SITING PROCESS FOR HLW REPOSITORY IN JAPAN

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ABSTRACT

In the year 2000, the geological disposal program for high-level radioactive waste in Japan moved from the phase of generic research and development (R&D) into the phase of implementation. Following legislation entitled the "Specified Radioactive Waste Final Disposal Act", the Nuclear Waste Management Organization of Japan (NUMO) was established as the implementing organization. The assigned activities of NUMO include selection of the repository site, demonstration of disposal technology at the site, developing relevant licensing applications and construction, operation and closure of the repository. As the first milestone of siting process, NUMO announced to the public an overall procedure for selection of preliminary investigation areas for potential candidate sites on October 29, 2001. The procedure specifies that NUMO will solicit volunteer municipalities for preliminary investigation areas with publishing four documents as an information package. These documents are tentatively entitled "Instructions for Application", "Siting Factors for the Preliminary Investigation Areas", a "Repository Concepts" as well as an "Site Investigation Community Outreach Scheme".

INTRODUCTION

As it is specified in the Long-term Program of the Atomic Energy Commission (AEC) of Japan, highly radioactive liquid waste separated during reprocessing of spent fuel is vitrified, stored for a period of 30 to 50 years for cooling and finally disposed of in a stable geological environment deep underground (1). Following the extensive technical achievements and activities for public understanding of high-level radioactive waste (HLW) disposal (2), the "Specified Radioactive Waste Final Disposal Act" (the Act) was legislated in June 2000, and thereby was established the Nuclear Waste Management Organization of Japan (NUMO) in October 2000 as an implementing organization to further pursue the overall HLW management program.

The assigned activities of NUMO include selection of the repository site, demonstration of disposal technology at the site, developing relevant licensing applications and construction, operation and closure of the repository as well as R&D necessary for implementation. According to the present schedule, repository operation may start as early as the 2030s. As the first milestone of siting process, NUMO announced to the public an overall procedure for selection of preliminary investigation areas for potential candidate sites on October 29, 2001. This paper briefly describes the current status of siting process for HLW repository in Japan.

INSTITUTIONAL BACKGROUND

As shown in Figure 1, the Act specifies the overall framework for implementation and defines the roles and responsibilities of the Government (i.e. METI: Ministry of Economy, Trade and Industry)[*] and relevant organizations including NUMO, the funding management organization (i.e. RWMC: Radioactive Waste Management Funding and Research Center) and the power reactors owners including Japan

[*] Reorganization of the Japanese Government was implemented on January 6, 2001. Policy making and regulation of HLW disposal are managed by the Ministry of Economy, Trade and Industry (successor to MITI). These activities are supervised by the Atomic Energy Commission (AEC) and Nuclear Safety Commission (NSC), both of which belong to the Cabinet Office.

Nuclear Cycle Development Institute (JNC). Under the Act, the METI should establish and revise the basic policy and the final disposal plan for a 10-year term in every 5 years.

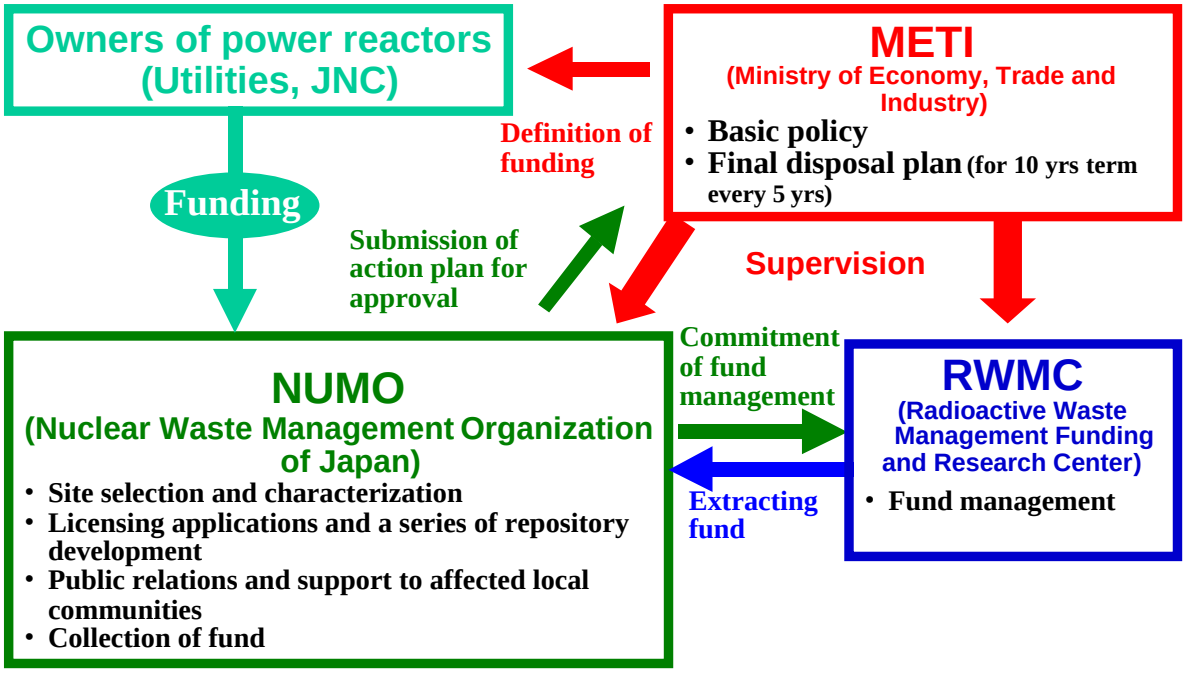

Fig. 1. Framework of implementation

NUMO is responsible for planning and conducting site selection, and developing relevant licensing applications for repository construction, operation and closure according to the METI's basic policy and final disposal plan.

The Act provides that the siting process shall consist of following three steps. Detailed investigations will be carried out in each stage and, finally, a repository site will be selected.

- In the first stage, literature survey will be conducted in nation-wide scale. Then preliminary investigation areas for potential candidate sites are nominated based on area-specific literature surveys focusing on long-term stability of the geological environment.
- Detailed investigation area(s) for candidate site(s) are then selected from preliminary investigation areas for potential candidate sites by surface-based investigations including boreholes carried out to evaluate the characteristics of the geological environment.
- In the final third stage, detailed site characterization including underground experimental facilities will lead to selection of the site for repository construction.

The siting processes, carried out by NUMO, are supervised by the METI. As specified in the Act, NUMO is required to submit a report describing the results of the investigations at the end of each step and before proceeding to the next step. Publication of the report will be notified to local residents and the document will be open for inspection by them. METI must solicit opinions from the Governors and Mayors of concerned communities prior to finalizing decisions made during the site selection process. These opinions shall be respected in terms of the decision making specified in the final disposal plan. The key points of the METI's final disposal plan authorized by the Cabinet on Sep 29, 2000 are summarized in Table I.

Table I. Key points of Final Disposal Plan (Authorized by the Cabinet on 29 Sep. 2000)

Inventory
• Amount of spent nuclear fuel by the end of year 1999: corresponding to ~13,300 canisters
• Estimated amount of spent nuclear fuel around the year 2020: corresponding to ~40,000 canisters
Repository concept
• Geological disposal deep underground / multiple barrier concept
• A repository capacity: at least 40,000 canisters
• Start of the repository operation: around 2033~2038
• Annual emplacement rate: ~1,000 canisters
Siting
• Selection of detailed investigation areas: around 2008~2013 following selection of preliminary investigation areas
• Selection of disposal site: around 2023~2028

The Act states that the regulation relevant to safety of final disposal shall be legislated separately. The "Advisory Committee on Radioactive Waste Safety Regulations" of the Nuclear Safety Commission of Japan (NSC) has been holding discussions on development of safety regulations for the geological disposal system. The first report on the basis for safety standards for HLW disposal (NSC report) (3) was published in November 2000, and took account of public comments. The report mainly specifies safety fundamentals, guidelines for site selection, basic considerations for safety assessment and management of the disposal site. The report states that safety is fundamentally provided by the intrinsic safety features of the system resulting from appropriate siting and design of the repository supported by appropriate safety assessment to illustrate the long-term safety. Guidelines for site selection specify favorable geological conditions, including a stable geological environment and no indication of natural resources underground at the present time, which are consistent with the Act. It is stressed that two types of scenarios should be developed for safety assessment, namely a groundwater scenario as normal evolution scenario and a "what if" isolation failure scenario. The report emphasizes that a quality assurance system for design and construction of repository should be established as part of management of the disposal site. The report also emphasizes the need for monitoring of changes in the geological conditions in order to confirm the baseline conditions for post-closure safety assessment and the need for retrievability over the period during which the monitoring is carried out. According to the report, NSC is planning to issue the safety guidelines for license application prior to selection of the potential disposal sites.

SELECTION PROCEDURES

Site selection will proceed in a stepwise manner as defined in the Act. Such a stepwise procedure is aiming at ultimately leading transparently to selection of a site for a HLW repository. As the first milestone of siting process, NUMO announced to the public an overall procedure for selection of preliminary investigation areas entitled "Basic Strategy for Selection Procedures for Preliminary Investigation Areas for the Disposal of HLW" (Selection Procedures) (4) on October 29, 2001. The Selection Procedures also outlines the strategy for selection of detailed investigation areas and final disposal site.

As the acceptance and support of local residents are essential for the progress of the project, explanations of investigation plans in advance and the results of the investigations should be provided to local residents on a yearly basis.

Selection of preliminary investigation areas

In accordance with the Selection Procedures, NUMO will invite volunteer communities to apply as preliminary investigation areas. The areas (and their surroundings) for which applications have been

accepted will be subject for detailed area-specific literature surveys and preliminary investigation areas will then be selected from these. The units for volunteer applications are *Shi* (city), *Cho* (town) and *Mura* (village) (coalitions are permitted). As shown in Figure 2, the open solicitation procedure will be announced in the fiscal year 2002, as soon as all preparations have been made. In the meantime, NUMO will provide explanations to municipalities whenever requested, irrespective of whether the announcement has been made or not. NUMO will initiate activities aimed at obtaining the acceptance and support of both the general public and local communities by hosting forums throughout the country.

Fig. 2. NUMO's strategy for stepwise site selection process

At announcement of the open solicitation around fiscal year 2002, NUMO will publish four documents as an information package. These four documents are tentatively entitled "Instructions for Application", a "Siting Factors for the Selection of the Preliminary Investigation Areas" and "Repository Concepts", as well as a "Site Investigation Community Outreach Scheme". The documents are aimed at providing fundamental information for the discussions within the stakeholders and general public of municipalities to make a decision whether the planned repository could be accepted. The details of these different documents are currently in preparation. In particular, the "Siting Factors for the Selection of the Preliminary Investigation Areas" and the "Repository Concepts" will be prepared taking account of advises from experts both in Japan and abroad.

- ***Instructions for Application***
  The "Instructions for Application" document includes general information on the application procedure, areas necessary for investigation and items in area-specific literature survey.

- ***Siting Factors for the Selection of the Preliminary Investigation Areas***
  HLW has to be disposed of in deep, stable geological formations. Information is thus provided on siting factors to be applied by NUMO for selection of preliminary investigation areas, for example factors specified in the Act and the NSC report such as no record of significant tectonic movement,

no evidence of unconsolidated sediments and no mineral resources. The siting factors will be documented as "Siting Factors for the Selection of the Preliminary Investigation Areas" (Siting Factors) and taken into considerations in area-specific literature surveys. While the requirements for site selection stipulated in the Act represent necessary conditions to be met at the stage of selection of preliminary investigation areas, the Siting Factors should go beyond these basic requirements and take into account the practicalities of implementing the staged site selection procedure as a whole. Therefore, the Siting Factors for consideration should be sufficiently comprehensive to cover all envisaged situations that could arise in the selection procedure for preliminary investigation areas.

- ***Repository Concepts***
  The configuration of the repository may differ depending on the geological environment and conditions in particular areas and some examples of repository design will therefore be provided in a "Repository Concepts". This will include conceptual specifications and illustrations of repositories, information on safety. The Repository Concepts document is aimed at providing information to support discussions within stakeholders and residents of municipalities with a view to making a decision on whether the planned repository could be accepted. The document includes a set of repository concepts developed for patterns of the siting environments expected in the potential candidate sites to be selected taking into account the Siting Factors. An overview of the performance of the different repository concepts will also be provided in the document. For the purpose of contributing to discussions within municipalities, the Repository Concepts document is also required to be not only easily understandable to the stakeholders and the general public but also technically reliable. To ensure this, NUMO is planning to establish a sound technical basis to support the document, which will be summarized in separate detailed documents.

- ***Site Investigation Community Outreach Scheme***
  Disposal of HLW in deep geological formations can be achieved only when potential areas exist that will accept such a project. The Act states that the areas that accept the project should be provided with some measures that contribute to the industrial development and improvement of lifestyles in the area; these are dependent on the stage of selection and are independent of any economic benefits associated with the repository construction and operation. NUMO will conduct consultations with local residents regarding such measures which are appropriate to the conditions in an area and will make serious efforts to implement these measures. In the "Site Investigation Community Outreach Scheme", the plans for respecting the opinions of local residents are developed and explained. These are aimed at providing benefit to volunteer municipalities from not only financial but also other positive social aspects. NUMO is requesting the Government that the subsidy provided for in three key laws regulating power development, namely the "Power Development Promotion Tax Act", the "Power Development Promotion Measures Special Account Act" and the "Act on Development of Areas around Power Plants", would be utilized for these measures.

Selection of preliminary investigation areas will be promoted as shown in Figure 3. This procedure is discussed below.

Following the acceptance of application for a volunteer municipality is accepted, NUMO will conduct area-specific survey of literature including past records on earthquakes, volcanic activity, uplift and erosion for areas where the volunteer municipality is located. The surveys will be conducted also with the cooperation of experts and researchers who has specific scientific knowledge to the area.

The evaluation of the area will be then conducted in terms of compliance with NUMO's Siting Factors. The results of evaluation will be documented as a report for each area, and will then be submitted to the Governors and Mayors of the municipalities concerned. NUMO will open the evaluation report for inspection in relevant Prefectures. NUMO will accept all comments on the evaluation report for

consideration and prepare a report which will include a compilation of the comments and NUMO's responses to these comments; this will then be sent to the Governors and Mayors of the relevant municipalities.

Taking the comments on the evaluation report into consideration, NUMO will select preliminary investigation areas from among the areas covered by the area-specific literature survey and, based on the Act, will submit to METI an application for approval of the selection of the preliminary investigation areas. The decision on the preliminary investigation areas has to be described by METI in the final disposal plan. In terms of the Act, METI has to solicit comments from the Governors and Mayors of the relevant municipalities and has to respect these comments in approving the selection of the investigation areas. Since decisions on suitability at the local scale will need to be made on the basis of detailed local information, it is impossible to exclude all the areas with unfavorable conditions for geological disposal at this stage. Areas with unfavorable conditions will, however, be excluded by further investigations in later stages, even if they are nominated as preliminary investigation areas.

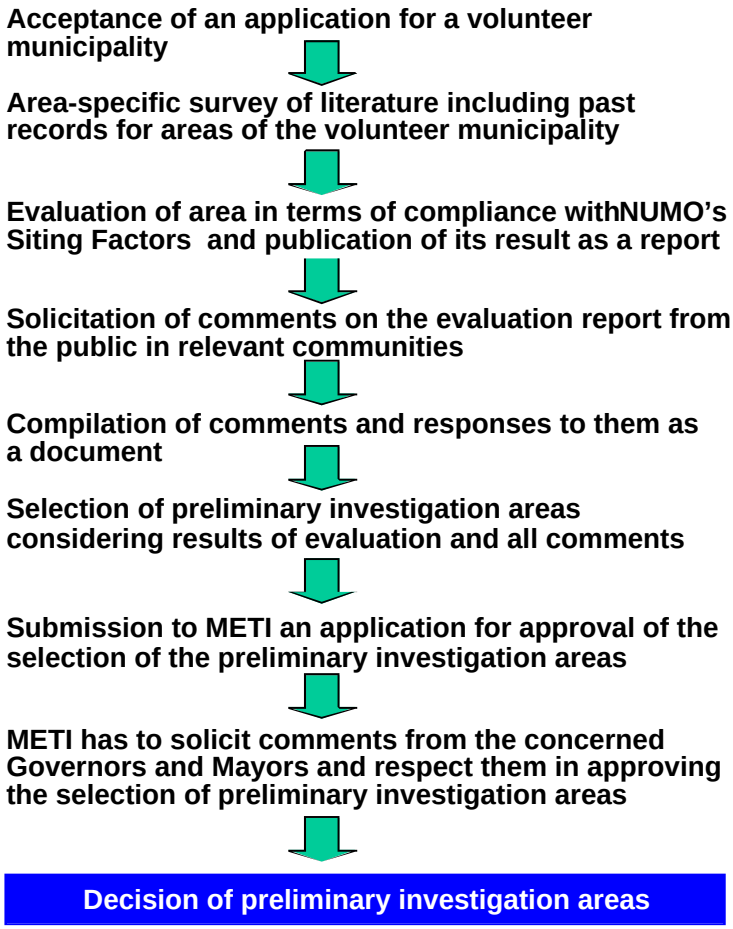

Fig. 3. Selection Procedure for preliminary investigation areas

As a result of this procedure, the selection of preliminary investigation areas is finally confirmed by updating the METI's final disposal plan based on the approval for the NUMO's application. When METI revises the final disposal plan, the Minister is required to solicit comments from the Atomic Energy Commission and a decision by the Cabinet is also required. NUMO is expecting that preliminary investigation areas will be selected from among these areas in the late 2000s.

Selection of detailed investigation areas and a repository site

In the selected preliminary investigation areas, NUMO will conduct geological explorations using boreholes and other surface-based methods, for example by geophysical surveys (investigation of the underground from the air or water using artificial seismics, radar, etc.) and excavation of trenches for near-surface investigations. Detailed investigation areas will be selected from among the areas investigated in the early 2010s, in accordance with the revised final disposal plan. The procedure for selecting the detailed investigation areas will be in principle the same as that for preliminary investigation areas, but with the modified Siting Factors.

Once the detailed investigation areas have been selected NUMO will conduct investigations of physical and chemical properties specified in the Act, including measurement of rock strength, groundwater chemistry in the formations of interest and groundwater flow. These investigations will be carried out in underground facilities in the detailed investigation areas. A final repository site will be selected from among these detailed investigation areas in the late 2020s, in accordance with the final disposal program.

When a site for the repository has been selected, NUMO will duly proceed with the construction of the facility and will commence disposal operations in the late 2030s, in accordance with the national disposal program.

CONCLUDING REMARKS AND THE WAY FORWARD

As described, NUMO's siting process strongly depends on discussions within municipalities. It is therefore especially important to promote public understanding of geological disposal and to obtain and maintain public trust. In order to ensure the decision making process is transparent, NUMO will make available a variety of information relevant to its siting activities through the publication of documents, web-sites, etc., and provide opportunities for inhabitants around the preliminary investigation areas to voice their opinions. To promote this communication, NUMO has been so far establishing contacts with all prefectural governments. During the next couple of years, it will be crucial for NUMO to develop a company image nationally and publicize it – building stakeholder knowledge and confidence and establishing national leadership in the nuclear waste management field. Some technical requirements for this will be to:

- develop in-house competence, tools and technical credibility
  - to respond to multiple applicant areas and work closely with many municipalities
  - for site specific investigations of preliminary investigation areas
- develop sound technical basis for supporting Siting Factors and Repository Concepts and use them as a tool to develop a comprehensive NUMO's R&D plan
- integrate the NUMO R&D plan with other relevant organizations

Japan has been active in promoting international cooperation in connection with its R&D program, based on both bilateral and multilateral frameworks. NUMO so far concluded general agreements for collaboration with Posiva (May 2001), Nagra (June 2001), SKB (September 2001) and ANDRA (December 2001). Such agreement is also in preparation with U.S. DOE. The output from the collaboration will be very valuable in improving NUMO's repository program by identifying areas of strength and weakness and thereby in generally ensuring sound technical basis. This will be also the case in confidence building for implementation of HLW geological disposal because the repository development program will continue over a long time period. Bearing this in mind and recognizing that success in one country's program would lead other countries, NUMO will further promote international collaboration in our program sharing experiences with other programs toward the final goal.

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