Experience from Siting and Design of the Wolsong Low- and Intermediate-Level Radioactive Waste Disposal Center in Korea

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1. Introduction

The objectives and associated set of internationally agreed upon principles of radioactive waste management clearly state that radioactive waste has to be dealt with in a manner that protects both human health and the environment, both now and in the future, without imposing undue burden on future generations [1]. Low- and Intermediate-Level Radioactive Waste (LILW) in the Republic of Korea is generated from commercial nuclear power plants (NPPs), research institutes, nuclear fuel manufacturing facilities, and spent radioisotopes (RI). After the Atomic Energy Act in 1986, the South Korean government has failed nine times to secure a disposal site from 1986 to 2004. A new announcement from the government to change the site selection procedure, in 2005, made Gyeongju city as a candidate site. In January 2007, the Korea Hydro & Nuclear Power Co., Ltd. (KHNP) submitted an application to the national nuclear regulatory authority, the Ministry of Education, Science and Technology (MEST), for the first stage license that would authorize ther KHNP to construct and operate the Wolsong LILW Disposal Center. In this paper, we discuss experiences from siting and design of the Wolsong Low- and Intermediate-Level Radioactive Waste Disposal Center.

2. Site Selection

Since the creation of the legal grounds for the implementation of the project by the 1986 revision of the Atomic Energy Act (AEA), the Government of the Republic of Korea has actively implemented the selection of the sites for radioactive waste disposal facilities. There have been nine failed attempts to secure a disposal site from 1986 to 2004 due to 1) safety concerns about the disposal facility, 2) lack of transparency and fairness during project implementation, and 3) lack of social consensuses among the stakeholders.

In February 2004, the Ministry of Knowledge Economy (MKE) announced new site selection procedures, and MKE/KHNP endeavored in various ways to enhance the acceptance by local residents of disposal facilities. As a result, local residents voluntarily petitioned to host the facilities in ten areas, but site selection ultimately failed due to the absence of preliminary applications by local government heads.

Afterwards, on March 11, 2005, the MKE organized the Site Selection Committee (SSC) in order to guarantee the transparency and fairness of the site selection process. The SSC, consisting of 17 civilian experts from diverse fields, managed and supervised the entire site selection process. In addition, the "Special Act on Support for Areas Hosting Low and Intermediate Level Radioactive Waste Disposal Facilities" was legislated and announced on March 31, 2005 to stipulate support for areas hosting LILW disposal facilities, including special financial support, entry fees, and relocation of the KHNP headquarters. The act also stipulated the following to enhance the democracy and transparency of the selection process: 1) the host area is to be selected through resident voting in accordance with the Referendum Act, 2) the selection plan, site survey results, and selection process are to be implemented openly and transparently, and 3) open forums and discussions are to be held for the local residents.

Accordingly, on June 16, 2005, the MKE announced the candidate site selection method and procedures as well as the support to be provided to the host areas and initiated the process through an announcement regarding LILW disposal facility candidate site selection. Regarding candidate site selection procedures, as depicted in Fig. 1, the local governors applied to host the facilities with consent from local councils. Then, in accordance with the results of the site suitability assessment, the MKE requested local governors to conduct the local referendums in appropriate regions in adherence with the Referendum Act. Local governors proposed and held the referendums. Based on the results of the local referendums, areas with the highest percentage of favorable responses would be selected as the final candidate site.

The local governments that had appropriately applied to host the LILW disposal facility by August 31, 2005 were in the four areas of Gunsan, Gyeongju, Pohang, and Yeongdeok County, and these four local governments conducted referendums. In accordance with the results of the referendums, with the percentage of favorable responses among its residents amounting to 89.5%, Gyeongju was selected and announced as the final candidate site on November 3, 2005; the results of the referendums in the four cities and counties are given in Table 1. On January 2, 2006, the MKE designated and thereupon announced that the prospective rural development area comprising the entire 49 Bonggil-li, Yangbukmyeon, Gyeongju, North Gyeongsang Province (approximately 2,100,000㎡) had been selected as the final candidate site for the LILW disposal facility (the MKE Notice No. 2005-133).

Table 1. Results of referendums for site selection (2005).

Classification	Gyeongju	Gunsan	Yeongdeok	Pohang
Number of eligible voters	208,607	196,980	37,536	374,697
Number of actual voters (absentees)	147,636 (70,521)	138,192 (65,336)	30,107 (9,523)	178,586 (63,851)
Voter turnout	70.8%	70.2%	80.2%	47.7%
Percentage of favorite responses	89.5%	84.4%	79.3%	67.5%

3. Facility Design

A rock cavern type disposal facility initially scheduled to dispose of 100,000 waste packages (and ultimately 800,000 waste packages) was conceptualized. The current licensing application for a 100,000 waste package (waste volume of 35,200 m^3) facility has been approved simultaneously for operation and construction. For 100,000 waste packages, the total radioactivity is about 5.63E+15 Bq. The disposal facility consists of six silos, and the capacity of each silo is approximately 16,000 drums. LILW in the Republic of Korea is generated from commercial NPPs, research institutes, nuclear fuel manufacturing facilities, and spent radioisotopes (RI).

The facility layout of six disposal silos for the initial 100,000 waste packages is depicted in Fig. 2. The engineered barrier system of the disposal silo consists of waste packages, disposal containers, backfills, and a concrete silo. The conceptual drawing of the post-closure disposal silo is presented in Fig. 3. [2]

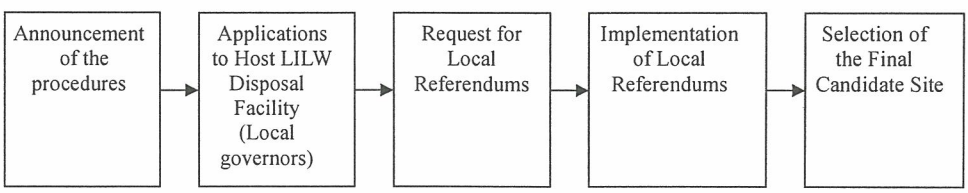

Fig. 1. Site selection procedures of the LILW disposal facility.

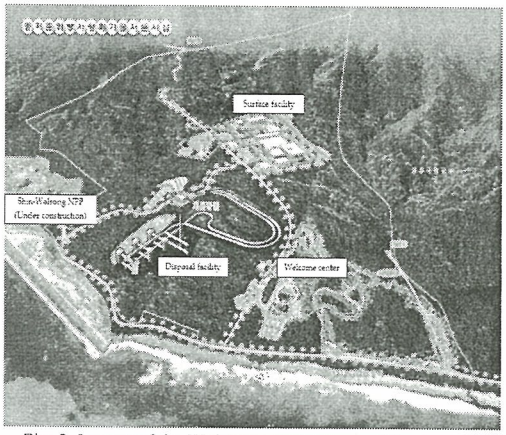

Fig. 2. Layout of the Wolsong LILW Disposal Center.

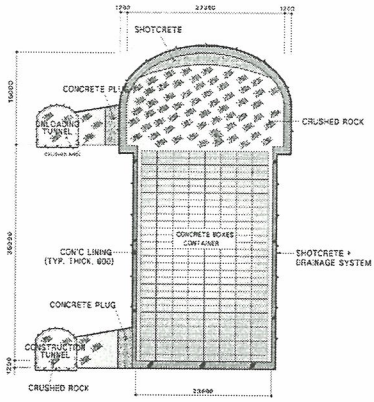

Fig. 3. Concept of disposal silos after closure at the Wolsong LILW Disposal Center.

4. Conclusion

The departure of the Wolsong LILW Disposal Center and the KRMC implies the necessity to change the existing domestic waste management system. Since the complete pathway of the LILW is now established from generation to disposal, the waste management system can proceed naturally to disposal. Until now the regulation has reflected a viewpoint of disposal in predisposal management, but from now on the disposal facility operator should be a practical controller in this stream. This change is very natural in that the acceptance of waste in disposal is judged by the disposal facility operator in terms of its own criteria which specify waste characteristics and, thus, all the previous steps, including pretreatment of waste, treatment, conditioning, storage, and characterization.

A proper apportionment and mutual assistance is essential between the disposal facility operator, waste generators, and the regulatory institute so that the new system will work well. First of all, the disposal facility operator should establish guidelines on relevant predisposal management and the waste characterization program in relation to disposal, and provide them for waste generators and predisposal managers in a timely manner. Waste generators and predisposal managers should check the existing methods and practices for waste management in terms of the waste acceptance criteria, and adjust them, if necessary, to the repository operator's guidance under close cooperation with the operator.

In addition, the regulatory institute should distinguish the respective scope and content of the regulation, as mentioned above, between the predisposal management and the disposal of waste, and refer to or consult the disposal facility operator about predisposal matters. In short, there is a necessity for close cooperation among the related organizations, particularly for this transition period so that the system can settle down.

3. REFERENCES

[1] IAEA, Safety Fundamentals "The principles of radioactive waste management," Safety Series No. 111-F, Vienna (1995).

[2] Jin Beak Park et. al., "Wolsong Low- and Intermediate-Level Radioactive Waste Disposal Center: Progress and Challenges, *Nuclear Engineering and Technology*, (2009) 41:1-16.