EFFORTS IN THE FIELD OF EDUCATION FOR JAPANESE GEOLOGICAL DISPORSAL OF HIGH-LEVEL RADIOACTIVE WASTE

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Abstract

Nuclear Waste Management Organization of Japan (NUMO) was established in October 2000 based on the "Specified Radioactive Waste Final disposal Act" as the authorized implementing entity approved by the Minister of Economy, Trade and Industry (METI). Since its establishment, NUMO has been engaging in public communication to increase an understanding of the importance of the geological disposal project.

The geological disposal is the 100-years project from the start of investigation for exploring a repository construction site till the closure of the repository. Therefore, multiple generations will be involved in this project. For raising awareness of the geological disposal project as one of social issues among next generations, especially elementary school and junior/senior high school students, NUMO has been supporting school teachers and college students who are willing to work on developing teaching plans and materials. NUMO encourages them to actually teach geological disposal to their students in their school classes. In 2016 NUMO produced basic teaching materials for elementary school students/junior high school students/and instructional materials for teachers and distributed them to education committee and schools across Japan.

NUMO also has been supporting college debate classes on the topic of geological disposal of high-level radioactive waste since 2012. NUMO provides its supports by sending experts on radiation and geological disposal for special lectures, by organizing tours to local nuclear power plant and a research facility of geological disposal and by answering to various questions from the students. In addition, NUMO has been carrying out communication activities using a communication vehicle "Geo Mirai", where exhibits and a 3D-animation theater are installed, throughout Japan. Thorough these activities various questions and opinions have been obtained from a wide range of generations which will be utilized to improve NUMO's communication.

1. Introduction

NUMO was established as the implementing body of the Japanese geological disposal project of high-level radioactive waste in October 2000 in accordance with the "Specified Radioactive Waste Final disposal Act".

Since the establishment, NUMO has put its efforts on continued technical development and has expanded public relations and communication activities for raising awareness about and disseminating an understanding of the importance and safety of the project to date.

This paper introduces outlines and outcomes of NUMO's efforts in the field of education and current communication activities targeting the next generation.

2. Efforts in the field of education

To enhance an understanding of the geological disposal project over long time periods, it is important to have the next generation who will play a core part of shaping future national opinion know of and raise their awareness about geological disposal of high-level radioactive waste as one of social issues.

To tackle this, NUMO has been supporting school teachers who are willing to work on developing teaching plans and materials and college students aiming to be teachers for disseminating an understanding of geological disposal of high-level radioactive waste among the next generation (elementary, junior/senior high school students).

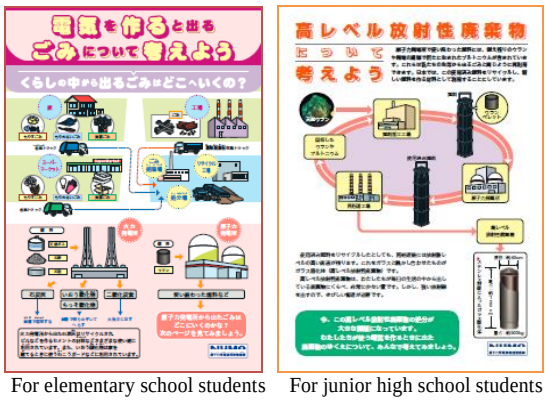
In 2013, when NUMO launched this approach, it held workshops in 10 different locations throughout Japan. With prior information provision about the geological disposal project, it had discussions with teachers to seek solution to this issue. From 2014, NUMO started to support teachers' groups in about 10 different locations, which study this issue aiming to actual practices in classrooms (e.g. development of teaching plans and materials).

Outcomes such as teaching plans and class reports including videos of teaching scenes are shared on NUMO's specially set-up website, and they can be

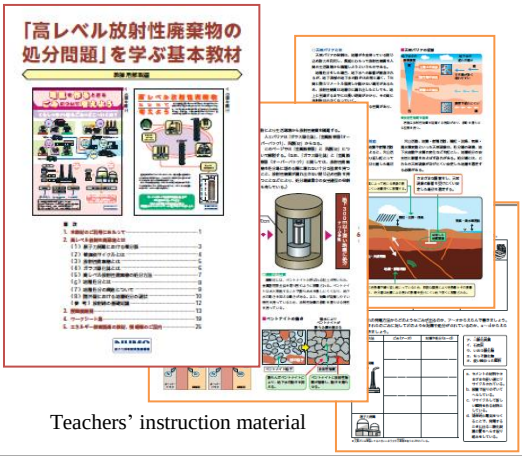
downloaded for free for further utilization (the outcomes posted on the website: 45 teaching plans (23 for elementary schools, 16 for junior high schools and 6 for senior high schools), 11 class reports, etc, as of October 2017).

Additionally, every March, NUMO holds a national workshop, inviting school teachers throughout the country to report outcomes from their workshops and share their information interactively. By posting the contents of the national workshop in newspapers specializing in education, those educators who could not participate in the workshop were also adequately informed.

In 2016, with support from teachers, NUMO produced teaching materials for elementary and junior high school students and an instructional material for teachers, and distributed them to the Boards of Education and schools of high interest in energy education nationwide. The material for elementary school students focuses on "Waste from electricity generation", and the one for junior high school students focuses on "Energy problems", and the teachers' instructional material includes teaching plans, worksheets and the procedure of a bentonite experiment, which teachers who deal with this issue in their classes for the first time can easily utilize.



For elementary school students　For junior high school students



Teachers' instruction material

Figure 2.1: Teaching materials

Comments received from teachers included positive feedback. For example, "Figures and explanations are easy to understand" or "It's useful because contents can be explained in turn from the top". Thus, it led to the increase in distribution of the materials to local schools and utilization in classrooms.

As results of continued efforts, after a thorough study of this issue, teachers who did not have enough knowledge before came to be able to teach it in their classes. According to reports from teachers, over 208 classes were conducted nationwide and about 7,000 students took them.

Furthermore, the publication of the "Nationwide Map of Scientific Features for Geological Disposal" by the Government this July increases teachers' interest in this issue. In response, through the Boards of Education nationwide, NUMO is currently providing information to teachers outside these activities.

NUMO will continue these efforts in the field of education and develop an environment where both teachers and students can learn the geological disposal project as their own important issue.

FY	Number of Workshop participants	Number of the national workshop participants	Number of practices in classrooms
2013	288	92	—
2014	239	91	32
2015	212	160	79
2016	324	218	97
Total	**1,063**	**561**	**208**

Table 2.1: The result of workshop participants and practices in classrooms

3. Delivery lectures on geological disposal

Since 2015, NUMO has been providing information by visiting school classes and educators' meetings. By the end of March 2016, NUMO lectured to about 3,000 people in 54 schools within two years. Most of requests were from universities. In addition to the lecture on geological disposal NUMO performs an experiment to show characteristics of the bentonite. Lectures including discussions in which participants can think about geological disposal as their own issue (e.g. "What kind of places are suitable for geological disposal?" "The possible risks and measures of geological disposal", etc.)

FY	Times (Number of students)			
	Elementary school	Junior high school	Junior college, University	Educators meeting
2015	2 (142)	1 (141)	12 (912)	7 (202)
2016	2 (244)	3 (169)	20 (910)	7 (216)
Total	**4 (386)**	**4 (310)**	**32 (1,822)**	**14 (418)**

Table 3.1: The result of delivery lectures

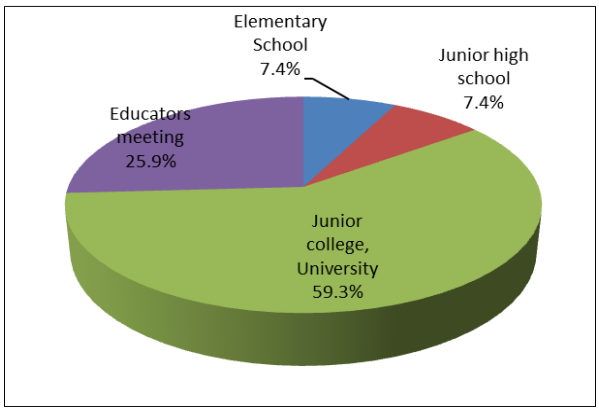


Table 3.2: The ratio of delivery lectures

In the case of the lecture at universities, NUMO carries out surveys by a questionnaire to see if there is any change in thoughts of participants: "Was there the change of your feeling to take a lecture?" 70-80 percent of students said “yes” to the question. To the question, "What was the change of your feelings?" A lot of students marked the choice "I want to tell my family or a friend about what I learned” “I am interested in this topic and wanted to check it in detail in web page".

Once NUMO has an opportunity to give a lecture on geological disposal, we are often asked to deliver lecture once again. It seems that the teachers and student realize the importance of this issue once they have an opportunity to learn about it.

4. Support on college debate classes on the topic of geological disposal of high-level radioactive waste

NUMO has been supporting college debate classes which deal with the topic of geological disposal of high-level radioactive waste since 2012. About 380 college students took these classes. The theme of debate is “Should Japan abolish the geological disposal program of high-level radioactive waste and mandate its permanent active control?”. NUMO supports these classes by sending experts on radiation and geological disposal for special lectures, by organizing one-day tours to a local nuclear power plant and a research facility of geological disposal and by providing answers to their various questions.

In dealing with issues on “controversial facility” such as a repository, it is more likely that opinions of the public and local stakeholders are polarized, and proponents and opponents tend to end up with just advocating their own views to each other. Thus, it is anticipated that local stakeholders will make their own judgments after learning both sides of opinions. In these circumstances, NUMO considers that an approach of developing one’s opinion based on learning simultaneously both sides of views can be very effective.

Additionally, since current debate classes are carried out in the Department of Education, it is thought that a majority of students who take these classes will engage in education-related occupations. Thus, it is expected that such future candidates of educators will provide information of geological disposal to the next generation through classes based on their knowledge gained in debate classes during college years.

It is also expected that NUMO can obtain valuable information on what these students in debate classes concern about geological disposal after obtaining a sufficient amount of knowledge on the geological disposal project through classroom debates.

Figure 4.1: A debate class in University

5. Dialogues using a communication vehicle, “Geo Mirai”

Since 2013, NUMO has been carrying out face-to-face dialogues to visit local cities with its communication vehicle, “Geo Mirai” for disseminating an understanding of geological disposal throughout the country (see figure 5.1).

The dialogues were carried out in various places, such as science museums, commercial facilities and parks where participation of the next generation can be expected. By the end of March 2017, NUMO visited 89 locations and communicated with about 58,000 visitors.

Figure 5.1: Exterior view of communication vehicle, “Gio Mirai”

In the communication vehicle, NUMO explains about geological disposal, especially for the next generation, in a comprehensible manner, by showing a 3D animated movie that explains the importance and safety of geological disposal; by displaying mockups of the multiple barrier system; and by performing hands-on experiments with bentonite clay to show its characteristics.

Comments received from visitors included positive feedback. For example, "It increased my understanding of NUMO's efforts for geological disposal" or "Wide-ranging discussions on geological disposal are needed as it is a national agenda".

Thus, NUMO learned that the dialogues using such a communication car were quite effective for raising interest in and awareness of geological disposal.

Figure 5.2: Inside communication vehicle "Gio Mirai

NUMO carry out the following actions.

- Hosting events for families in nationwide science museums among other places:
  Hold seminars on geological disposal in national museums and other available locations country of the whole and explanation in the display booth
- Organizing tours for families to visit domestic underground research facilities:
  For targeting elementary and junior high school students and their parents, opportunities for visiting domestic underground research facilities are provided.

6. Lessons learned from communication activities for the next generation to enhance their understanding of geological disposal

- To have teachers deal with the topic of geological disposal in their classes, support is needed to reduce their time for class preparation through provision of teaching plans and materials. In addition, since many teachers use a PC and beamer in their classes these days, provision of other materials such as PowerPoint slides is helpful.
- For junior high school students or older, general materials in communication activities can be used with explanation in plain words, however, for elementary school students, more attractive measures such as using video materials is needed.
- Today, since "Active learning" is recommended in the field of education and difficult social issues, such as geological disposal, is used for group work.
- When exchanging opinions with university students of high understanding, they will understand the safety measures of geological disposal, however, they still feel uncomfortable about accepting a repository near their houses. It suggests that understanding safety of geological disposal does not always lead to peace of mind and such a negative feeling would not change even with additional information provision. Therefore, further consideration is needed in this problem.

7. Conclusions

For pursuing the geological disposal project of high-level radioactive waste in a steady manner, it is important that public understands why the project is needed and how to ensure the safe. Especially, NUMO considers that it is important to raise interest and awareness of the next generation since the project requires almost one hundred years from the start of investigation for site selection till the closure of the repository.

NUMO will continue making effort that the next generation and educators will have an opportunities to learn geological disposal.