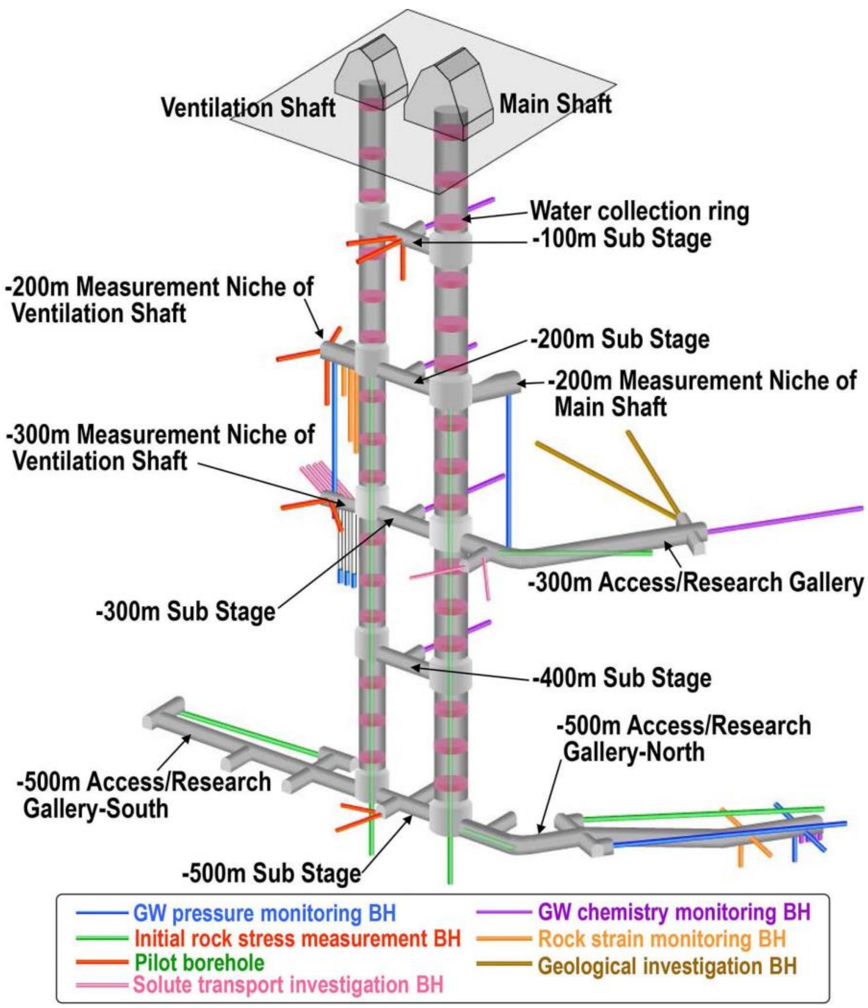

Fig. 5. Layout of Mizunami URL

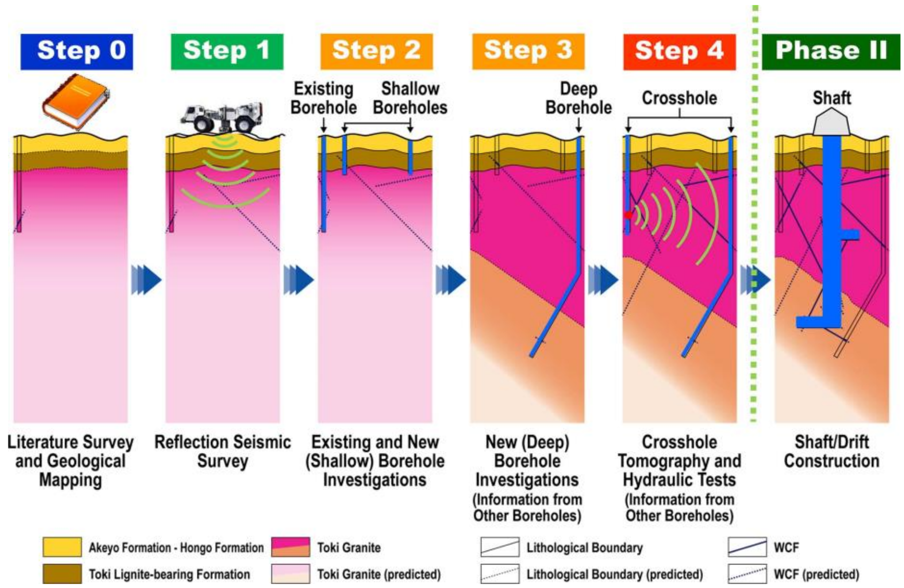

Fig. 6. Flow of surface-based investigations in Phase I.

Summary of R&D Activities in Phases I to III

The Phase I investigations at the MIU began in FY 1996 and were conducted to FY 2004. A variety of investigations, including compilation of pre-existing information, geological mapping, reflection seismic surveys, borehole investigations, cross-hole tomography and cross-hole hydraulic tests were conducted in and around the MIU Site in some steps as shown in Fig. 6. The geosynthesis methodology was applied at each step of investigations [14]. Updated models of the geological environment were developed based on information obtained during each step, thus allowing clarification of key issues and identification of others to be resolved during the next investigation step.

The Phase II investigations have been conducted from FY 2004 to 2013. In Phase II, the distributions and properties of the geological environment incorporated in the site-scale models (several km^2) constructed in Phase I were reviewed to evaluate the systematic investigation methodologies employed in the Phase I investigations, by comparison of models and their output with data acquired during the Phase II investigations. At the same time, a drift-scale model (hundreds of m^2) has been constructed. In addition, changes in the deep geological environment caused by excavation of the underground facilities can be determined by the monitoring in and around the MIU Site [15]. The Phase II investigations consist of geological mapping, geophysical investigations, measurement of water inflow and its chemistry and borehole investigations in the drifts. Additionally, hydrological, hydrochemical and rock mechanical monitoring have been carried out to observe changes in the geological environment induced by the underground facilities [16]. The main aims of the Phase II investigations are to understand how to design the underground facilities taking hydrogeological and rock mechanical characteristics of rock mass into account, and how to estimate the environmental impact during facility construction. Engineering technologies, such as design, construction planning, construction, countermeasure and safety management, have been applied and evaluated through the construction of the underground facilities [17].

The Phase III investigations have been underway since FY 2010. As a part of the Phase III investigations, the mass transport study has been conducted to understand mass transport properties in a crystalline rock environment with laboratory and *in-situ* tests mainly in the research galleries on the GL -300m stage. Studies focused on characterization of water conducting fractures taking fracture filling and host rock alteration around fractures into consideration, on study of the sorption capacity and diffusivity of rock matrix and fracture filling minerals, and on the effect of colloids, organics and microbes on nuclide transport/retardation [18, 19, 20].

As collaboration studies, various experiments and researches have been carried out with CRIEPI (Central Research Institute of Electric Power Industry), AIST (National Institute of Advanced Industrial Science and Technology), RWMC (Radioactive Waste Management Funding and Research Center), Nagra, KAERI and other research organizations. Furthermore, utilization of the underground facilities has occurred by using the galleries for observation of earthquake by TRIES (Tono Research Institute of Earthquake Science) and for storage of nuclear emulsion films for the OPERA (Oscillation Project with Emulsion-tRacking Apparatus) experiment*[1] by Nagoya University.

HORONOBE URL PROJECT

Overview and Progress to Date

The Horonobe URL Project involves two major research areas, geoscientific research and R&D on geological disposal technology, to enhance the reliability of relevant disposal technologies through investigations of the deep geological environment within the sedimentary formations in Horonobe Town, northern Hokkaido. The project proceeds in three overlapping phases in the same way as the MIU Project. The overall project goals are to establish the basic techniques for characterizing the deep geological environment, to develop the basis for engineering technologies applicable to deep underground use and to confirm the applicability of geological disposal technologies in specific geological environments [21].

The URL Site is located at 60 m above sea-level in the north-western peninsula of Hokkaido, about 50 km south of Wakkanai City (Fig. 3). Neogene to Quaternary sedimentary rocks are distributed in and around the URL site. The sedimentary rocks are lithologically divided into the Wakkanai Formation, Koetoi Formation, Yuchi Formation, and Sarabetsu Formation [22]. Two large-scale faults and a fold structure with an NNW strike have been identified [23, 24] and active Quaternary structures such as faults have also been identified to the east of the Horonobe Town [25]. It is also known that the Neogene sedimentary sequences to be characterized (the Wakkanai and Koetoi Formations) have generally low permeability and contain both saline and fresh groundwater, with dissolved gases (Fig. 7).

Under an agreement between Horonobe Town, Hokkaido Prefecture and JNC (now, JAEA), with the participation of the Science and Technology Agency (now, the MEXT: Ministry of Education, Culture, Sports, Science and Technology), dated November 16, 2000 on "Geoscientific Research in Horonobe", the Phase I investigations were started in March 2001. In July 2002, based on surveys of existing information and aerial and ground reconnaissance surveys at a regional scale done the previous year and taking into consideration preliminary requirements for the geological environment and safety, as well as social and environmental constraints, a 3 km × 3 km area in the Hokushin district in the north-central part of Horonobe Town was selected as the URL and for the surface-based investigations. The Phase I investigations continued for about five years up to the end of March 2006. Based on the results of the Phase I investigations, Neogene argillaceous sedimentary formations, the Wakkanai and Koetoi Formations, were selected as the host rocks for the URL. A site for constructing the underground and surface facilities (URL site) was subsequently selected within the URL area, 3 km from central Horonobe Town. JAEA purchased the site in March 2003. In July 2003, preparation of the land started and the construction of the underground facilities was initiated in November 2005, as were the Phase II investigations [26]. Phase III started in FY 2010. Currently, the underground facilities consist of three shafts (the Ventilation Shaft, the East and West Access Shafts) and three horizontal galleries at 140, 250 and 350 m depths. By the end of FY 2013, the three shafts had been excavated to 350 m depth and the construction of the 140 m and 250 m galleries were completed. The construction of the 350 m gallery was completed in June 2014 (Fig.8).

*[1] http://operaweb.lngs.infn.it/

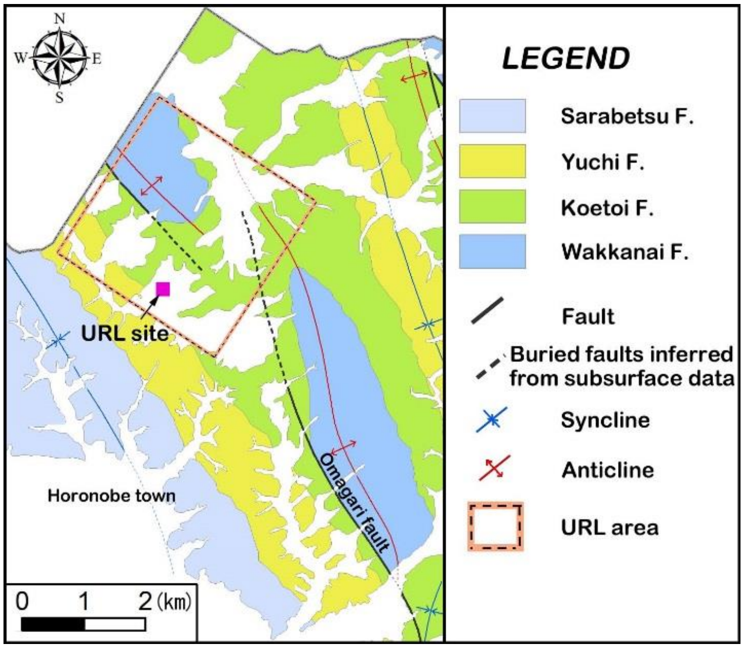

Fig. 7. Geological setting of Horonobe URL Site.

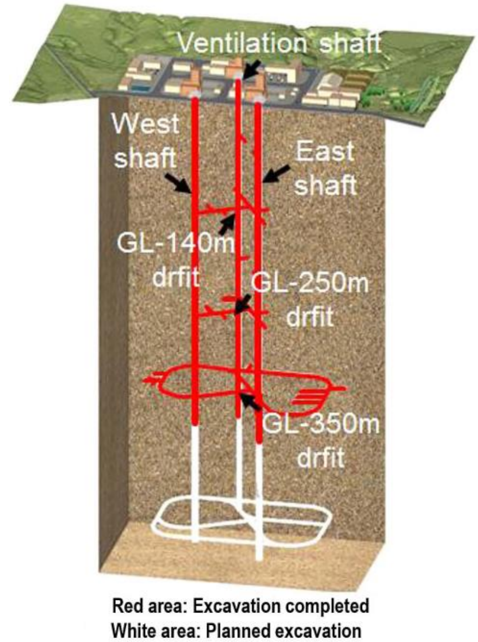

Fig. 8. Layout of Horonobe URL.

Summary of R&D Activities in Phases I to III

The Phase I investigations at Horonobe were conducted from FY 2000 to 2006. In Phase I, a geological environment model, incorporating geology, geological structure, hydrology, groundwater chemistry and rock mechanics, was constructed based on the results of geological mapping, surface geophysical surveys and deep borehole investigations, and the underground facilities were designed and the construction plan was developed.

The Phase II investigations started in FY 2005. The objectives of Phase II are to verify the technical findings of Phase I through actual excavations and to evaluate the accuracy of the geological environment model constructed in Phase I and modify it if necessary. In Phase II, geological mapping, geophysical investigations, measurement of water inflow and its chemistry and borehole investigations were conducted in the drifts. Additionally, hydrological, hydrochemical and rock mechanical monitoring have been carried out to observe changes in the geological environment induced by the excavation of the shafts and galleries. Drift-scale models (from several meters to several tens of meters) were also developed based on data obtained during Phase II to estimate the hydrogeological and geochemical conditions around the drifts. With respect to engineering technology, existing construction, countermeasures and safety management technologies have been applied and evaluated through the excavation of the shafts and galleries.

Phase III started in FY 2010 in parallel with investigations in Phase II. The Phase III investigations have the following objectives:

- Evaluation of the effect of earthquakes on underground facilities;
- Development of disposal technologies for an underground environment deeper than 300 m;
- Development of monitoring and analysis technologies for the geological environment around a disposal facility as it recovers after tunnels are backfilled, *i.e.* post-closure technologies;
- Performance of full-scale demonstration experiments (engineered barrier system: EBS); and
- Confirmation of safety assessment methodology.

In Phase III, a full-scale *in-situ* experiment of the EBS, an overpack corrosion tests, *in-situ* mass transport tests and study on low alkaline cement are planned in order to observe near-field coupled THMC (Thermal-Hydrological-Mechanical-Chemical) phenomena and *in-situ* mass transport properties, to develop long-term monitoring technology and to confirm applicability of safety assessment methodologies. These tests at the 350 m drift started recently.

With respect to collaboration studies, various experiments, researches and demonstrations have been carried out with H-RISE (Horonobe Research Institute for the Subsurface Environment), RWMC, CRIEPI, AIST, Nagra, ANDRA and other research organizations and international projects.

FUTURE PLAN AND ROLE OF JAEA'S GENERIC URLS

Future Plans for Mizunami and Horonobe URLs

In August 2013, JAEA was required to reassess the URL project plans as part of their organization reform from the MEXT and announced the next five-year plan for the Mizunami and the Horonobe URLs in September 2014. As part of the organization reform, JAEA has summarized the R&D results from the last five years of research (FY 2010-2014) in a web-based report, the CoolRepH26, now only available in Japanese and accessible on the Internet*[2]. The English version of CoolRepH26 will be available in 2015. Based on the CoolRepH26, the main research issues were identified for the next five-year plan. The Mizunami and the Horonobe URL Projects will focus on the following research issues in the next five years (FY2015-2019):

- Mizunami URL
  - Development of countermeasure technology to control groundwater inflow into deep underground facilities, including water-tight grouting technology;
  - Development of modelling technology for mass transport, including fracture network modelling technology for heterogeneous fracture networks and technology for analysis and evaluation of long-term changes of the geological environment; and
  - Development of drift backfilling technology, including long-term monitoring technology for observation of the geological environment recovery.
- Horonobe URL
  - Near-field performance study, including H12-V concept (vertical emplacement) test, overpack corrosion test, *in-situ* mass transport test and high temperature test;
  - Demonstration of repository design options, including the DER Test (demonstration of remote emplacement and retrievable technologies) and the LDM Test (layout determining methodology); and
  - Verification of crustal movement on the buffering capacity of sedimentary rocks, including BC Test (buffering capacity of sedimentary rock) and SC Test (severe condition).

At the Mizunami URL, the preparation for a groundwater recovery experiment to study recovery processes of the geological environment in the near-field after drift backfill and to develop long-term monitoring technology, as a part of the development of drift backfilling technology, is underway (Fig. 9). A post grouting experiment is conducted to demonstrate the feasibility of water-tight grout technology at the -500 m Access/Research Gallery in FY 2014. At the Horonobe URL, a full-scale EBS test (Fig. 10), overpack corrosion tests and *in-situ* mass transport tests started at the 350 m drift in FY 2014 [27]. The various data on the rock mass and the EBS have been monitored to establish confidence in the developed models regarding near-field performance.

As a part of the above mentioned research issues, the study on the effects of the long-term evolution of the geological environment on geological characteristics such as groundwater flow and chemistry for

*[2] http://kms1.jaea.go.jp/CoolRep/index.html

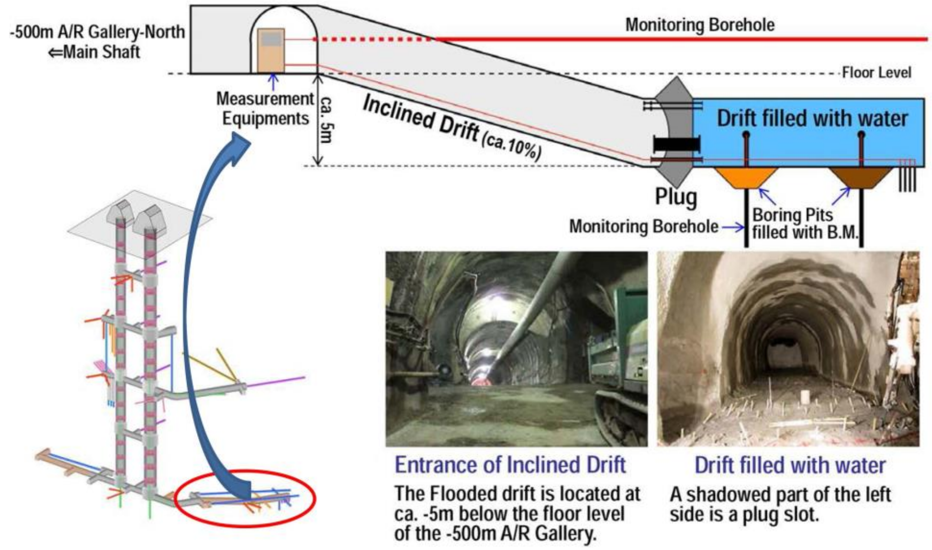

Fig. 9. Groundwater recovery test at Mizunami URL.

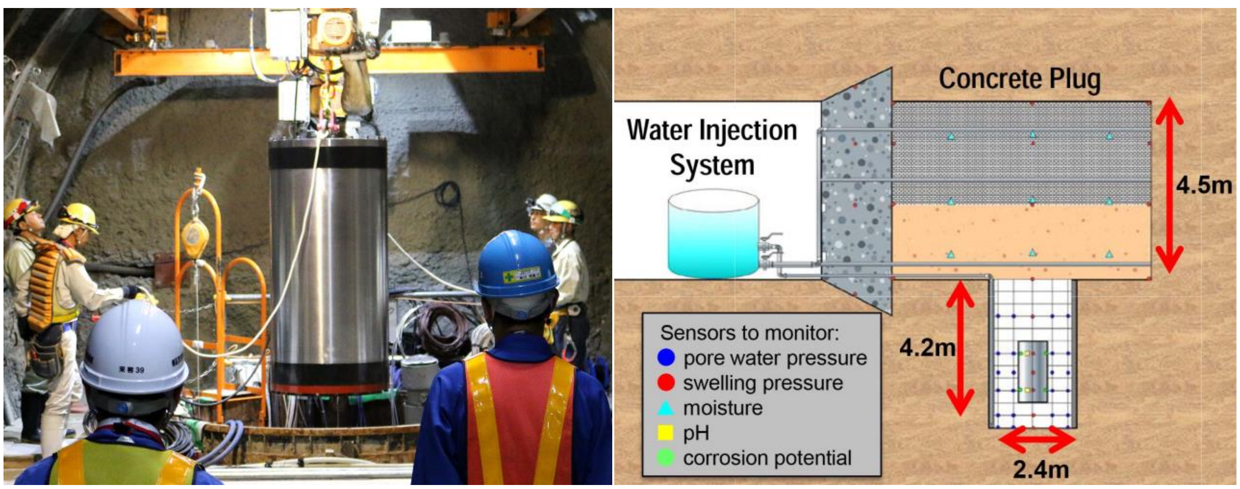

Fig. 10. Full-scale EBS test at Horonobe URL.

reduction of uncertainty inherent in the evaluation of long-term stability of the geological environment has become especially critical for HLW geological disposal in Japan in the aftermath of the Great East Japan Earthquake in 2011.

Role of JAEA's Generic URLs in Japan in an International Context

As described by the NEA's report [28], generic URLs are expected to provide general experience in underground construction techniques, model testing, verification of measurement techniques, and information, understanding, and experience related to specific rock types that may be considered as potential repository host rock at another site or sites. Generic URLs also provide a wide range of possibilities for underground research by universities and other research institutes, as well as serving as a tool for enhancing public understanding of R&D activities related to geological disposal [29]. The Mizunami and the Horonobe URLs fulfilled these roles and the outputs from both URLs have been widely published and are expected to make a timely contribution to the national disposal program and to the establishment of safety regulations as follows [30] (Fig.11):

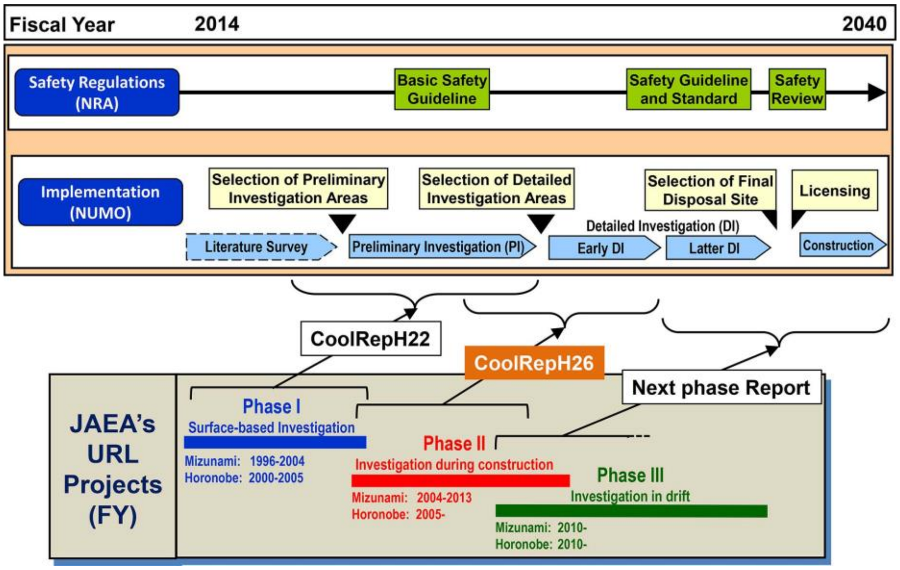

Fig. 11. JAEA's R&D activities to support national program of HLW geological disposal.

- Techniques have been developed for characterizing the deep geological environment based on the surface-based investigations (Phase I). These take into account data requirements for the design of underground facilities and associated infrastructure, along with associated safety assessment.
- Data obtained from investigations during the excavation phase (Phase II) serve to verify the results from the surface-based investigations and, additionally, to characterize the perturbations caused by the excavation process. Such perturbations, e.g. changes in groundwater flow and rock mechanical properties, are monitored and compared to model predictions in Phase I.
- Detailed investigations in the underground facility (Phase III) will contribute to improving investigation techniques for the deep geological environment. Data will also be compiled to specifically test models and their associated databases.
- Making the URLs available for visits by all interested stakeholders, including local communities, national academics, professional experts, and the general public, can promote understanding and acceptance of geological disposal projects. A key factor here is the considerably visceral impact of directly experiencing conditions in a deep geological environment and seeing the scale of investigation activities and demonstration of disposal technology. Both URLs have received more than 110,000 visitors from both Japan and abroad to date.
- Apart from technical and scientific aspects, the URLs could be used as an effective tool for establishing dialogue between the general public and researchers to enhance understanding and to build confidence in the credibility of the organizations involved.

Furthermore, as part of international cooperation, the training courses of the Swiss ITC School (School of Underground Waste Storage and Disposal) and IAEA URF (Underground Research Facility) Network were held at the Horonobe and the Mizunami URLs in 2010 and 2013, respectively (Fig. 12). In 2015, another training course in the IAEA URF Network will be held at the Horonobe URL.

In the next five-year plan, further detailed data related to characteristics of the near field environment and their temporal evolution and the resilience of disposal system to the effects of natural change of the geological environment will be obtained from the Phase III investigations in both URL projects. Changes in groundwater flow and chemistry due to natural phenomena such as earthquakes, which are an infrequent event in stable continental regions, have been observed and relevant data and knowledge will also be acquired in the future.

Fig. 12. Training course of IAEA URF Network at Mizunami URL.

These data will be useful to reduce uncertainties in evaluation of the long-term stability of the geological environment and may allow extension of near-field concepts to the geological environment in tectonically active mobile belts, thus enabling more realistic evaluation of the geological environment. Therefore, JAEA's general URLs can be expected to supply information for the analysis of perturbation scenarios and provide a precedent for countries having a similar geological environment, such as those in the Circum-Pacific area, in addition to their existing roles.

CONCLUSION

Generic URLs are a fundamental element of Japan's HLW management policy. JAEA has been promoting two purpose-built generic URL projects at Mizunami and Horonobe, the former in crystalline rock and the latter in sedimentary rock. This effort is contributing to the implementation and safety regulation with respect to R&D on geological disposal technology and also to promoting public understanding of the geological disposal of HLW. These URLs have also contributed as training facilities for specialists in cooperation with international organizations such as the IAEA URF Network.

In according with the next five-year plan, JAEA will promote both URL projects with the objective of building further technical confidence. Both URLs will also be utilized as a communication tool supporting dialog and learning amongst stakeholders to promote understanding of geological disposal. Consequently, JAEA's generic URLs have a huge role in the achievement of safe and secure geological disposal in the future.

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