

Nuclear Waste Issue

We must think about it now for the generation 100 years from now

High-level radioactive waste (HLW) from nuclear power plants: how should it be disposed of?
 Many people have heard through news reports or other media that this has become a social issue.
 What should we do now to prevent burdening future generations with this issue?



Photo: courtesy of Japan Nuclear Fuel Limited

To begin with, what is HLW? The basic policy of Japan is to promote a nuclear fuel cycle that reprocesses spent fuels and effectively utilizes the plutonium retrieved, from the viewpoint of effective utilization of resources and reduction of the volume and harmfulness of HLW. However, liquid HLW is generated even in the reprocessing process. This liquid waste will be solidified in combination with glass, and that is the final form of high-level radioactive waste (vitrified waste). Currently in Japan, which has used nuclear power generation for more than 50 years, vitrified waste already exists and is

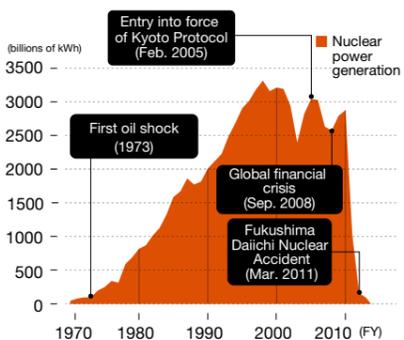
stored at surface interim storage facilities. If Japan continues to management such HLW above ground, future generations will face an extraordinarily high risk and burden for tens of thousands of years. In order to avoid this, the government of Japan is currently planning to implement geological disposal system (see next page) which means burying the waste in stable geological formation. Specifically, the Nuclear Waste Management Organization of Japan (NUMO) was established to play the leading role in implementing the geological disposal project, and NUMO has called for local government entries to the literature survey but no candidates has been found.

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The government of Japan will take the initiative in dealing with HLW and proceed with measures toward final disposal. In order to fulfill its responsibility, the government of Japan

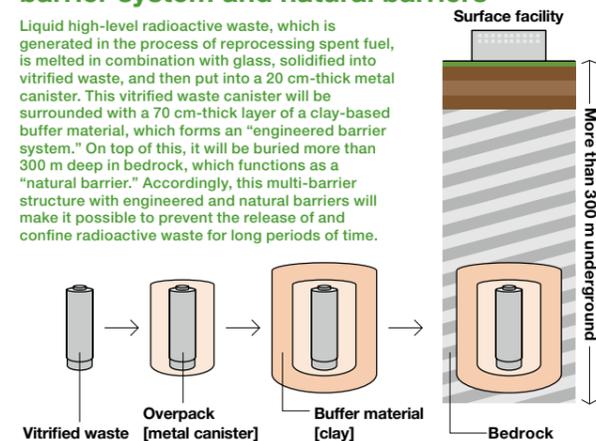
reconsiders the HLW final disposal policy from 2013. In May 2015, the Basic Policy was revised as a cabinet decision under Final Disposal Act, such as by suggesting scientifically preferable areas as the first step toward disposal site selection. However, this final disposal issue, especially concerning disposal site selection, cannot be solved only through one-sided efforts from the government. It is important that the individual residents in the local communities understand the issue itself and the necessity of its resolution before answering whether or not they can accept HLW in their communities. For that reason, it is essential to have close communication between the government, citizens, and experts. We will introduce activities for dialogues which have been organized by the government and NUMO on the following page. Knowing about such efforts in each local community will certainly give you an opportunity to think about the HLW issue for yourself.

Trends in Nuclear Electric Power Generation (kWh)



Confinement of radionuclide using a multi-barrier system employing engineered barrier system and natural barriers

Liquid high-level radioactive waste, which is generated in the process of reprocessing spent fuel, is melted in combination with glass, solidified into vitrified waste, and then put into a 20 cm-thick metal canister. This vitrified waste canister will be surrounded with a 70 cm-thick layer of a clay-based buffer material, which forms an "engineered barrier system." On top of this, it will be buried more than 300 m deep in bedrock, which functions as a "natural barrier." Accordingly, this multi-barrier structure with engineered and natural barriers will make it possible to prevent the release of and confine radioactive waste for long periods of time.



New process of disposal site selection based on the new Policy

According to the new process for disposal site selection, the government will first suggest the scientifically preferable areas to general public. After judging the progress in the local community's understanding, the government will make formal requests of (or, offers to) the relevant local governments for cooperation in investigations. It will then proceed to the three-step selection process which is prescribed by law: a literature survey using based on literature and other data such as past references and records, a general survey including a borehole survey, and a detailed survey to be carried out after constructing an underground facilities.



Regarding the geological disposal of HLW, the fact is that very few people show interest. What should we do to promote people's understanding about the issue in such circumstances? We asked Associate Professor Ekou Yagi, who has served as a facilitator at symposiums related to HLW.

Regarding the final disposal issue, there are various opinions. Some are negative. Some people have doubts or anxiety about the method of geological disposal. Some express objections about the site selection process, while others are against the use of nuclear power generation itself. However, in situations where it is difficult to say that many people are interested in this issue, it is important to go through the following process before arguing for or against the policy: talk with people who have as wide a range of different opinions as possible, learn about others' opinions and values, and then develop each person's own idea about the issue. Also, to date, various efforts have been made to increase dialogue on

the geological disposal issue. During a dialogue in which I also participated, someone once asked: "Why don't you stop endless discussions and proceed with the initial survey (literature survey) for a possible candidate area?" This opinion seems to support government policy in some respects. But I am not sure if the person who asked this question would have the same opinion if they lived in the survey area. It might be more difficult for them to come to a decision. It is important for each of us to consider these issues as if they directly affected us and to deepen this discussion. I think that advancement of discussion, including such considerations, will be a crucial factor in moving this project forward in the future.

Nothing can be gained from dialogue with a time limit. We need to exchange opinions in detail concerning all aspects of this issue and share our common understanding. And, above all, in order to deepen such efforts, it is essential to build trust in the government and NUMO as the main bodies. Who will take responsibility for pursuing this issue to the end? First of all, the responsible bodies must show their determination in confronting the issue. That must be the first step in communication or dialogue.



Personalizing the problem will allow for mature discussions

Dr. Ekou Yagi

Associate Professor at Center for the Study of Communication-Design, Osaka University
 Specializing in science and technology studies and human factors studies

Participants listened, thought about and discussed among themselves

Future Directions to Be Pursued Gleaned from Dialogue

To have people realize that final disposal is their own problem, regardless of whether they are for or somewhat against such disposal, is the first step toward resolving the final disposal issue. In order to have as many people become interested in final disposal as possible, METI has held nationwide symposiums and small group workshops in collaboration with entities including NPOs which are already engaged in local communities.

We held 18 symposiums throughout Japan with 3,600 participants!!

Opportunities to respond to participants' anxieties and questions

From May to June 2015, when the Basic Policy was revised as a cabinet decision, METI held symposiums for the purpose of deliberating the final disposal of high-level radioactive wastes (HLW) with the public in nine cities throughout Japan, including Tokyo, Osaka, and Nagoya. Furthermore, in October 2015, which was designated as the Month for Dialogue with the Public on Final Disposal of HLW, we held a second round of symposiums as part of the initiative. The discussion was deepened through employing various devices including using the most discussed themes from the first symposium, i.e. "How should appropriateness of disposal sites be determined?" and "How should we proceed with the selection of the sites?" etc. as the main themes for this series. We would like these symposiums to inspire individuals to deeply consider the final disposal issue, rather than to see final disposal an issue that only concerns some regions. These 18 symposiums were attended by 3,600 participants with a large array of diverse viewpoints. The greatest feature of the symposiums was that we focused on communication with the participants. We not only gave keynote speeches and provided information, including explanations of the national government's policies, but also made sure to spend sufficient time in communication with participants through question-and-answer sessions



Citizens expressed both support and opposition in direct information and opinion exchanges with experts and representatives from the national government and the Nuclear Waste Management Organization (NUMO) at the symposiums held nationwide.

and panel discussions and by continuing to answer participants' questions even after the symposiums concluded. As expected, participants were most interested in the safety of geological disposal and the new process for the selection of disposal sites, through which the national government suggests scientifically preferable areas. We thoroughly and carefully explained the safety of geological disposal based on scientific evidence. At the same time, concerning the selection of disposal sites, we demonstrated our intention to continue to hold dialogues and deliberate the issue together with general public and residents near potential disposal sites

due to our belief that it is most important to build a relationship of mutual trust with such residents. The outline of each symposium can also be seen on the METI website, and we have released the materials used in our explanations. We cannot proceed with a difficult issue like the final disposal of HLW if only people living or working near potential disposal sites are interested in the issue. In order to drive the whole society to deliberate this issue and to steadily proceed with a systematic resolution to this issue, we are committed to continuously holding dialogues and providing information in the future.

Workshop Hokkaido

In Hokkaido, a wide range of citizens including women and elderly residents who have an interest in geological disposal in local communities participated in the workshops. There were opinions from a variety of perspectives.



Keiko Sugita
Hokkaido Team
Let's discuss High-level Radioactive Waste
Ms. Sugita, as a facilitator and science and technology communicator, provides opportunities to connect medical care practitioners and residents.

The ability to draw out many opinions is important for facilitators

The discussions on potential final disposal sites for high-level radioactive wastes are very sensitive. Perceptions and opinions on this issue will differ depending on the participant's age, gender, career, and background. Needless to say, it is difficult to provide adequate responses to appease everyone. However, I think participants whose opinions have been listened to and whose wishes have been considered by a facilitator might feel convinced of our integrity to a certain extent. In principle, dialogues are an opportunity to carry out collaborative work in which a participant both shares their information and listens to other participants in a spirit of equality and honesty, rather than simply an opportunity for a participant to convince other participants to agree with his/

her opinion. Even if participants cannot approve of or agree with one another's assertions and opinions, each participant's feeling of difficulty caused by their conflicts of opinion and hard choices will lead them to the next step. I think a good dialogue has both the potential to encourage participants to take collaborative action and to uncover issues which need to be solved. It is easy to say, "Dialogues are important," but a mere gathering of people is not a dialogue. The more difficult the theme, the higher the level of skill the facilitator who leads the dialogue is required to have. I'm thinking of polishing my skills based on the experiences I acquired through this workshop, so as to further increase the number of productive dialogues.



Gathering a wide range of information to ensure positive outcomes for the next generation

In Kitakyushu, engineers of various ages and specialties met to hold discussions. I think this workshop inspired many engineers to develop their own ideas on how to address geological disposal. In a debate in which participants were divided into four groups, specific issues in ensuring safety came to the forefront. For example, continuous monitoring over the long term is expected to wear down the facilities, but carrying out excavation to repair the deteriorated monitoring equipment can increase the possibility of radiation leaks. How should we respond to problems that involve such trade-offs? I think we should address such problems by collecting engineering knowledge. In addition, we have heard a wide range of ideas, such as creative ideas for visually expressing the

safety of geological disposal in an understandable manner and ideas on the importance of the enhancement of public education to disseminate this knowledge to future generations. I think it is necessary to interpret geological disposal as an opportunity for the advancement of new technologies such as technologies for predicting earthquakes and faults to hand down such technologies to the next generation, rather than simply passing on a negative legacy to the next generation. An unfortunate side-effect of the massive benefits in our daily life provided by electric power is the production of CO2 and other waste products. We will be able to create a brighter future by seriously deliberating this issue and endeavoring to solve it.

Workshop Kitakyushu

Professional engineers who are experts in science and technology met to discuss the issues in ensuring the safety of geological disposal and handing down critical knowledge to children.



Yoshida Tsuyoshi
Association of CO2 Counselors in Kyushu and Yamaguchi NPO
Leveraging his expertise in measures against global warming, he is practicing and supporting environmental integrity activities in his household and local community.

We asked METI State Minister Takagi

What steps are necessary to solve the final disposal issue?

We asked Mr. Yosuke Takagi, State Minister of Economy, Trade and Industry, who visited a planned final disposal site in Europe, about his thoughts on solving the issue.



--- Regarding the final disposal of high-level radioactive wastes, what do you think is necessary now in order to move forward to resolve this issue?

Takagi: I think that it is most important to enhance people's trust in two areas: one is trust in the science behind this, and the other is the trust in the people involved in the work with high-level radioactive waste, including electric power companies, the Nuclear Waste Management Organization of Japan (NUMO), and the government. Geological disposal has many advantages; for example, it is hardly influenced by natural disasters such as earthquakes and typhoons, and

metal in the containers is protected from oxidation because there is very little oxygen present. Many people in Japan, however, are not aware of such scientific facts.

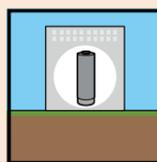
Additionally, what kinds of steps are the government and related organizations taking to determine the disposal site? It is likely that not many people understand this. It is natural in a sense to feel anxiety about what we do not understand. Thus, the government's role is to increase people's trust concerning these two aspects through the provision of accurate information. I think that a strong relationship of trust will be a powerful driving force in resolving these issues.

--- State Minister Takagi, you also visited a planned final disposal site overseas. What impression did you have?

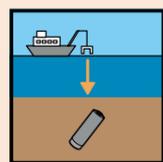
Takagi: The visit reaffirmed my conviction that having correct information is critical. My trips to Finland and France served to provide me with a much deeper understanding of the final disposal issue. For example, at ONKALO (underground rock characterization facility), which is at the planned final disposal site for Finland, construction has been steadily proceeding through careful operations including with the excavation of a tunnel that goes down a vertical distance of 1 meter for every 10 meters excavated. Also, analysis of geological surveys is conducted simultaneously with the work, including analysis of the state of the fault planes. Geological disposal is not simply digging into the ground to bury the waste. In addition, after seeing the real construction site, the civil engineering technology demands for this disposal method are obvious. Such thoughts again firmly convinced me that geological disposal would be fully possible in Japan, too. As demonstrated by construction of the Kanmon Tunnel and the Seikan Tunnel in the past, and by the ongoing construction project for a giant tunnel going through the Southern Alps of Japan

What about disposal methods other than geological disposal?

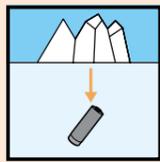
It is a huge risk and burden for humans to manage high-level radioactive wastes on the ground over tens of thousands of years. Therefore, various methods have been considered around the world, including sub-seabed disposal through isolation under the seabed, ice sheet disposal through burial under the Antarctic ice, and space disposal through launching waste into space with rockets. However, due to existing treaties and doubts about the reliability of rocket launching technologies, geological disposal is also internationally regarded as the optimal method at the present time. To date, Finland and Sweden have already determined their disposal sites. France is also planning to select a candidate site near its underground research laboratory.



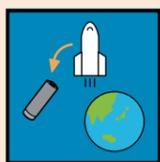
Long-term management



Sub-seabed disposal

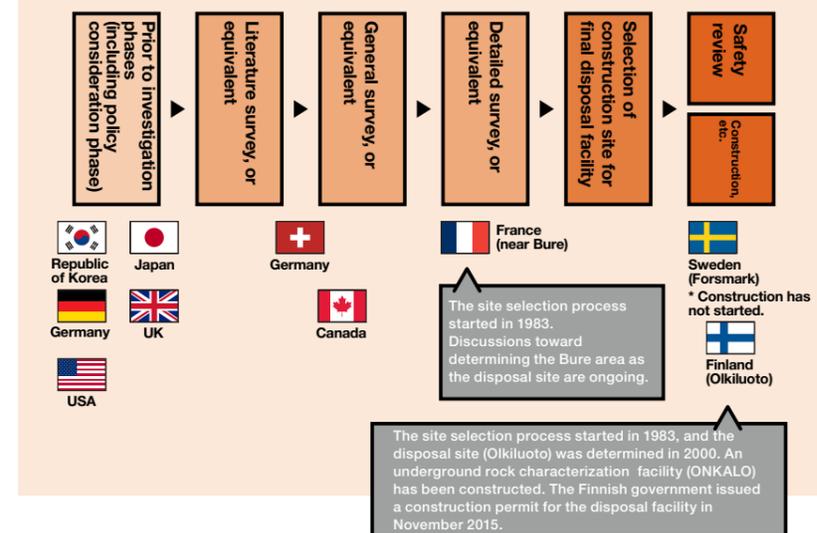


Ice sheet disposal



Space disposal

Overseas Situation



for linear-motor Shinkansen trains, Japanese civil engineering technology and tunnel excavation technology are the world's best.

Sufficiently thorough for resolution, without burdening future generations

--- In Finland, for example, what kind of process did they follow to determine the planned final disposal site?

Takagi: Essentially, Finland also carefully discussed the issue as a

nation, which is the same as our current approach in Japan. Finland started the disposal site selection process in the 1980s, and determined the final disposal site in 2000. It took nearly 20 years to decide. When I visited Finland, a local official explained that it created new employment, and the municipality has the advantage of obtaining income from the fixed asset tax. That left an impression on me. This is a win-win relationship between the government and the municipality of the planned disposal site.

--- Lastly, please tell us your thoughts on this issue.

Takagi: I understand, for example, regarding the resumption of the operation of nuclear power plants, that there are both opinions in favor and against it. However, the final disposal of a massive amount of high-level radioactive wastes which already exists must be resolved, regardless of opinions in favor of or against nuclear power plants. Of course, it is essential as a prerequisite to take sufficient time engage in nationwide discussions in order to steadily move forward. I mentioned the importance of trust in the beginning, but a relationship of mutual trust cannot be established without dialogue. On the other hand, it is an important principle that we should not leave this problem to future generations. We must not forget about it. The final disposal of high-level radioactive wastes is our problem, which our generation, which has received benefits from nuclear energy, should solve. As for myself, I will continue to take responsibility for this issue to resolve it as the State Minister of Economy, Trade and Industry, as a statesman, and as a Japanese citizen.



METI | Comments by the personnel in charge

Efforts we are making to remove the burden of high-level radioactive waste for future generations.

Are you familiar with the term "high-level radioactive wastes"?

In July 2015, for the first time in five years, we presented a booth teaching about geological disposal at events held in conjunction with METI Kids Day.

Despite the current critical view of nuclear power generation, over 500 parents and children entered the booth to learn about this issue with 3D cinema and experiments over two short days.

Concerning the final disposal issue, we are very interested in allowing people to recognize the necessity of geological disposal and to that end, we have made continuous efforts to communicate this necessity through a variety of events since May 2015 including holding symposiums and town hall meetings nationwide.

At those meetings, we received some

criticism and many questions, for example, "Is it really possible to realize geological disposal?" and "Isn't the national government going to one-sidedly determine the disposal sites and force residents near such sites to accept its decision?" Meanwhile other people commented, "This is the first time I've heard about this issue," and "I will discuss this issue with my family when I get home."

We shouldn't proceed with the final disposal of high-level radioactive waste if too few people have an interest in such disposal.

We would like citizens to have an interest, no matter how small, in this issue, and we would definitely like people to support our efforts for final disposal when we proceed with the selection of a disposal site. We will continue visiting various places throughout Japan to communicate and discuss the importance of this fact.



Chikako Ogami, Assistant Director
Akihiko Fujioka, Subsection Chief
Radioactive Waste Management Policy Division,
Agency for Natural Resources and Energy

In addition to surveys and studies to improve the reliability of technologies for the geological disposal of high-level radioactive waste, this Division is conducting nationwide information provision and dialogue regarding the necessity of and future efforts for this disposal method.