

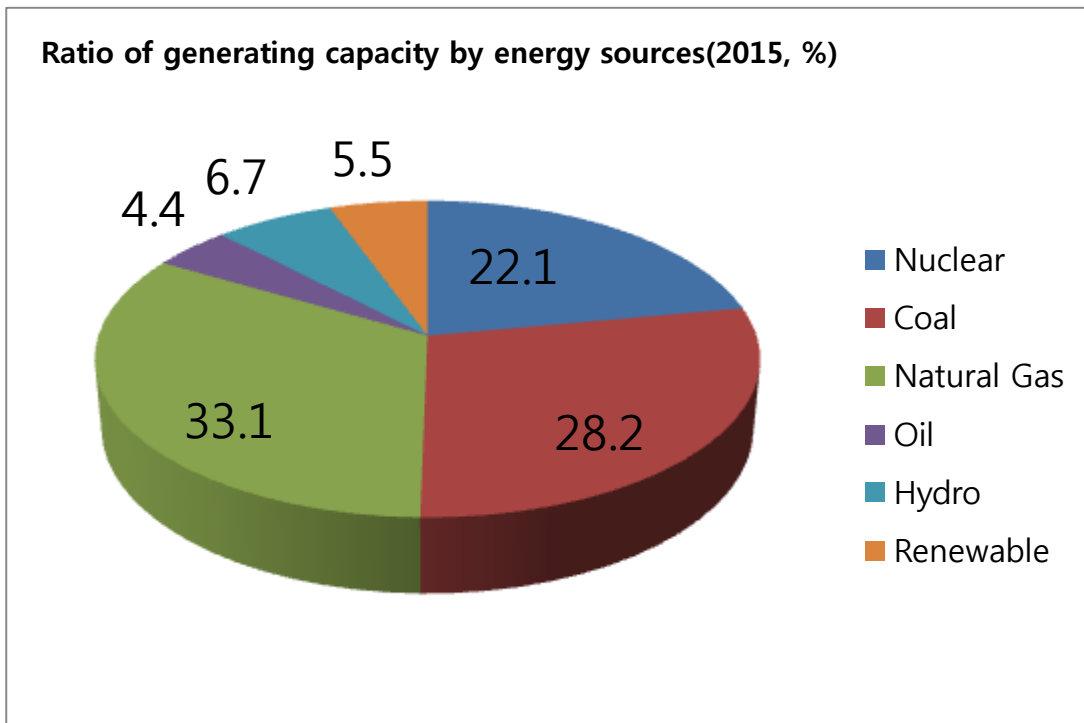
RADIOACTIVE WASTE MANAGEMENT PROGRAMMES IN OECD/NEA MEMBER COUNTRIES

KOREA [2016]

NATIONAL NUCLEAR ENERGY CONTEXT

Commercial utilization of nuclear power in Korea started in 1978, and there are 24 reactors in operation as of Dec. 2015. In 2015, NPPs generated about 164.8 TWh of electricity, 28.5% of the total electricity generated that year. The 24 reactors are located at 4 different sites (Kori, Hanbit, Hanul, and Wolsong). The four reactors at the Wolsong site are Pressurized Heavy Water Reactor (PHWRs), while the others are Pressurized Water Reactors (PWRs).

Three reactors are under construction and six reactors are planned for construction. According to the 7th Basic Plan of Electricity Supply and Demand, the total number of reactors to be constructed by 2019 will be 12, which means nuclear energy will account for 23.4% of total generating capacity in Korea.



Source: http://home.kepco.co.kr/kepco/KO/ntcob/list.do?boardCd=BRD_000097&menuCd=FN05030101

SOURCES, TYPES, AND QUANTITIES OF WASTE

The Nuclear Safety Act (NSA) defines ‘Radioactive Waste’ as radioactive materials or other materials contaminated by such radioactive material (including spent nuclear fuel), which is all subject to disposal.

Under the NSA, Radioactive waste in Korea is classified into two categories. One is high-level radioactive waste (HLW) defined as radioactive waste with specific activity greater than 4,000 Bq/g of alpha-emitting radio nuclides with a half-life of more than 20 years and a heat-generating capacity exceeding 2 kW/m³. In Korea, HLW consists of only spent nuclear fuel (SNF). Low-and-intermediate level waste (LILW) means the radioactive waste other than the HLW.

LILW is defined to be categorized by its radioactivity in the Enforcement Decree of the NSA and details regarding LILW sub-categorizations are described in the Nuclear Safety and Security Commission (NSSC) Notice No. 2014-003. According to the Notice, LILW is classified into three sub categories: very low level waste (VLLW), low level waste (LLW) and intermediate level waste (ILW).

The cumulative amount of SNF generated from NPPs is 16,290 assemblies from PWRs and 408,796 bundles form PHWRs as of Dec. 2015. SNF from NPPs has been currently stored at four reactor sites, either in SNF pools or in dry storage facilities (only applies to PHWRs).

LILW is generated from NPPs, nuclear fuel fabrication plant, Korea Atomic Energy Research Institute (KAERI), and other institutions such as hospitals, industry and universities using radioisotope. LILW generated from NPPs consists of dry, active waste; solidified liquid waste; spent resin; and spent filters. By the end of 2015, 98,887 drums (200 liter/drum) of LILW were generated from NPPs. About 6,163 drums were transported from NPPs to the Wolsong LILW Disposal Center (WLDC), and the rest are stored at four reactor sites. The amount of SNF and LILW generated from each NPP site as of Dec. 2015 is listed in Table 1.

Before the underground silo type facility in WLDC started operation, the RI waste had been collected and stored at RI Waste Management Facility of Korea Radioactive Waste Agency (KORAD). Since July 2015, RI waste has been transported to the WLDC directly from the place of origin. By the end of 2015, about 3,225 drums of RI waste were generated.

Table 1. Inventory of SNF and LILW generated from reactor operations (as of Dec. 2015)

Nuclear Power Station		HLW (SNF)		LILW	
Site	Number of Reactors	Storage Capacity (Assemblies, or Bundles)	Cumulative Amount (Assemblies, or Bundles)	Storage Capacity (Drums)	Cumulative Amount (Drums)
Kori	6(PWR)	6,494	5,613	61,592	43,702
Hanbit	6(PWR)	9,017	5,693	26,412	23,166
Hanul	6(PWR)	7,066	4,855	24,091	18,812
Wolsong	4(PHWR)	499,632	408,796	23,603	13,207
	2(PWR)	1,046	129		
Total	24	523,255	425,086	135,698	98,887

Source: http://www.khnp.co.kr/board/BRD_000178/boardMain.do?mnCd=FN050801

RADIOACTIVE WASTE MANAGEMENT POLICIES AND PROGRAMMES

Waste management policies

The national policy on radioactive waste management is determined by the Atomic Energy Promotion Commission (AEPC) (formerly called Atomic Energy Commission (AEC)). The 249th meeting of the AEC, which was held in Sept. 1998, developed a “National Radioactive Waste Management Policy” aiming to construct and operate a LILW disposal facility by 2008 and a centralized SNF storage facility by 2016; however, the site selection had not been successful. Therefore, a revision of the policy was made at the 253rd meeting of the AEC held in Dec. 2004. It was decided that an LILW repository should be constructed by 2009. Wolsong was determined to be an LILW repository site, and the 1st stage of construction of the disposal center was completed in June 2014, and approved for operation in December 2014.

The national policy on SNF management has not been decided yet. Because the 253th meeting of the AEC stipulated that a national policy for SNF management should be determined later considering domestic and international technologies and a public consensus. Currently, SNF is being stored at a reactor site under the KHNP’s responsibility.

After establishing in 2009, KORAD undertook the study on SNF management option to technically support the policy-making through expert group consensus. The study was finished in 2011. In Nov. 2011, the government established a ‘Forum for SNF Management Policy’, whose members included experts in various fields, member of NGOs, and local residents of NPP sites. After 10-month review of SNF management options and the gathering of public opinions, the Forum submitted a final report to the government in Sept. 2012. The recommendation consisted of 14 agendas including ‘construction of the interim storage facility no later than 2024’. Then, in Nov. 2012 the Atomic Energy Promotion Commission decided to proceed with the Public Engagement under the provision of the Radioactive Waste Management Act (RWMA).

Based on the decision made in 2012, the public engagement started with the launch of the Public Engagement Commission on SNF management (PECOS) in October 2013. PECOS consisted of 12 members, who are experts in human & social science and technical engineering, representatives recommended by residents in NPP areas. The commission played a role of deciding principles and methods of the public engagement program, initiating public consultation and discussion, and submitting recommendation to government after in-depth review and analysis on SNF management options.

In June 2015, PECOS submitted the recommendation report to the government as a result of the public engagement. It includes that the safety for people comes top priority of national policy on SNF management, the final disposal facility for SNF should be constructed by 2051, and the URL site should be selected by 2020.

The national policy on SNF management will be made based on the result of the public engagement, taking into consideration the national/international trends on policy and technology development.

LILW management Practices

LILW generated during the operation of NPPS is subjected to treatment process such as volume reduction, stabilization, etc. at on-site treatment facilities. These wastes are stored at the temporary storage facilities at reactor sites before transported to the WLDC for final disposal. RI waste generated from domestic RI users is collected by KORAD, responsible for safe management of radioactive waste including SNF.

After Wolsong, located in the outskirts of Gyeongju city, was designated as the LILW disposal site, many efforts were made for the 1st phase construction of underground silo type facility. The construction of the underground silo type facility was completed in 2014, and the Nuclear Safety & Security Commission (NSSC) approved its operation in December of the same year. The underground silo type facility can accommodate about 100,000 drums. After stepwise expansion, the overall capacity of WLDC will be 800,000 drums.

As the 2nd phase construction, the license application for the near surface disposal facility of WLDC was submitted to the government in Dec. 2015. The 2nd phase facility of WLDC is scheduled to be completed by the end of 2019, accommodating 125,000 drums. KORAD also plans to construct the 3rd phase facility for decommissioning waste disposal.

SNF management Practices

Active nuclear energy utilization causes a significant amount of SNF accumulation. As Korea takes the ‘wait & see’ policy on SNF management, SNFs are temporarily stored at each reactor site.

SNF generated from CANDU reactors is first placed in wet storage bays for cooling and radioactive decay. After at least 6 years of cooling in the storage bays, SNF is put into stainless steel fuel baskets and transported to above ground on-site dry storage facilities. There are two kinds of dry storage facilities currently used for on-site storage of SNF from CANDU reactors, concrete silos and MACSTOR/KN-400 (M/K-400) concrete storage modules with the capacity of 332,631 bundles and 168,000 bundles respectively. Although the two types of dry storage facilities and wet storage bays are operated, it is expected that the storage capacity will be saturated in the near future.

SNF generated from PWRs is now stored at reactor pools, but all storage pools are expected to reach their full capacity in several years. To expand the insufficient storage space at reactor sites, re-racking and transshipment to neighboring reactors are utilized, and construction of additional MACSTOR modules at reactor site is considered as a short-term solution until a national SNF management policy is determined. A project to install a high density storage racks was carried out at Kori Units 3&4, Hanul Units 1~4 and Hanbit Units 1, 3, 4, 5 and 6. By that project completed at the end of 2014, the total storage capacity for PWR SNF reached 23,623 assemblies.

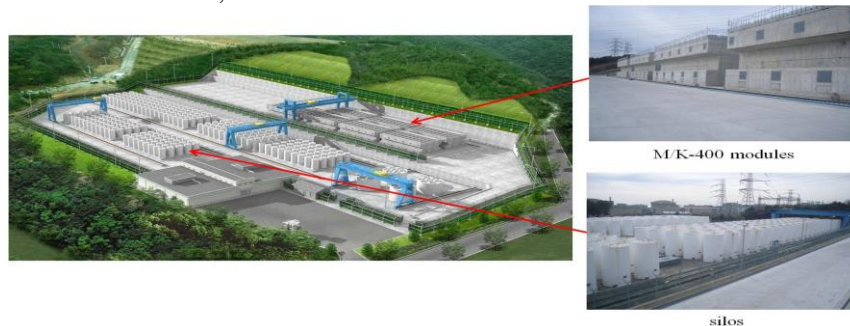


Fig. 1 Dry storage facility for SNF FROM PHWRs at Wolsong site

DECOMMISSIONING AND DISMANTLING POLICIES AND PROJECTS

National plan on D&D

After the nuclear accident in Fukushima, to be prepared for the upcoming decommissioning of NPPs, Korea is now actively developing decommissioning technologies for the nuclear facilities which are no longer in use as well as during the operation to enhance the radiation safety. Korea will develop decommissioning key technologies for NPP by 2016 and eventually secure commercial D&D technologies by 2021. Our development scope for D&D technologies can be summarized as follows:

- High performance decontamination technologies
- Economically improved remote dismantling technologies
- High volume reduction decommissioning waste treatment technologies, and
- Safe & effective site remediation technologies.

The decision made the government in 2015 to shut down the Kori Unit 1, the very 1st commercial NPP in Korea, also raised the importance to foster the industrial infrastructure for safe and effective way of D&D. Accordingly, AEC approved the plan for safe and effective D&D industry in 2015. This plan presents the strategy and roadmap for securing the key technologies and developing human resources in the area of D&D.

D&D project of KRR-1, and KRR-2

While dismantling work of KRR-2 was completed in 2009, dismantling of the reactor structures and internals of KRR-1 was launched in the middle of 2011. KRR-1, a research reactor with a thermal power of 250 kW, faced a permanent shutdown in Jan. 1995, after reaching first criticality in Mar. 1962, and was chosen to be preserved as a monument after a free-release of the building and site. This project is scheduled to be completed in 2020. Radioactive wastes from the decommissioning of KRR-1 and KRR-2 were classified according to their characteristics and radioactivity levels, packed into 200-liter drums or 4 m³ containers, and stored in the reactor hall of KRR-2.

The database system, called DECOMMIS (DECOMMissioning Information management System), was developed and has been operated to collect all of the relevant information related to the decommissioning waste, including its generation, decontamination, packing, and storage. It enables managing the decommissioning waste in a systematic way and reporting safety information to the WACID, which is a DB system developed and operated by the Korea Institute of Nuclear Safety (KINS) for managing nationwide safety information on radioactive waste management. DECOMMIS is very helpful for the public to understand the safety and management of decommissioning work and radioactive waste from the decommissioning site. It will also be very useful for the decommissioning of other nuclear facilities.

COMPETENT AUTHORITIES

Before the NSSC was newly established in October 2011, the Ministry of Education, Science and Technology (MEST) was in charge of national nuclear safety and regulatory matters including licensing of nuclear installations and businesses. The Fukushima accident created momentum to set up the NSSC as a national mandate and it was formally established on 26 October, 2011 as a presidential

commission on nuclear safety as well as security and non-proliferation. Following the inauguration of the new government and subsequent restructuring of government organizations in February 2013, however, the NSSC was now placed under the Prime Minister's Office. Accordingly, relevant laws and regulations were amended to reflect the changes under the new government organizations.

Today, the NSSC is in charge of nuclear safety regulation including nuclear installations and licensing matters; the Ministry of Industry, Trade and Energy (MOTIE) is responsible for promotion of nuclear industry; and the Ministry of Science, ICT and Future Planning (MSIP) is mainly charged with nuclear research and development.

More specifically, the nuclear safety and regulatory system of Korea is composed of the NSSC as a regulatory authority, Korea Institute of Nuclear Safety (KINS) as an expert organization for nuclear safety, and Korea Institute of Nuclear Non-proliferation and Control (KINAC) for nuclear control.

The NSSC is composed of nine members including the Chairman. The Chairman and one member are standing members. The standing member holds an additional position of the Secretary General. The Secretariat, which deals with the general affairs of the Commission, consists of two bureaus and six offices as shown in Fig. 2.

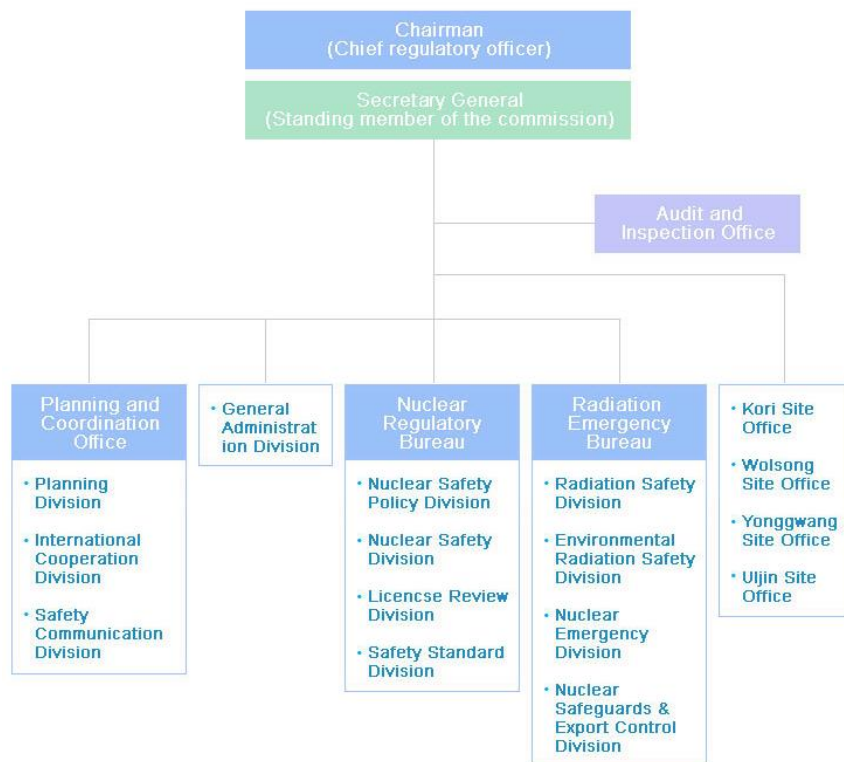


Fig. 2 Organization Chart for the Nuclear Safety and Security Commission

The Korea Institute of Nuclear Safety (KINS) was established as an expert organization for nuclear safety in February 1990, according to the enactment of the Korea Institute of Nuclear Safety Act to conduct nuclear safety regulation as entrusted by the Nuclear Safety Act and the Act on Physical Protection and Radiological Emergency. Its major functions relevant to nuclear safety regulation are regulatory review, inspection, research and development, and technical support for nuclear safety regulation, and so on.

The Korea Institute of Nuclear Non-proliferation and Control (KINAC) was established in June 2006 to perform the tasks of safeguards, control of export and import of nuclear materials, physical protection, and research and development concerning nuclear facilities and nuclear material.

The Korea Radioactive Waste Agency (KORAD) was established in Jan. 2009 to build a structure of mutual control and balance by differentiating the producers of radioactive waste from their disposal operators, which follows the IAEA recommendations and global standards for safe and effective management of radioactive waste, based on the “Radioactive Waste Management Act” legislated on Mar. 28, 2008. KORAD is responsible for the transport, storage, and disposal of radioactive waste and SNF including R&D activities, as well as siting, construction, and operation of related facilities. Administration of a radioactive waste management fund and public relations for radioactive waste management are also important missions of KORAD.

The Korea Hydro and Nuclear Power Co., Ltd (KHNP), an electricity utility, is responsible for the safe and economic construction and operation of NPPs, and for securing financial resources for radioactive waste management.

The Korea Atomic Energy Research Institute (KAERI), a national institute for nuclear research, carries out a R&D project for the treatment and disposal of HLW.

FINANCING

Since 1983, NPP licensees have deposited the cost required for the disposal of LILW, SNF generated in NPP decommissioning and operation processes on a yearly basis and have accumulated this cost as in-house liability in accordance with the provisions of Electricity Business Act.

As per the RWMA legislated in 2008, however, such in-house liability has been converted into the Radioactive Waste Management Fund since Jan. 1, 2009. According to the RWMA, those who have generated radioactive waste shall transfer the cost of maintaining radioactive waste to the KORAD, and the corporations will pay this maintenance cost to the fund. However, as for the SNF generated by NPP licensees, to implement projects related to the management of SNF smoothly, the cost of managing such fuel has been imposed on NPP licensees as the SNF management costs and reverted to the fund.

The appropriate cost is determined every two years by government, KORAD, KHNP, etc, by applying an annual escalator to the costs for disposal of LILW, interim storage and disposal of SNF, and decommissioning of NPP.

PUBLIC INFORMATION

For more information, the websites of the relevant authorities and organizations are listed below.

Government

Nuclear Safety and Security Commission (NSSC)

Website: www.nssc.go.kr

Ministry of Science, ICT and Future Planning(MSIP)

Website: www.misp.go.kr

Ministry of Trade, Industry and Energy (MOTIE)

Website: www.motie.go.kr

Regulation-related

Korea Institute of Nuclear Safety (KINS)

Website: www.kins.re.kr

Korea Institute of Nuclear Non-proliferation and Control (KINAC)

Website: www.kinac.re.kr

Research Institute

Korea Atomic Energy Research Institute (KAERI)

Website: www.kaeri.re.kr

Industry

Korea Radioactive Waste Agency (KORAD)

Website: www.korad.or.kr

Korea Hydro & Nuclear Power Co., LTD (KHNP)

Website: www.khnp.co.kr

KEPCO Engineering & Construction Co., INC (KEPCO-E&C)

Website: www.kepc-enc.com

KEPCO Nuclear Fuel (KEPCO-NF)

Website: www.knfc.co.kr

Others

Korean Radioactive Waste Society

Website: www.krws.or.kr

Korean Nuclear Society

Website: www.nuclear.or.kr

Korean Association for Radiation Protection

Website: www.karp.or.kr

Korea Atomic Industry Forum

Website: www.kaif.or.kr

Korea Nuclear Energy foundation

Website: www.knef.or.kr

Korean Association for Radiation Protection

Website: www.karp.or.kr