

The NUMO Strategy for HLW and TRU Waste Disposal

K. Kitayama, Y. Oda

Nuclear Waste Management Organization of Japan (NUMO)

Tokyo, Japan

ABSTRACT

Shortly after the Nuclear Waste Management Organization of Japan (NUMO) was established, we initiated an open call to all municipalities, requesting volunteers to host a repository for vitrified HLW. The first volunteer applied for a preliminary literature survey phase last January but, unfortunately, it withdrew the application in April. This failure provided an invaluable lesson for both the relevant authorities and NUMO; subsequently the Atomic Energy Commission of Japan and associated organizations are examining a support plan to back up NUMO's open solicitation. On another front, a recent amendment of "The Specified Radioactive Waste Final Disposal Act" also allocates specific "TRU" waste for deep geological disposal, requiring a demonstration of safety to a similar level as that for HLW. To implement the radioactive waste disposal project, NUMO has developed a methodology appropriate to our specific boundary conditions – the NUMO Structured Approach. This takes into account, in particular, our need to balance competing goals, such as operational safety, post-closure safety and cost, during repository tailoring to specific sites. The most important challenge for NUMO is, however, to attract volunteers. We believe that our open and structured R&D program is critical to demonstrate technical competence which, in turn, enhances the credibility of our various public relations activities.

INTRODUCTION

With the aim of siting a repository for vitrified HLW from reprocessing, the Nuclear Waste Management Organization of Japan (NUMO) started open solicitation of volunteers of candidate sites from municipalities across the country in February 2002 and has made efforts to encourage applications in cooperation with the national government and electric power companies. These three organizations have engaged in an extensive communication program, including focused public hearings and PR activities at a national level, complemented by community-based activities to improve understanding and explain extended measures to support host regions. As a result of these activities, several municipalities have expressed interest in the project; however, this has not led to the application for the first stage of site literature surveys. Experience in the municipalities that expressed initial interest suggested the necessity to enhance efforts to gain understanding of disposal concepts in order to increase consensus to initiate literature surveys.

As indicated in Figure 1, we have established a stepwise siting process that gradually progresses from an initial

literature survey (LS), leading to selection of areas for Preliminary Investigation and then Detailed Investigation (DI) before a site is finally selected. To provide the required level of flexibility required by this process, a procedure for tailoring repository designs, safety cases and site characterization processes to volunteers – the NUMO Structured Approach (NSA) – has been developed. This also facilitates the recent expansion of the NUMO remit to include “TRU” waste and a move towards more active encouragement of volunteers, as discussed in more detail in the following sections.

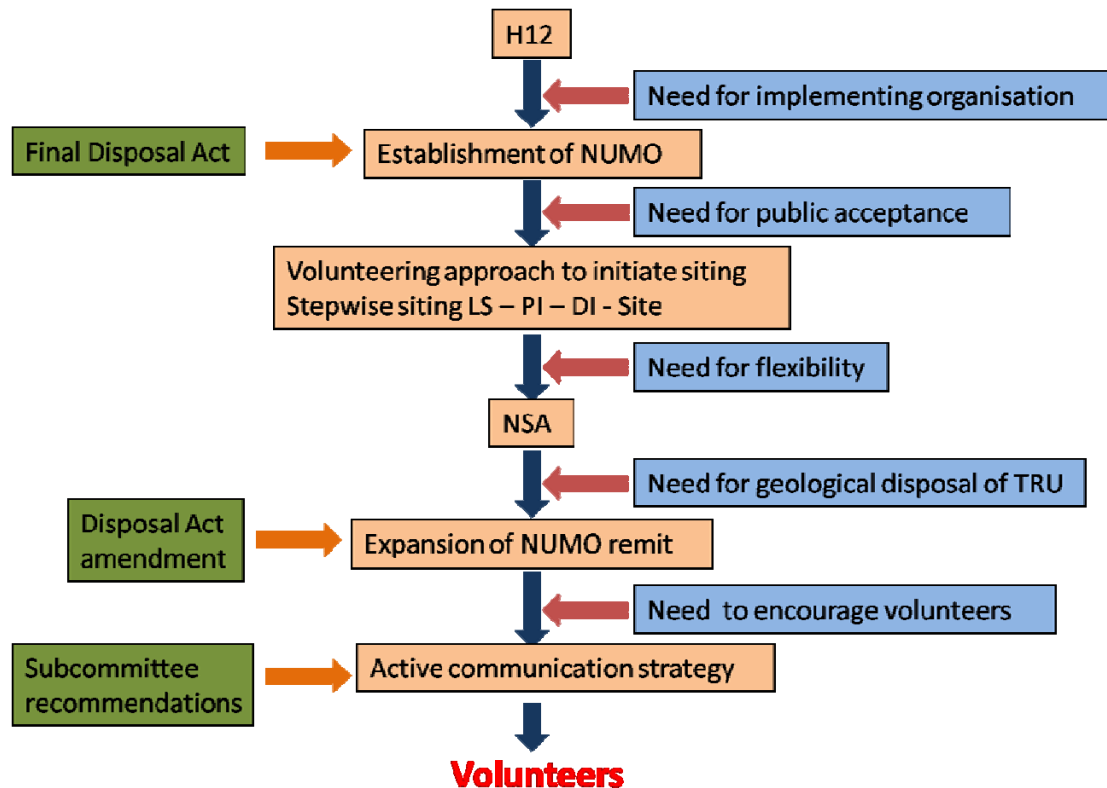


Figure 1 Overview of the NUMO program (see text for explanation of abbreviations)

ENHANCED COMMUNICATION PROGRAM

More than 10 municipalities have been reported in newspapers as having interest in the repository project and considering application for the initial literature survey which would lead to selection of sites for preliminary characterization. Some of them actually took actions toward formal application. At Toyo-cho, in particular, since August 2006 national government and NUMO staff attended briefing meetings to overview the disposal project and explain its safety. Despite this, surrounding municipalities and prefectural governors responded very negatively to the idea of the survey. In January 2007, Toyo-cho submitted the first application for a literature survey; however, this application was withdrawn following a local election which led to replacement of the mayor with one opposed to this initiative. The Toyo-cho literature survey was thus canceled.

As a result of this event, firmer measures to promote the final disposal project were discussed in the Nuclear Power Subcommittee of the government Agency for Natural Resources and Energy. Challenges identified by reviewing open solicitation activities to date are discussed below (see also Figure 2).

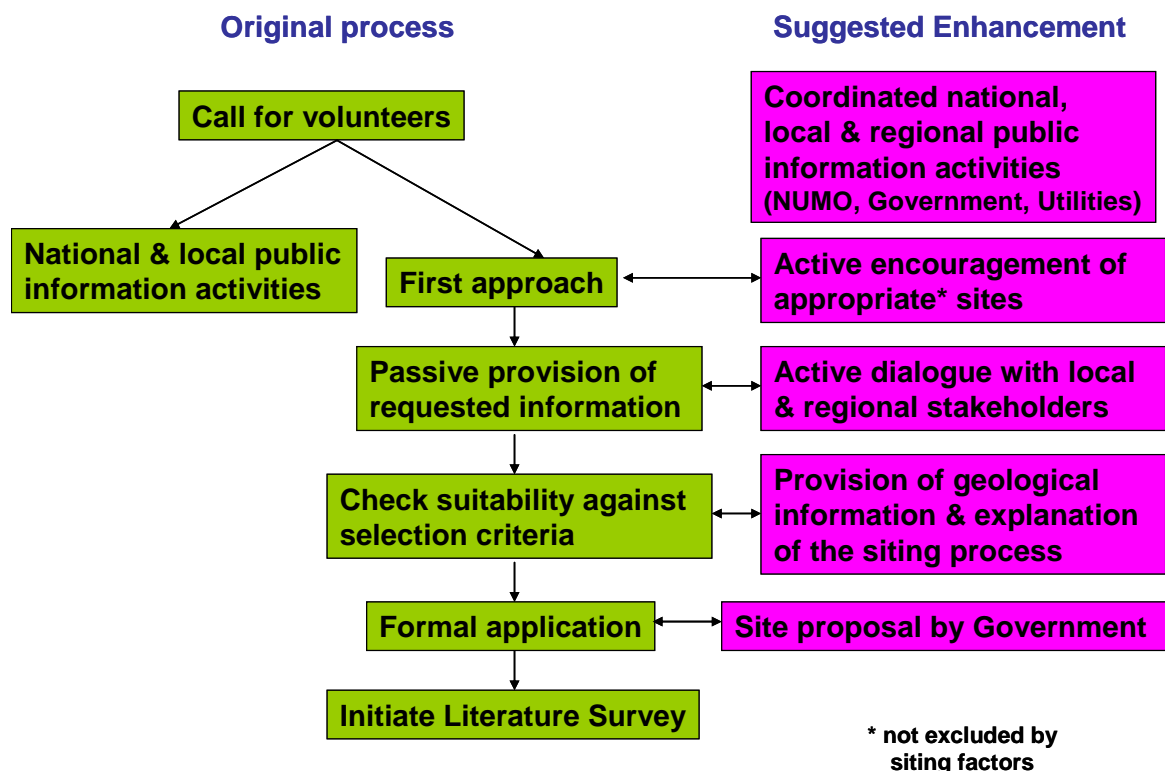


Figure 2 Overview of proposed enhancement in the process of soliciting volunteers

Improvement and enhancement of interactions with the public

It is clearly important for promoting the repository project to improve understanding and gain cooperation – not only from the residents of the investigation area, but also from the general public who benefit from nuclear power generation. While the necessity of nuclear power may be accepted due to the need for stable supply of energy and global environmental issues, the associated necessity of HLW disposal seems to be less well recognized. Therefore, recognition of the need for, and benefits arising from, the final disposal project by the public is a critical issue. In order to improve this situation, the national government has held a series of Geological Disposal symposia, in cooperation with related regional organizations and provided reports of the symposia to newspapers and websites. In addition, for the purpose of improving their understanding, it has encouraged the prefectural governments in each region to participate in the symposia. Japanese government staff have also made efforts to directly visit each prefectural government office to outline the disposal project.

Additionally, the national government, NUMO and the electric power companies clearly need to improve cooperation and demonstrate commitment on the following issues:

(1) Information service to the general public and to the public administrators

Coordination of the timing, content, and selected advertising media (newspapers, magazines, and TV) to optimize PR programs. Additionally, it could also be beneficial to send delegations to the main cities in neighbouring countries.

(2) Proactive provision of accurate information to the mass media

The challenge here is twofold – providing a basic communication interface to the mass media and ensuring that accurate information is transmitted, particularly when arguments based on scientifically incorrect information is utilized by project opponents.

(3) Increasing visibility to the public

The national government and NUMO, in particular, should actively promote activities in cooperation with relevant NGO organizations, particularly those that are well established and are considered credible due to their past involvement in civil activities.

(4) Utilization of public service announcements

In order to build understanding and interest in younger generations, communication efforts in educational institutions are very important. These should present the HLW disposal project integrated within the context of a better understanding of the general role of nuclear power

Reinforcement of local PR activities

In potential repository site locations, it is necessary to improve the residents' understanding of the project – in particular the safety of geological disposal, the site selection procedures and the efforts made to further regional development of host communities. We have seen that, as soon as actions towards volunteering for literature survey are made, strong reaction from people outside the region develops, causing anxiety in the host community. Particularly in regions where nuclear power is unfamiliar, residents are particularly vulnerable to misinformation by opponents, which needs to be countered by focused PR activities.

(1) Timely execution of local PR activities

Prompt communication actions, not only by national government and NUMO staff, but also neutral experts and opinion makers should be encouraged and extended to surrounding municipalities and prefectural capitals.

(2) Provision of preliminary geological data

Municipalities potentially interested in allowing a literature survey may need to determine whether their geological conditions are suitable or not before submitting an application and hence NUMO should develop

a system to provide such information.

Efforts by the national government

Prior to applying for a literature survey, the head of the municipality and the municipal assembly are expected to explain to the residents technical aspects associated with the necessity and the safety of the disposal project. In practice, assigning such a task to these individuals has been seen to be an excessive burden - one which should actually be borne by the national government and NUMO. It has been pointed out by the national congress and municipal administrators that the role of the national government as a main player needs to be emphasised.

To ensure transparency of procedures and respect the autonomy of the municipalities, the current open solicitation of volunteers should continue. However, the national government should actively solicit interest in suitable municipalities, to complement passive open solicitation by NUMO. In such a case, the imposed burden may be perceived to be less as a head of a municipalities would be required only to decide whether to accept or reject the government proposal.

Presentation of regional development opportunities

In cases such as Toyo-cho, the purpose of the subsidies provided during the investigation stages was clearly not well enough understood. These were often interpreted as enticements aimed at local governments suffering from financial difficulties. The subsidy program actually aims to support regional development in relation to the project and this needs to be better explained.

(1) Explanation of regional development support throughout the repository project

As is increasingly the case worldwide for major projects, the national government and NUMO, in collaboration with the electric power companies, are required to develop a concept for how this could further the community's development. Regional development can be facilitated by utilizing government subsidies based on the Electric Power Development Legislative Package and NUMO's regional outreach schemes, but also by managing the project with the needs of the region in mind. Such a regional development "vision" should include not only the host community, but also surrounding municipalities and the prefecture as a whole. Key regional development issues include:

- Basing NUNO offices and facilities locally
- Attracting research institutes or companies that support the project to the site
- Targeted regional development, including favoring of local industry and expansion of local resources and infrastructure

- Installing expert groups and NGOs to provide independent evaluation studies for the municipality
- A scheme of long-term financial support, based on the subsidy program within the Electric Power Development Legislative Package and NUMO's outreach program
- Priority treatment for collaborations with other ministries and agencies

(2) Clarification of subsidy utilization during the investigation stages

The development of a repository project clearly benefits the general public by allowing the utilization of nuclear power. On the basis of intra-generational equity, it seems reasonable for the region that bears the load of hosting the disposal site to receive some form of compensation. This is certainly not a payment for accepting risks, rather recognition of the disturbances caused by any major industrial project. From this viewpoint, it is reasonable to initiate payments from the initial literature study phase – to allow the region to be able to assess the perturbations that could arise during the following phase of work and collaborate with NUMO to find options to minimize them

Promotion of R&D and international cooperation to enhance public understanding

In spite of the inherent safety of a geological repository, there are a number of more visceral concerns that can cause anxiety. Such anxiety cannot be combated by technical arguments alone, but require a level of trust and confidence that the organisations involved understand all complex scientific issues and will address all concerns honestly. The technology to safely execute waste disposal and the associated R&D for safety assessment needs to proceed systematically from both mid- and long-term perspectives. but should also provide opportunities for the public to learn about the work involved. Much of this technical work is required by all the countries utilizing nuclear power and hence offers many opportunities for international collaboration.

(1) R&D approaches to promote public understanding

- (a) Development of the geological disposal demonstration facilities and their utilization for PR purposes.
The facilities of JAEA and other research institutes should be utilized to help the public understand the concept of geological disposal project and get a feeling of how safe it is by visiting underground research laboratories and other facilities which have a large visual impact. Making such visits available for residents of the siting regions and interested members of the general public could be a useful role of the national government in the move towards improving the basis for establishing dialogue with the public.
- (b) Development of approaches to explain the very long-term safety of geological disposal
The complex modeling analysis that is used to demonstrate long-term safety of repositories is inherently opaque to general audiences. The national government should thus develop approaches to explain the safety of the geological disposal in a manner that is understandable to all stakeholders.

(2) R&D on safety issues

From the viewpoint of building credibility with the general public, R&D work to support the disposal project should not only be aimed at building a robust safety case, but also communicating this to all interested parties.

(3) Promotion of international cooperation

Safe disposal of radioactive wastes is a concern for all countries, particularly those utilizing nuclear power. Japan has tried to learn from the experience of other countries that are making progress in site selection. Good examples are Sweden and Finland which have both utilized a combination of technical nomination and open solicitation of host sites..

Consolidation of organizational roles

It appears that the roles of Government and NUMO have not been clearly communicated but, in any case, the former should be strengthened to demonstrate leadership in this area. Together, both parties need to build the capability to respond to the questions of stakeholders, something that is perceived to be a problem in the past. To respond to this challenge, establishing a network of expert communicators – particularly those perceived to be neutral, might be valuable.

(1) Strengthening of organizational system and functions

In order to promote the repository project, it would be crucial for the national government, NUMO, and electric power companies as well as other related organizations to carry out their responsibilities in a coordinated manner, with appropriate role sharing and efficient cooperation.

(2) Establishment of an expert network

The national government, NUMO, and electric power companies must consider asking for cooperation from neutral experts and organizations to help improve understanding of the general public in the inherent safety of geological disposal. To do that, all three parties should establish a network with key communicators in relevant organizations and academic circles and involve it actively within their public information activities.

TRU WASTE DISPOSAL

A recent amendment of “The Specified Radioactive Waste Final disposal Act” now allocates “TRU” waste for deep geological disposal (Figure 3). This is associated with amendments of the related regulations and laws to improve the consistency of treatment of the disposal of all radioactive wastes. TRU waste is defined in Japan as a category of LLW (which effectively includes everything that is not HLW) that contains significant quantities of longer-lived radionuclides, particularly those that may be relatively mobile in a disposal system.

Initially, this term was applied to all wastes resulting from reprocessing and MOX fuel fabrication [1], which leads to internal inconsistencies and incompatibility with international usage. We thus reserve further use of this term to cover only that LLW selected for deep geological disposal.

The amendment of the Act is based on the foundation provided by the “Second Progress Report on Research and Development for TRU Waste disposal in Japan” [1] issued by the Japan Nuclear Cycle Development Institute (JNC, now, Japan Atomic Energy Agency: JAEA) and the Federation of Electric Power Companies of Japan (FEPC). In this progress report, the characteristics of TRU are described and appropriate geological disposal concepts are investigated. In the absence of regulations in Japan, a safety assessment utilized foreign guidelines to demonstrate the fundamental safety of these disposal concepts in a generic manner.

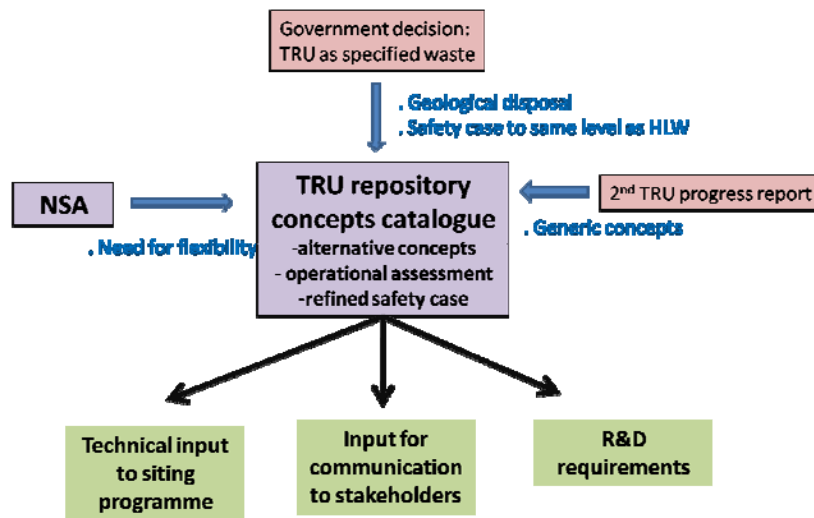


Figure 3 Incorporation of TRU into the NUMO geological disposal program

Japanese TRU wastes have wide ranges of both radioactivity and physic-chemical properties, but are allocated for deep geological disposal due to high concentrations of alpha emitters and other long half-life, mobile nuclides (e.g. I-129 and C-14). In the second TRU report, TRU wastes were grouped into 4 types based on their characteristics. Group-1 includes waste with high concentrations of the weakly-sorbing nuclide I-129. Group-2 includes hulls and end-pieces containing large concentration of C-14. In Group-3, wastes contain chemicals such as NaNO_3 , which could potentially have an impact on radionuclide migration. Group-4 consists of other miscellaneous wastes. Because of these wide varieties of waste materials, an idealized TRU waste repository layout was considered in which each waste group was emplaced in a separate disposal panel. To develop optimized waste management strategies, NUMO will revisit such designs and also investigate whether benefits could be gained by co-locating a TRU repository at a HLW disposal site in a suitable host rock (Figure 4). It should be emphasized, however, that until the repository concept analysis for TRU is carried out (see Fig 3), these sketches of layouts must be considered illustrative only.

As indicated also in studies carried out in other national programs, the 2nd TRU report shows that, while safe geological disposal is certainly feasible, in any defined geological setting it is likely to give rise to predicted doses above those from HLW. This may be due, to some extent, to the less-developed understanding of this more complex waste and hence NUMO considers that efforts are needed to bring the safety case supporting the geological disposal of TRU waste to a level at least equivalent to that for HLW. The key challenges are: (1) enhancement of the technical basis for TRU waste disposal and the associated approach to repository concept development, (2) investigation of alternative technology for conditioning of problematic waste streams, (3) improvement of the safety evaluation methodology, particularly for the option of collocation.

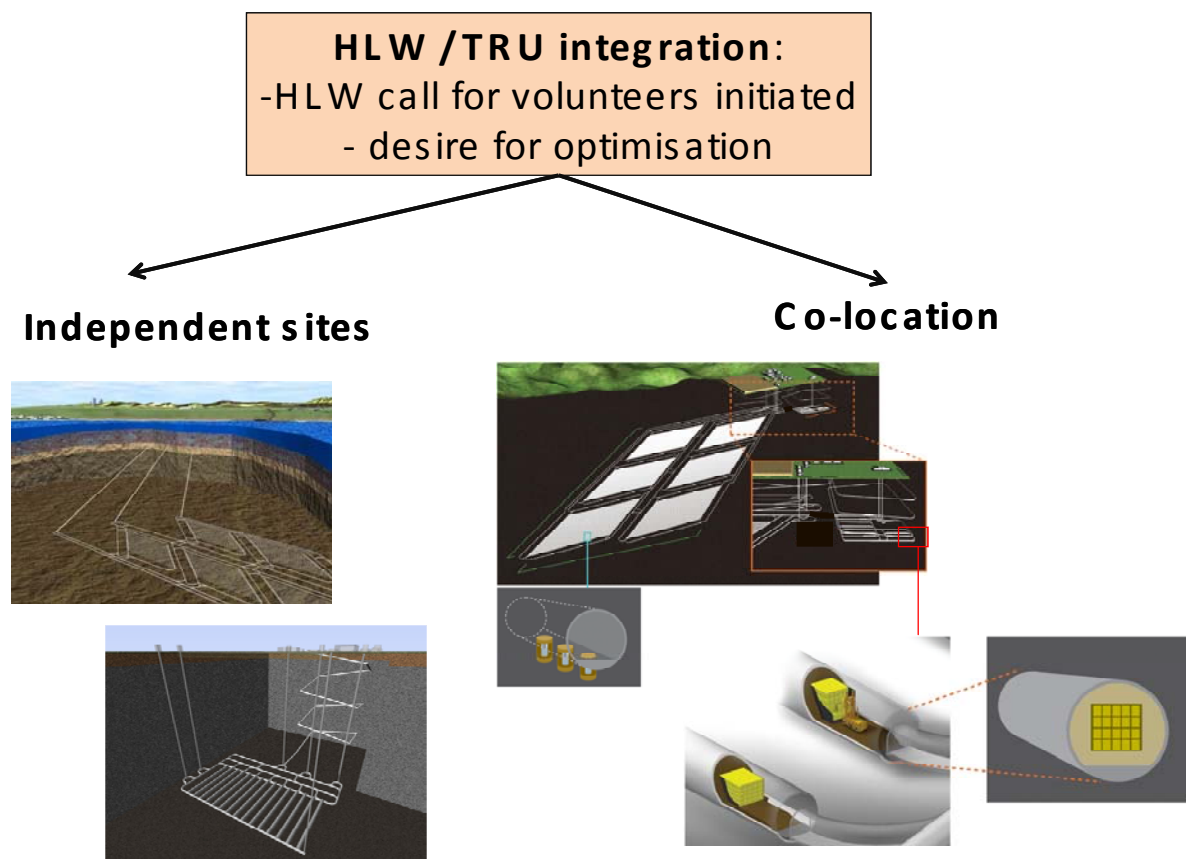


Figure 4 Sketches of possible HLW and TRU disposal options

NUMO'S R&D POLICY

The constraints already specified by the staged implementation of the geological repository make advanced planning essential; we have already done a lot of preparation for the literature study phase and planning the preliminary investigation phase is ongoing. Requirements to consider safety, cost and operational logistics has

led to supporting studies to examine stepwise development of designs, layout and operational plans. Here, practicality is the critical concern, which distinguishes our work from the idealized generic studies that have been carried out in the past. There is also a need for stepwise development of required technological; this will be implemented with requirements for closure being carefully kept in mind. To achieve our ambitious program milestones, we have to have a solid implementation philosophy. Naturally, we don't know how many volunteers we will get and what characteristics each volunteer site will have. Nevertheless, each volunteer site has common requirements for a tailored site evaluation program, a tailored repository concept and site specific performance assessment. Thus the implementation philosophy has to be a form of adaptive staging, intended to maintain flexibility without losing focus during such a long duration project. The methodology developed, the NUMO Structured Approach (NSA) [3] has been documented in detail in a recently published report.

The details vary somewhat, but we consider that the fundamental NSA is fully applicable to phases after site selection, including construction, operation and closure. Between selection of sites for PI and licensing of the chosen site, knowledge about the geological environment will have improved considerably and we will tailor the repository concept to the best available model of the site. The design will, however, also have to be optimised in terms of not only long-term safety, but also operational safety / practicality and quality assurance procedures. We have thus decided that establishing the methodology for carrying out such optimisation is a priority for R&D in the intervening period. The basic performance assessment modeling capability needs to be extended, however, to allow a more realistic assessment of total system performance, which will be needed to compare options. In addition, efforts are underway to rigorously assess operational phase safety and the practicality of assuring quality of the constructed engineered barriers. These are key components of the total safety case, which are identified as being in need of particular attention now, as they may better discriminate between sites while information is still limited.

The NSA is complemented by a series of other management tools, most importantly: an overarching Quality Management System and a Requirements Management System to support practical implementation of the NSA - in particular transparent decision-making. A further series of components provide the technical toolkit to assist day-to-day application of this process: these are described further in the NSA report.

The NSA provides a flexible approach to develop an optimised R&D plan, with clear priorities associated with either the progress in siting or the long lead time for development of understanding and technology needed at later program stages. This plan will, of course, be regularly updated as understanding develops and boundary conditions change - for example due to wishes of stakeholders such as the host community. It is particularly important to identify future needs - for example, despite the fact that volunteers have yet to come forward, the processes associated with repository closure are being discussed as this is important in defining the regulatory process and hence it is now a high priority area for NUMO to develop fundamental concepts.

CONCLUSIONS

The most important challenge for NUMO is, of course, to attract volunteers. The enhanced program to promote the HLW disposal project in Japan is being developed based on hard experience; the Japanese government, the electric power companies, and other concerned bodies will now prioritize their cooperation with NUMO. A particularly promising aspect of this program is the improvement and enhancement of dialogue with the public and the prompt and accurate response to misinformation by opponents. Until now, we have focused effort to develop technologies and to promote public understanding and cooperation only for the case of HLW disposal; in the future we have to make more efforts for TRU waste. Integrated disposal of TRU and HLW may be a practical option, but NUMO is open to examining all management approaches to find that most appropriate to the development of our siting efforts.. We will thus continue the open solicitation process, with co-location discussed based on the geological conditions and the opinions of stakeholders in potential host communities. Finally, we believe that our open and structured R&D program is critical to demonstrate technical competence and, in turn, enhances the credibility of our various public relations activities which we now consider to be even more critical than before.

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