# Korean Third National Report under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

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Ministry of Education, Science & Technology

The Republic of Korea

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# FOREWORD

The government of the Republic of Korea, as a contracting party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereinafter referred to as "Joint Convention") which entered into force on June 18, 2001, and deposited the ratification of on September 16, 2002, described the state of implementing the contracting party's obligations in the Third National Report, pursuant to Article 32 (Reporting) of the Joint Convention.

This National Report was prepared in accordance with the "Guidelines Regarding the Form and Structure of National Reports" under the Joint Convention reflecting the observations given in the Summary Report of the Second Review Meetings. Revised and added parts as compared with the Second National Report are highlighted in bold and italics. This Report maintains the structure of article-by-article approach based on every implementation of obligations contained within the topical arrangement of the Joint Convention. The cutoff date of this national report preparation was December 31, 2007, otherwise specified in the report.

Facilities covered in this National Report are the civilian facilities and their associated lands, buildings and equipments in which spent fuel and radioactive waste were handled, processed, treated, stored or disposed of on such a scale that consideration of safety is required under the jurisdiction of the Republic of Korea as defined in Article 2 and 3 of the Joint Convention.

This National Report was drafted by the "Working Group for the Implementation of the Joint Convention" organized by the Ministry of Education, Science and Technology and Korea Institute of Nuclear Safety. This Report was reviewed by relevant governmental and industrial organizations, and deliberated by Radiation Protection Sub-Committee of the Nuclear Safety Commission.

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# List of Abbreviations

| | |
|---|---|
| **AEA** | Atomic Energy Act |
| **AEB** | Atomic Energy Bureau |
| **AEC** | Atomic Energy Commission |
| **ADU** | Ammonium Di-Uranate |
| **AFR** | Away From Reactor |
| **ALARA** | As Low As is Reasonably Achievable |
| **APR1400** | Advanced Power Reactor 1400 |
| **AR** | At Reactor |
| **AUC** | Ammonium Uranyl Carbonate |
| **DAW** | Dry Active Waste |
| **DECOMIS** | Decommissioning Information System |
| **EBA** | Electricity Business Act |
| **ECL** | Effluent Control Limit |
| **EOC** | Emergency Operation Center |
| **HANARO** | High-flux Advanced Neutron Application Reactor |
| **HLW** | High-Level Radioactive Waste |
| **IAEA** | International Atomic Energy Agency |
| **ICRP** | International Commission on Radiological Protection |
| **IMEF** | Irradiated Material Examination Facility |
| **INES** | International Nuclear Event Scale |
| **KAERI** | Korea Atomic Energy Research Institute |
| **KEPCO** | Korea Electric Power Corporation |
| **KHNP** | Korea Hydro & Nuclear Power Co., Ltd. |
| **KINS** | Korea Institute of Nuclear Safety |
| **KISOE** | Korea Information System on Occupational Exposure |
| **KIRAMS** | Korea Institute of Radiological & Medical Science |
| **KNF** | Korea Nuclear Fuel Co., Ltd. |
| **KOPEC** | Korea Power Engineering Co., Inc. |
| **KPS** | Korea Plant Service & Engineering Co., Ltd. |
| **KRIA** | Korea Radioisotopes Association |

| | |
|---|---|
| **KRR** | Korea Research Reactor |
| **KURT** | Korean Underground Research Tunnel |
| **LEMC** | Local Emergency Management Center |
| **LILW** | Low and Intermediate Level Radioactive Waste |
| **LWR** | Light Water Reactor |
| **MES** | Radioactive Waste Management System |
| **MKE** | Ministry of Knowledge Economy |
| **MLTM** | Ministry of Land, Transport and Maritime Affairs |
| **MOE** | Ministry of Environment |
| **MOPAS** | Ministry of Public Administration and Security |
| **MOL** | Ministry of Labor |
| **MEST** | Ministry of Education, Science and Technology |
| **NEMC** | National Emergency Management Committee |
| **NETEC** | Nuclear Engineering and Technology Institute |
| **NPP** | Nuclear Power Plant |
| **NSC** | Nuclear Safety Commission |
| **OEMC** | Off-site Emergency Management Center |
| **OPR1000** | Optimized Power Reactor 1000 |
| **PWR** | Pressurized Water Reactor |
| **PHWR** | Pressurized Heavy Water Reactor |
| **PIEF** | Post-Irradiation Examination Facility |
| **PNSC** | Plant Nuclear Safety Committee |
| **PSR** | Periodic Safety Review |
| **PWR** | Pressurized Water Reactor |
| **RI** | Radioisotope |
| **RIPF** | Radioisotope Production Facility |
| **RAWMIS** | Radioactive Waste Management Information System |
| **SFSP** | Spent Fuel Storage Pool |
| **SITES** | Site Information & Total Environmental Database Management System |
| **SSC** | Site Selection Committee |
| **URT** | Underground Research Tunnel |
| **WACID** | Waste Comprehensive Information Database |

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# A. Introduction

The Government of the Republic of Korea has maintained a consistent national policy for a stable energy supply by fostering nuclear power industries due to the insufficient energy resources in the country. Nuclear power accounts for approximately 40 percent of the total electricity generation in the Republic Korea.

Since the commencement of the first commercial operation of Kori Unit 1 in April 1978, 20 units of NPPs are commercially operating as of October ***2008***. Four units out of the 20 operating NPPs are Pressurized Heavy Water Reactors (PHWRs) at Wolsong site. The remaining sixteen units located at Kori, Yonggwang and Ulchin sites are Pressurized Light Water Reactors (PWRs). ***There are 6 units (4 units of OPR1000, 2 units of APR1400) under construction; in addition, 2 units are in the planning stage of construction.***

***In August 2008, the government set out a plan to significantly reduce the nation's dependency on fossil fuels and more than quadruple the use of renewable energy by 2030. In addition, nuclear power will expand to account for 27.8% of total energy consumption in 2030 compared to 14.9% in 2007. The nuclear share of installed capacity and electricity generation will increase from 26% to 41% and from 36% to 59%, respectively, during the same period. For this, the government plans to construct about 10 more nuclear power plants additionally.***

***The International Atomic Energy Agency (IAEA) officially recognized the Republic of Korea's nuclear transparency by approving the broader conclusion at the regular meeting of the IAEA Board of Governors held in June 2008.***

***The Korea Institute of Nuclear Safety (KINS) opened the International Nuclear Safety School in January 2008 to share its nuclear safety knowledge and experience with the international community. It has also functioned as the IAEA's regional training center in Asia since its conclusion of the Nuclear Safety Cooperation Agreement (NSCA) with the IAEA, thus playing a leading role in promoting nuclear safety learning and cooperation on a global and regional basis.***

Spent fuel generated from NPPs has been stored in spent fuel storage pools at reactors or on-site dry storage facility. ***The dry storage is used only for PHWR spent fuel sufficiently decayed at storage pools.*** The low and intermediate level radioactive waste (LILW) generated from the NPPs has been stored at on-site radioactive waste storage facilities.

Only one research reactor is now in operation: HANARO reactor at the Korea Atomic Energy Research Institute (KAERI) located in Daejeon. Its operations commenced in

1995 and it has thermal power of 30 MW. Two research reactors, KRR-1 and 2, located at the former KAERI site in Seoul, were permanently shut down, and the reactors and the auxiliary facilities have been decommissioned since 1997.

All fuels for the domestic NPPs are fabricated by the Korea Nuclear Fuel Co., Ltd. (KNF) in Daejeon. The radioactive waste generated from fabrication process is stored at on-site radioactive waste storage facilities. In addition, as of the end of 2007, the number of user licensees utilizing radioactive materials in medicine, research work and industry has increased steadily to nearly 3500. These facilities are located throughout the country and generate various types of radioactive waste. Radioisotope (RI) contaminated waste from these facilities is stored at an RI waste management facility at the Nuclear Engineering and Technology Institute (NETEC) of the Korea Hydro and Nuclear Power Co., Ltd. (KHNP) in Daejeon.

The Government of the Republic of Korea has striven to secure disposal site for the safe management of radioactive waste since early 1980s. The 249th meeting of the Atomic Energy Commission (AEC), held in September 1998, developed the "National Radioactive Waste Management Policy", which aims to construct and operate a LILW disposal facility by 2008 and a centralized spent fuel interim-storage facility by 2016; however, the site selection had not been successful for a few years. Therefore, a revision of the policy was made at the 253rd AEC meeting held on December 17, 2004, that stipulated that the construction and operation of the LILW disposal facility would be accomplished by 2008. However, the national policy for spent fuel management including construction of the centralized spent fuel interim-storage facility was to be decided in view of domestic and international technology development later on.

***In June 2005, the Government of the Republic of Korea issued a Public Notice on the selection of a candidate site for the LILW disposal facility, and the city of Gyeongju was selected as the final candidate site in November 2005 following the procedures such as a site suitability assessment, local referendums, etc. as specified in the Public Notice. In June 2006, the Disposal Method Selection Committee decided on a rock cavern repository as the disposal method for the first stage. The KHNP submitted an application to the Ministry of Education, Science and Technology (MEST), for a permit to construct and operate the proposed LILW disposal facility in January 2007. The KINS reviewed these permit application documents, and the MEST issued the permit for construction and operation of the LILW disposal facility on July 31, 2008. The KHNP is currently undertaking construction of the LILW disposal facility in accordance with the permit issued.***

The locations and operational status of major radioactive waste generation sources and management facilities in Korea are shown in Figure A.1-1.

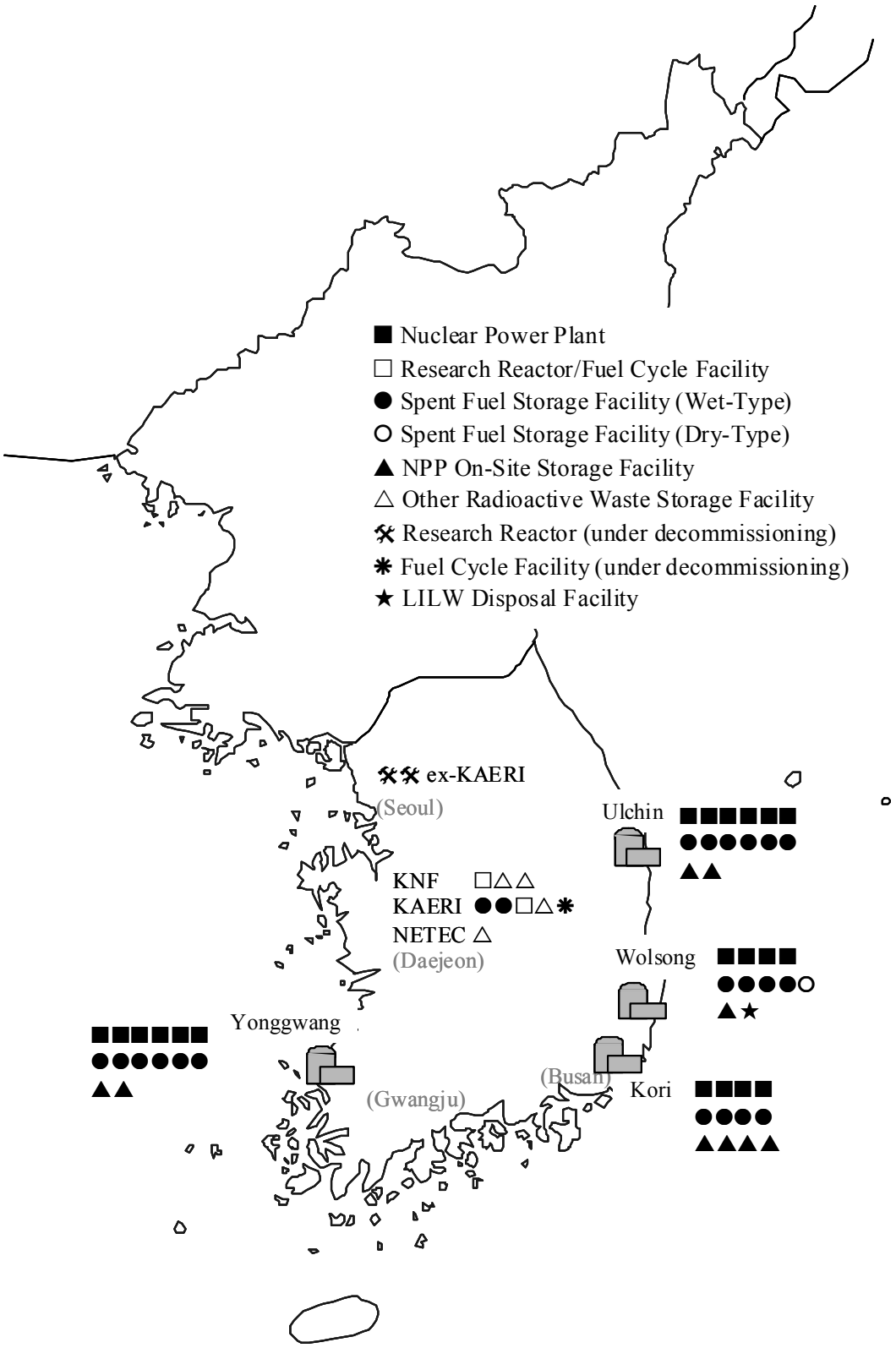


**Figure A.1-1. Locations and operational status of major radioactive waste generation sources and management facilities *(as of October 2008)***

# B. Policies and Practices (Article 32, Paragraph 1)

**ARTICLE 32. REPORTING**

1. In accordance with the provisions of ARTICLE 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:

(i) spent fuel management policy;
(ii) spent fuel management practices;
(iii) radioactive waste management policy;
(iv) radioactive waste management practices;
(v) criteria used to define and categorize radioactive waste.

## B.1 National policy and principles

### B.1.1 National policy

The Atomic Energy Commission (AEC) developed the "National Radioactive Waste Management Policy" at the 249th meeting held on September 30, 1998**.** The policy stipulates that the site selection process for radioactive waste repository shall be managed transparently, and the government shall explain to public about its will for securing safety during site selection process. The summary of the national policy statements includes the following;

**Direct control by the government**

Radioactive waste, which needs long-term safe management, shall be managed under the responsibility of the government.

**Top priority under safety**

Radioactive waste shall be safely managed in due consideration of biological and environmental impact so as to protect the individuals, society and the environment from the harmful effects of radiation and to observe international norms on the safety of radioactive waste management.

**Minimization of radioactive waste generation**

Radioactive waste generation shall be minimized.

**"Polluter pays" principle**

The expenses related to radioactive waste management shall be levied on the radioactive waste generator at the point of radioactive waste generation, without imposing undue burden on future generations.

**Transparency of site selection process**

Radioactive waste shall be managed transparently and openly, and the radioactive waste management project shall be promoted with regard to harmony with the local community, and to community development.

## B.1.2 Fundamental principles

The 253rd meeting of the AEC held on December 17, 2004, changed the "National Radioactive Waste Management Policy" regarding the disposal facility. The construction and operation of the LILW disposal facility shall be initiated first to secure the LILW disposal facility at the appropriate time. It will include the democratic and transparent site selection process and the enactment of the local community support. The summaries of the new policy are as follows.

- The LILW should be stored at the existing radioactive waste storage facilities on NPP sites or at the RI storage facilities at first, and then shall be disposed of in either near surface repository or rock cavern repository. The construction and operation of one or two radioactive waste disposal facilities shall be accomplished by 2008.
- The national policy for spent fuel management will be decided at a later date, with consideration given to the domestic and international technology development.

## B.1.3 Implementation plans

**Organizations in charge**

As a pertinent ministry for the safe and effective management of radioactive waste, the Ministry of Knowledge Economy (MKE) has the responsibility of establishing basic policies and project implementation plans for the storage, treatment and disposal of radioactive waste. These policies and plans shall be implemented by MKE under the review and approval of AEC.

The minister of the MKE shall appoint either NPP operator or nuclear related

organization established by special law, to perform the storage, treatment, and disposal activities for the radioactive wastes which are above the clearance level from generators of radioactive waste.

**Regulations, codes of practice, and standards**

The Ministry of Education, Science, and Technology (MEST) together with the Korea Institute of Nuclear Safety (KINS) develops regulations and codes of practice needed for the safe management of spent fuel and radioactive waste. Specific guidelines may be formulated by the operating organization, the KHNP. Domestic regulations and codes shall be consistent with international norms including relevant Safety Fundamentals, Safety Principles, and Safety Guides provided by the IAEA.

**Interim storage for spent fuel**

Spent fuel generated from NPPs has been stored within each plant by expanding the storage capacity. With the consideration of the sufficiency of spent fuel storage capacity beyond 2016, the national policy for spent fuel management including the construction of the interim storage facility for spent fuel shall be decided in a timely manner through national consensus by public consultation among stakeholders.

***LILW disposal facility***

***In order to implement the fundamental principles approved at the 253rd meeting of the AEC, the Government of the Republic of Korea decided upon the construction of a disposal facility that could dispose of 100,000 drums (hereafter, "drums" means "200 liter-drum equivalents" unless otherwise mentioned) for the first stage and that would ultimately reach a total of 800,000 drums after gradual expansion. As for the disposal method, it was decided to adopt a near-surface repository or a rock cavern repository depending on site conditions.***

***To enhance public acceptance of the LILW disposal facility, an Act titled "Special Act on Support for Areas Hosting Low and Intermediate Level Radioactive Waste Disposal Facility" were legislated and announced on March 31, 2005. As stipulated in the Special Act, the MKE has implemented the entire site selection process fairly and transparently by operating the Site Selection Committee (SSC), which consists of 17 civilian experts from diverse fields, proceeded openly with the host area selection plan, site investigation results, and site selection process and held open forums and discussions for local residents. As the results of local referendums held in regions whose local governments had applied to host disposal facility in accordance with the site selection procedures, the city of Gyeongju was selected as the final candidate site. The area of this final candidate site is large enough to accommodate a total of***

***800,000 drums of the LILW, and, as the first stage of construction, a rock cavern type of repository amounting to 100,000 drums was chosen. The disposal facility to be constructed in Gyeongju was named the "Wolsong Low and Intermediate Level Radioactive Waste Disposal Center"***.

***Radioactive waste management cost***

In accordance with the principle of laying the financial responsibility on those who have generated radioactive waste, the NPP operator accumulates the cost for radioactive waste management as an in-house liability, and other licensees pay the management cost when transferring radioactive waste to the Radioactive Waste Management Business Operator.

# B.2 Spent fuel management practices

## B.2.1 Nuclear power plants

Spent fuels generated from NPPs are stored in the spent fuel storage facility in each unit. The storage capacity for spent fuel has been expanded as a consequence of the delayed construction schedule of the Away-From-Reactor (AFR) interim storage in accordance with the conclusions of the 249th and the 253rd meetings of the AEC.

For PWRs, Kori Unit 3 and Ulchin Units 1 and 2 have already expanded their storage capacity by adopting high-density storage racks. ***Kori Unit 4 and Yonggwang Unit 3 and 4 have expanded their storage capacity by adopting the high-density storage racks from 2006 to 2007. Also Ulchin Unit 3 and 4 will expand their storage capacity through the same method by the end of 2008.*** As the storage capacity of the spent fuel pools at Kori Units 1 and 2 became saturated, the spent fuel generated from both units has been transferred to the storage pools at neighboring Kori Units 3 and 4.

***For PHWRs at Wolsong site, an on-site dry storage facility has been operating for a total capacity of 3,061 MTU within 300 concrete canisters to resolve the shortage of capacity of the pre-existing spent fuel pools of Wolsong Units 1, 2, 3 and 4. 100 canisters of those were constructed in November 2006. Additionally, 7 modules of MASCTOR(Modular Air-Cooled STORage)-400 which have 3,175 MTU of a total capacity is now under construction and scheduled to be finished by the end of September 2009.***

## B.2.2 Research facilities

**Korea research reactor (KRR-1 and 2)**

All of the 299 spent fuel rods from KRR-1 and 2 in storage were sent back to the USA in June 1998, as decommissioning projects of the research reactors were undertaken.

**HANARO research reactor**

HANARO research reactor is equipped with a spent fuel pool capable of storing spent fuels from 20 years operation of HANARO. The spent fuel pool in HANARO can store spent fuels from HANARO operation and test fuels which have been irradiated at HANARO and have taken post-irradiation examinations.

**Post-irradiation examination facility (PIEF)**

In the post-irradiation examination facility (PIEF), a water pool is equipped for storing up to 20 PWR spent fuel assemblies. The spent fuel transshipped from the NPPs for post-irradiation examination is stored in the fuel storage pool of the PIEF. The examination is carried out in the PIEF hot cells and the remaining parts of the fuel after examination are packed in rod-cut containers and stored in the pool.

# B.3 Radioactive waste management practices

## B.3.1 Nuclear power plants

**Gaseous radioactive waste management**

Gaseous radioactive waste is mainly generated from the degassing of the primary system and ventilation systems in the radiation controlled area of NPPs. The gaseous waste from the primary system shall be treated by gas decay tank or charcoal delay bed to reduce radioactivity and released into the atmosphere through a radiation monitor. Gaseous waste from the building ventilation system is also to be exhausted through a high-efficiency particulate filter and charcoal filter under continuous monitoring into the environment.

The Notice of the MEST addresses the maximum radioactivity concentration, effluent control limit (ECL), for gaseous effluent being released into the atmosphere at the restricted area boundary. The licensee shall conduct a periodic evaluation for the anticipated off-site dose due to gaseous effluent released into the environment, and routinely report results to the regulatory body. The off-site dose limit related to the

release of gaseous effluent is specified in Subsection F.4.3.

**Liquid radioactive waste management**

Liquid radioactive waste is mainly generated from the cleanup and maintenance process of reactor coolant and related systems containing radioactivity. In general, liquid radioactive waste is treated with evaporators, demineralizers, and/or filters. The effluent is released to the sea after monitoring.

The Notice of the MEST prescribes the ECL for liquid effluent being discharged into the environment at the restricted area boundary. The operators shall conduct periodic assessments for the expected off-site dose due to the liquid effluent discharged into the environment, and routinely report results to the regulatory body. The off-site dose limit related to the discharge of liquid effluents is also specified in Subsection F.4.3.

**Solid radioactive waste management**

Most solid radioactive waste consists of dry active waste (DAW) and secondary process waste. The DAW is generated during maintenance and repair of contaminated systems and includes items such as used parts, papers, clothes, gloves, shoes, etc. Secondary waste is generated from the liquid radioactive waste treatment system and included concentrated wastes from evaporators, spent resin from demineralizers, and spent filters from liquid purification systems.

The DAW is compressed by a conventional compactor (capacity: 10~30 ton) into drums. Solidification by cement, which had been commonly applied in the past, is not used any longer. Instead, the concentrated waste is now dried and stabilized by paraffin in drums and spent resin is kept in a high-integrated or equivalent container after drying in the spent resin drying facility. Spent filters are stored in a shielding container.

## B.3.2 Research facilities

The KAERI has several facilities where radioactive materials are handled, including HANARO research reactor, post-irradiation examination facility (PIEF), radioisotope production facility (RIPF), irradiated material examination facility (IMEF), nuclear fuel fabrication facility for research reactor, and other laboratories. Additionally, the KAERI operates the radioactive waste treatment facility and the storage facilities.

**Gaseous radioactive waste management**

In each facility, a ventilation system is equipped with filters to treat off-gas before its release to the atmosphere. The stacks of each facility, which is the final outlets, have

continuous air monitors. When the radioactivity concentration of off-gas exceeds the internal guidelines, the operation of the ventilation system should be stopped to keep the public dose rate lower than the target limits.

**Liquid radioactive waste management**

The liquid waste generated from each facility of the KAERI is collected in the tanks of the facilities and transferred to the radioactive waste treatment facility. All the waste is evaporated using the evaporator in the facility. The resulted condensate is processed in a solar evaporation, and the residual is bituminized. No liquid waste is discharged to the environment.

**Solid radioactive waste management**

The solid radioactive waste, generated from each facility at KAERI, except the spent fuels, is transferred to the radioactive waste treatment and storage facilities. Solid radioactive waste with a higher radiation dose rate than the internal guidelines is packed in 50L stainless steel drums, and kept in a concrete monolith with adequate shielding capacity. Solid radioactive waste with a radiation dose rate below the internal guidelines is packed in 200-liter steel drums with compaction of the waste, and kept in the storage facility. ***To promote the safety of radioactive waste management, monitoring cameras were installed at the storage facilities. The cameras can be remotely controlled to monitor the radioactive waste storage facilities so that any abnormality can be promptly detected.***

## B.3.3 Nuclear fuel fabrication facility

**Gaseous radioactive waste management**

Any radioactive materials from gaseous radioactive effluent shall be treated through a filter in the ventilation system before its release through the stack to the outside environment. As usual, gaseous radioactive waste is properly controlled so that the resulting off-site exposure dose may not exceed the regulatory limits by the blockage of release if there is any excess of the preset limits, under continuous monitoring of radioactivity within gaseous effluent.

**Liquid radioactive waste management**

Liquid waste is separated into two kinds of waste; one is PWR type waste from the PWR fuel fabrication facility and the other is PHWR type waste from the PHWR fuel fabrication facility. They are treated by several treatment systems such as lime precipitation, polymer coagulation, and/or centrifugation in accordance with their

characteristics. The treated liquid waste below release limits is allowed to batch-wise discharge. Data such as discharge volume, and release amounts of radioactivity are recorded and maintained.

**Solid radioactive waste management**

Most solid waste from the fuel fabrication facility consists of protective articles such as clothes, gloves, metals generated during facility repair, and lime deposits. They are classified into miscellaneous wastes, metals, synthetics, lime deposits, wood, glass, etc., and packed in 200-liter steel drums. The drums are stored in the waste storage facility, after measuring radioactivity, weight, surface contamination level, and radiation dose rate for each package.

### B.3.4 Radioisotope waste management facility

Radioisotopes are used in two forms; sealed source and open source. Open source waste is classified into combustibles, incombustibles, non-compactable, spent filters, animal carcasses, organic liquids waste, and inorganic liquids waste. Of all waste generated by RI users, open source waste is collected and delivered to the NETEC of the KHNP by the Korea Radioisotopes Association (KRIA), while the disused sealed source waste is directly delivered by RI users, or through an consignment agency, to the NETEC. The NETEC stores and safely manages the RI waste in the RI waste management facility.

In order to improve the storage efficiency of the RI waste management facility, part of the RI waste in storage is treated for volume reduction. The incombustible wastes like glass are compacted. The very low level, combustible waste and organic liquid waste are incinerated. For the safe and efficient storage, some disused sealed sources are stored in a special container after separating the source part from the source canister.

## B.4 Definition and classification of radioactive waste

The Atomic Energy Act (AEA) defines “Radioactive Waste” as radioactive materials or materials contaminated with radioactive materials which are the object of disposal, including spent fuel. The Enforcement Decree of the AEA defines high-level radioactive waste (HLW) as radioactive waste with radioactivity concentration and heat generation over the limit value specified by the MEST. In strict, others than HLW belong to the LILW in accordance with the AEA. The limiting values on radioactivity and heat generation rate are specified in the MEST Notice No. 2008-31 (Standards on

Radiation Protection, etc.) as follows:

- radioactivity : $\geq$ 4,000 Bq/g for $\alpha$-emitting radionuclide having a half life longer than 20 years
- heat generation rate : $\geq$ 2 kW/$m^3$

Until 1998, waste classification based on IAEA Technical Report Series No. 101 (1970) had been applied. In August 1998, the criteria for radioactive waste classification was amended with a view to emphasizing radioactive waste disposal safety as above, in due regard to the IAEA revised classification system of IAEA Safety Series No. 111-G-1.1 (1994).

The AEA also defines the clearance level adopted from the "exempt waste" concept of the IAEA radioactive waste classification. The clearance levels in Korea are such that annual individual dose shall be below 0.01 mSv/y and the total collective dose below 1 person-Sv/y concurrently. These are identical to the levels specified in the IAEA Safety Series No. 115 (1996).

# C. Scope of Application (Article 3)

**ARTICLE 3. SCOPE OF APPLICATION**

1. This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.

2. This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.

3. This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defense programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defense programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.

4. This Convention shall also apply to discharges as provided for in Articles 4, 7, 11, 14, 24 and 26.

## C.1 Application of Joint Convention

Under the application of the Joint Convention, the radioactive waste applied in this national report is defined in accordance with the AEA and its related technical standards. The spent fuels and radioactive wastes generated from commercial nuclear power plants, the research reactor facilities, the nuclear fuel cycle facility, and the RI users are covered in the National Report.

The definition and classification of radioactive waste is specified in Section B.4.

## C.2 Reprocessing of spent fuel

The national policy for the spent fuel management will be decided later in consideration of the domestic and international technology development. Therefore, under Article 3.1 of the Joint Convention, reprocessing activities of spent fuel are not described in the National Report, because those activities have not been conducted in Korea.

## C.3 Naturally occurring radioactive materials

Under Article 3.2 of the Joint Convention, the National Report includes the naturally occurring radioactive materials (NORMs) originating from the nuclear fuel cycle and the industrial use of licensed nuclear material.

## C.4 Radioactive wastes within military or defense programs

Pursuant to Articles 3.2 and 3.3 of the Joint Convention, radioactive waste within military or defense programs are not declared as radioactive waste for the purpose of the Joint Convention. But the RI wastes transferred to the RI management facility from the military use are incorporated in the inventory of the National Report.

# D. Inventories and Lists (Article 32, Paragraph 2)

**ARTICLE 32. REPORTING**

2. This report shall also include:

(i) a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;

(ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;

(iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;

(iv) an inventory of radioactive waste that is subject to this Convention that:

(a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;

(b) has been disposed of; or

(c) has resulted from past practices.

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;

(v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

## D.1 Spent fuel management

### D.1.1 Nuclear power plants

Spent fuel discharged from reactors is stored in the spent fuel pool at each unit for a certain periods, and the on-site storage capacity is expanded. Annex A-1 represents the location and characteristics of spent fuel storage facilities at each plant.

As of December 2007, spent fuel inventories for PWRs and PHWRs are 4,327.53 and 5,092.33 MTU (2,425.68 MTU under dry storage and 2,666.65 MTU under wet storage), respectively. The inventories, initial enrichment of fuel and type of spent fuel in storage are given in Table D.1-1.

**Table D.1-1. Inventory of spent fuel stored at NPP sites**

**(as of December 2007)**

| NPP Site | Type of Storage | Inventory (MTU) | Initial enrichment (w/o of $^{235}U$) | Fuel type |
|---|---|---|---|---|
| Kori | wet | ***1623.02*** | 3.4~4.2 | PWR |
| Yonggwang | wet | ***1491.08*** | 3.8~4.4 | PWR |
| Ulchin | wet | ***1213.43*** | 3.8~4.4 | PWR |
| Wolsong | wet<br>dry | ***2666.65***<br>***2425.68*** | natural uranium | PHWR |

## D.1.2 Research facilities

**HANARO research reactor**

The HANARO is a multi-purpose research reactor with the main object of its use for fuel performance testing, material irradiation testing, RI production, basic science and applications study, and is currently in use for various research and development activities.

The spent fuel storage pool of HANARO is a heavy concrete structure, of which the inside is lined with stainless steel plate. The vault comprises three storage lattices. The vault has enough capacity for temporarily storing new fuel as well as spent fuel to be generated during normal operation of HANARO for 20 years. Annex A-2 represents the location and characteristics of the spent fuel storage pool at HANARO.

The inventories and types of spent fuel stored at HANARO are as given in Table D.1-2.

**Post-irradiation examination facility (PIEF)**

The PIEF was constructed for the purpose of performance testing and evaluation for fuels irradiated in NPPs. ***It is equipped with the pools for reception, storage and non-destructive examination of PWR assembly and the hot cell facilities for the examination of spent fuel rods and chemical analysis.***

The PIEF consists of 3 pools, 4 concrete hot cells, 2 lead hot cells, and supporting installations. Annex A-2 represents the location and characteristics of the spent fuel storage pool at the PIEF.

***As of December 2007,*** spent fuels from NPP are stored in the PIEF in form of assemblies, spent fuel rods and specimen in order to carry out the post-irradiation examination. Table D.1-2 represents the detailed status of storage and amounts of fissile materials remaining within fuel elements.

**Table D.1-2. Inventory of spent fuel in the storage pools of research facilities**

**(as of December 2007)**

| Facility | Total uranium remained (kg-U) |
|---|---|
| HANARO | ***519.4*** |
| PIEF | ***3265.2*** |

# D.2 Radioactive waste management

## D.2.1 Nuclear power plants

Nuclear power plants currently in operation are furnished with gaseous, liquid, and solid waste treatment facilities and on-site storage facilities to ensure the safe management of radioactive waste generated in the process of operation. The gaseous waste treatment system comprises gas decay tanks and/or charcoal delay beds. The liquid waste treatment system is equipped with either liquid waste evaporators or selective ion exchangers. The solid waste treatment facility has spent resin drying systems, spent filter processing and packaging systems, concentrated waste drying systems, and dry waste compactors.

The on-site solid radioactive waste storage facility is a concrete slab-type building with separate storage for wastes according to radioactivity level, and is equipped with a radiation monitoring system. The location and characteristics of these facilities are listed in Annexes B-1 and B-2.

***As of December 31, 2007, 76,481 drums of radioactive waste*** generated from NPPs are stored at the on-site storage facilities. The disposal of radioactive waste has not been implemented yet. Table D.2-1 shows the inventory status of radioactive waste stored at the on-site storage facilities.

**Table D.2-1 Inventory of radioactive waste stored at NPP sites**

**(as of December 2007)**

| NPP Site | Inventory [drum] | Major radionuclide | Total activity estimated [TBq] |
|---|---|---|---|
| Kori | ***37977*** | $^{60}$Co, $^{137}$Cs, etc. | ***4.92E+02*** |
| Wolsong | ***6752*** | 〃 | ***9.75E+01*** |
| Yonggwang | ***18246*** | 〃 | ***2.25E+02*** |
| Ulchin | ***13506*** | 〃 | ***4.06E+02*** |

## D.2.2 Research facilities

The KAERI operates a radioactive waste treatment facility and storage facilities for the safe management of liquid and solid radioactive waste generated from research facilities. In Annexes B-3 and B-4, the location and characteristics of the radioactive waste storage facilities and treatment facility in KAERI are listed respectively.

All the liquid radioactive waste generated from the facilities in KAERI is processed through an evaporation process. The resulted concentrate is solidified by a bituminization process while the condensate is treated by a solar evaporation process. Solid waste is treated for volume reduction with a compactor and stored in the storage facilities in KAERI site.

The radioactive wastes generated from KRR-1 and 2 at the former site of the KAERI in Nowon-gu, Seoul were solidified in cement and packaged in 200-liter drums. They were transferred to the KAERI in Daejeon in 1985. Since then, these drums have been stored at the radioactive waste storage facilities.

**Table D.2-2 Inventory of radioactive waste stored at the KAERI facilities**

**(as of December 2007)**

| Facility | Inventory [drum] | Major radionuclide | Total activity estimated [TBq] |
|---|---|---|---|
| Radwaste Storage Facilities | ***11645*** | $^{54}$Mn, $^{60}$Co, $^{238}$U, $^{137}$Cs, $^{131}$I, etc. | ***1.3E+0*** |

Table D.2-2 represents the inventory status of radioactive waste in storage together with major radionuclide as of ***December 31, 2007.***

## D.2.3 Nuclear fuel fabrication facility

Two nuclear fuel fabrication plants are operated by KNF. The 1st plant started to produce PWR fuels in 1989 and the 2nd plant for PHWR/PWR fuels started its commercial operation in 1998. The solid waste treatment and storage concept of the two fabrication plats are almost the same and details on the storage facility are listed in Annex B-5. However, the liquid waste treatment process for the PWR fuel fabrication plant is different from that of the PHWR fuel fabrication plant as shown in Annex B-6.

***As of December 2007, the amount of waste generated from the nuclear fuel fabrication facility is up to 6,661 drums***. All of them are stored and managed safely at the on-site waste storage facilities. Table D.2-3 shows the inventory of radioactive waste stored at the on-site storage facilities.

**Table D.2-3. Inventory of radioactive waste stored at the KNF facilities**

**(as of December 2007)**

| Facility | Inventory [drum] | Major radionuclide | Total activity estimated [TBq] |
|---|---|---|---|
| Radwaste storage facilities | ***6661*** | $^{234}U$, $^{235}U$, $^{238}U$ | ***2.9E-01*** |

## D.2.4 Radioisotope waste management facility

The RI waste generated from domestic RI users is collected and stored at the RI waste storage facility. ***This facility stores 5,240 drums of RI wastes as of December 31, 2007*** and operates incinerator to treat combustible waste. Annex B-7 lists the location and main characteristics of the RI waste storage facility. Annex B-8 lists the main characteristics of the RI waste incineration facility.

Table D.2-4 shows the inventory status of RI waste stored in the RI waste management facility, as of December 31, 2007.

**Table D.2-4. Inventory of RI waste at the RI waste management facility**

**(as of December 2007*)***

| Facility | Inventory [drum] | Major radionuclide | Total activity estimated [TBq] |
|---|---|---|---|
| RI waste storage facility | 5018 (unsealed source waste) | $^{125}I$, $^{99m}Tc$, etc. | ***2.9E+02*** |
| | 222 (disused sealed sources) | $^{60}Co$, $^{137}Cs$, $^{241}Am$, etc. | |

### D.2.5 *Others*

***Taekwang Industrial Co., Ltd. in Ulsan generated radiologically contaminated by-products in the process of producing synthetic fiber using licensed nuclear material, depleted uranium, as a catalyst. Nuclear materials have not been used since they were replaced by a non-radioactive catalyst in 2004. The total inventory of radioactive waste stored in this facility is 7,131 drums, as of December 31, 2007.***

***Taegutec Co. in Daegu generated radiologically contaminated by-products in the process of producing wire. Since the shutdown of their production facilities in 2004, contaminated by-products have not been generated from the facility (decontamination and decommissioning of the facility were carried out from October 2004 to May 2005). The total inventory of radioactive waste stored in this facility is 52 drums, as of December 31, 2007.***

## D.3 Decommissioning

### D.3.1 KRR-1 and 2

***Radioactive wastes from the decommissioning of KRR-1 and 2 were classified according to their characteristics and radioactivity levels, packed into 200-liter drums or 4 $m^3$ containers and stored in the reactor hall of the KRR-2. The inventory of radioactive waste generated from KRR-1 and 2 decommissioning site is given in Table D.3-1. The major radionuclides in the activated waste are $^{60}Co$ and $^{152}Eu$, and are $^{60}Co$ and $^{137}Cs$ in the case of the contaminated waste***.

Annex C shows the list of nuclear facilities ***under decommissioning*** and the estimated waste from the decommissioning of KRR-1 and 2.

**Table D.3-1. Inventory of radioactive waste stored at the KRR-1 and 2 decommissioning site**

**(as of December 2007)**

| Facility | Inventory [drum] | Major radionuclide | Total activity estimated [TBq] |
|---|---|---|---|
| Temporary storage building | ***1044*** | $^{60}$Co, $^{137}$Cs, $^{152}$Eu, etc. | ***6.1E-01*** |

## D.3.2 Uranium conversion facility

***Radioactive waste from the decommissioning of the uranium conversion facility (UCF) is stored in temporary storage building in the conversion facility. The inventory of radioactive waste generated from the UCF decommissioning site is given in Table D.3-2. All the wastes are contaminated only with natural uranium.***

In Annex C, the estimated waste from the decommissioning of the UCF is also included.

**Table D.3-2. Inventory of radioactive waste stored at the uranium conversion facility decommissioning site**

**(as of December 2007)**

| Facility | Inventory [drum] | Major radionuclide | Total activity estimated [TBq] |
|---|---|---|---|
| Temporary storage building | ***303*** | natural uranium | ***7.9E-03*** |

# D.4 Record keeping and reporting

The nuclear licensee has been maintaining the relevant records on radioactive waste utilizing their own record-keeping system. In accordance with reporting provisions of the AEA, the licensee has reported related radioactive waste-related information as volume and/or amount of both radioactive waste and spent fuel generated on a quarterly basis together with their total accumulations to the KINS. ***The KINS has evaluated and managed the data and information periodically reported by the nuclear licensee, and confirmed them through regular inspections, etc.***

# E. Legislative and Regulatory Framework

## E.1 Implementing measures (Articles 18)

**ARTICLE 18. IMPLEMENTING MEASURES**

Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention**.**

The legislative, regulatory and other measures to fulfill the obligations of the Convention are discussed in relevant sections of this report.

## E.2 Legislative and regulatory framework (Articles 19)

**ARTICLE 19. LEGISLATIVE AND REGULATORY FRAMEWORK**

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.
2. This legislative and regulatory framework shall provide for:
   (i) the establishment of applicable national safety requirements and regulations for radiation safety;
   (ii) a system of licensing of spent fuel and radioactive waste management activities;
   (iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a license;
   (iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;
   (v) the enforcement of applicable regulations and of the terms of the licenses;
   (vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.
3. When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.

## E.2.1 Legislative framework

### E.2.1.1 Legislative framework of nuclear regulation

National laws related to the safety of spent fuel and radioactive waste management are the Atomic Energy Act (AEA), the Electricity Business Act (EBA), the Environmental Impact Assessment Act and others as shown in Table E.2-1. All the provisions on nuclear safety regulation and radiation protection are entrusted to the AEA. The AEA enacted as the main law concerning safety regulations for spent fuel and radioactive waste.

The laws concerning nuclear regulation, as shown in Figure E.2-1, consist of 4 levels: the AEA, the Enforcement Decree of the AEA, the Enforcement Regulations of the AEA (including regulations concerning technical standards of nuclear facilities, etc., and regulations concerning technical standards of radiation safety management), and the Notices of the MEST.

The AEA provides for basic and fundamental matters concerning the safety regulation. It includes provisions on the Atomic Energy Commission (AEC), the Nuclear Safety Commission (NSC), the permit for construction and operation of radioactive waste disposal facilities, and others as shown in Table E.2-1 and Figure E.2-2. The Enforcement Decree of the AEA (the Presidential Decree) provides the particulars entrusted by the AEA, and the administrative particulars including the detailed procedures and methods, etc., necessary for the enforcement of the AEA.

The Enforcement Regulation of the AEA (the MEST Ordinances) provides the particulars including detailed procedures, the format of documents, and technical standards, as entrusted by the same Act and the same Decree. The Enforcement Regulations were divided into namely, the Enforcement Regulation of the Act, the Enforcement Regulation Concerning the Technical Standards of Reactor Facilities, etc., and the Enforcement Regulation Concerning the Technical Standards of Radiation Safety Management, etc. At last, the Notices of the MEST prescribe regulatory requirements, technical standards and guidelines, as entrusted by the same Act, the same Decree and the same Regulation.

**Atomic Energy Act**

The AEA prescribes basic matters on waste safety to be applied to radioactive waste management facilities, as follows:

## Table E.2-1. Laws concerning nuclear regulation

| Title | Major Contents | Competent Authorities | Remarks |
|---|---|---|---|
| Atomic Energy Act | Basic law on the nuclear safety regulations | MEST | - |
| Korea Institute of Nuclear Safety Act | Provides the establishment and operation of the Korea Institute of Nuclear Safety | MEST | - |
| Act on Physical Protection and Radiological Emergency | Establishes more effective system for physical protection of nuclear material and nuclear facilities, and provides legal and institutional basis for preventing radiological disaster and preparing countermeasures against radiological emergency | MEST | - |
| Nuclear Liability Act | Provides the procedures and the extent of compensation for any damages which an individual has suffered from a nuclear accident | MEST | - |
| Act on Indemnification Agreement for Nuclear Liability | Provides the particulars on a contract between the government and the operator to make up any compensation not covered by insurance | MEST | - |
| Electricity Business Act | Provides the basic system of electricity business | MKE | The safety regulations of the installation, maintenance, repair, operation, and security of radioactive waste maintenance facilities are to adhere to the Atomic Energy Act |
| Electric Source Development Promotion Act | Provides special cases relevant to the development of electric sources | MKE | Prior designation notice of nuclear site |
| Basic Law of Environmental Policy | Mother law of the environmental preservation policy | MOE | The AEA is entrusted with the particulars on measures to prevent radiological contamination |
| Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc. | Provides the extent and procedures to assess environmental impact according to the Basic Law of Environmental Policy | MOE | Assessment of environmental impacts excluding radiological impacts |
| Framework Act on Fire Services | Provides for general matters on the prevention, precaution and the extinguishment of fires | MOPAS | The requirements for safety management of inflammables |
| Basic Act on Civil Defense | Provides for general matters on the civil defense system | MOPAS | Preparedness against disasters due to nuclear accidents is included in the basic civil defense plan |
| Basic Act on Management of Disasters and Safety | Provides for general matters on the control of man-made disasters | MOPAS | It prescribes corrective or complementary measures for violations in the implementation of the basic civil defense plan |
| Industrial Accident Compensation Insurance Act | Provides insurance to compensate workers in case of an industrial disaster | MOL | Nuclear workers are to be compensated in accordance with the compensation standards in the AEA. |
| Industrial Safety and Health Act | Provides for the preservation and enhancement of workers' health and safety | MOL | The AEA is entrusted with the particulars on radiological safety |
| Building Act | Provides for general matters on construction | MLTM | When the sites of disposal facilities have obtained prior approval, they are to be seen as having obtained construction permission in accordance with Building Act |

- provisions on the permit for construction/operation of disposal facilities,
- provisions on step-by-step safety inspections related to installment and operations of radioactive waste management facilities,
- provisions on restrictions regarding disposal practices of radioactive wastes including prohibition of dumping into sea,
- provisions on the safe transport and package of radioactive waste, and
- provisions on the establishment and implementation of a basic policy and management program in order to manage radioactive wastes in a safe and efficient manner.

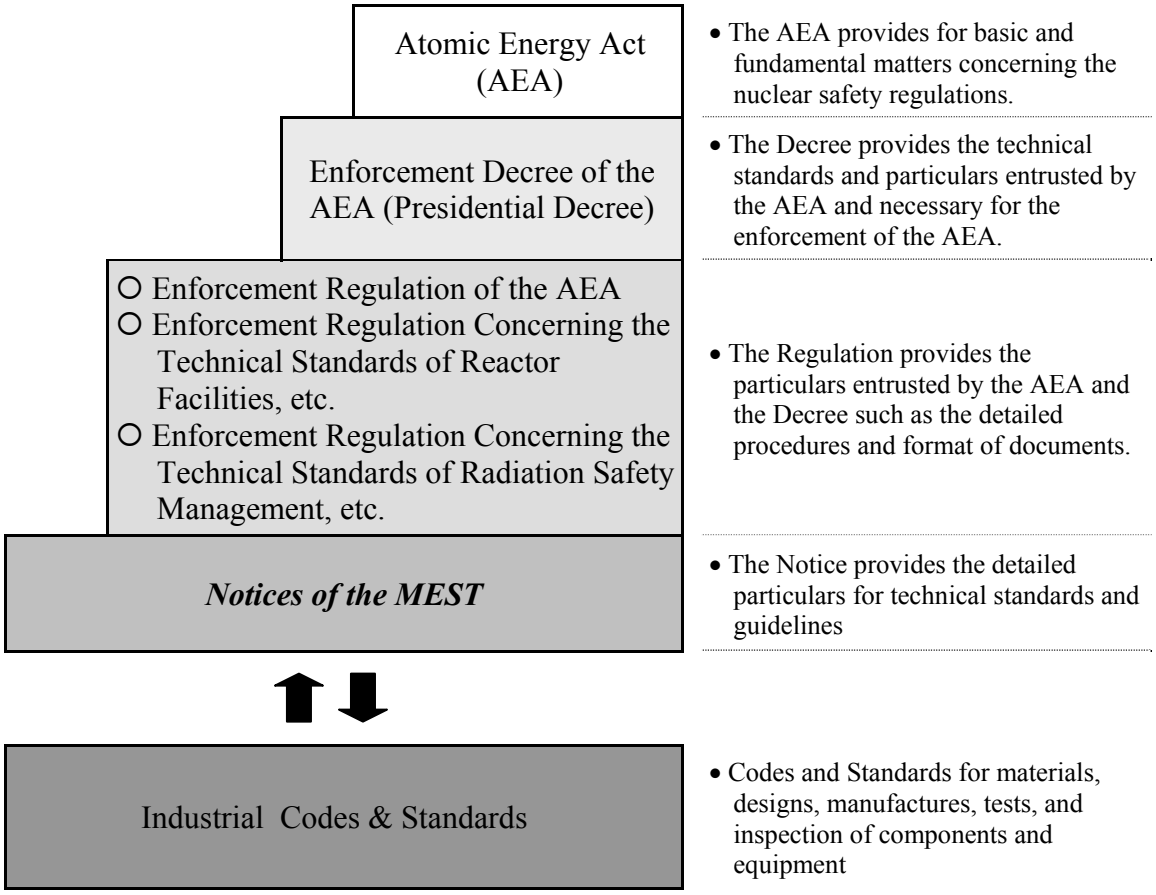


**Figure E.2-1. Legal hierarchy of the Atomic Energy Acts**

**Enforcement Decree of the Atomic Energy Act**

The Enforcement Decree of the AEA (Presidential Decree) specifies the detailed requirements for implementing basic matters on waste safety, referred to in the AEA, as follows:

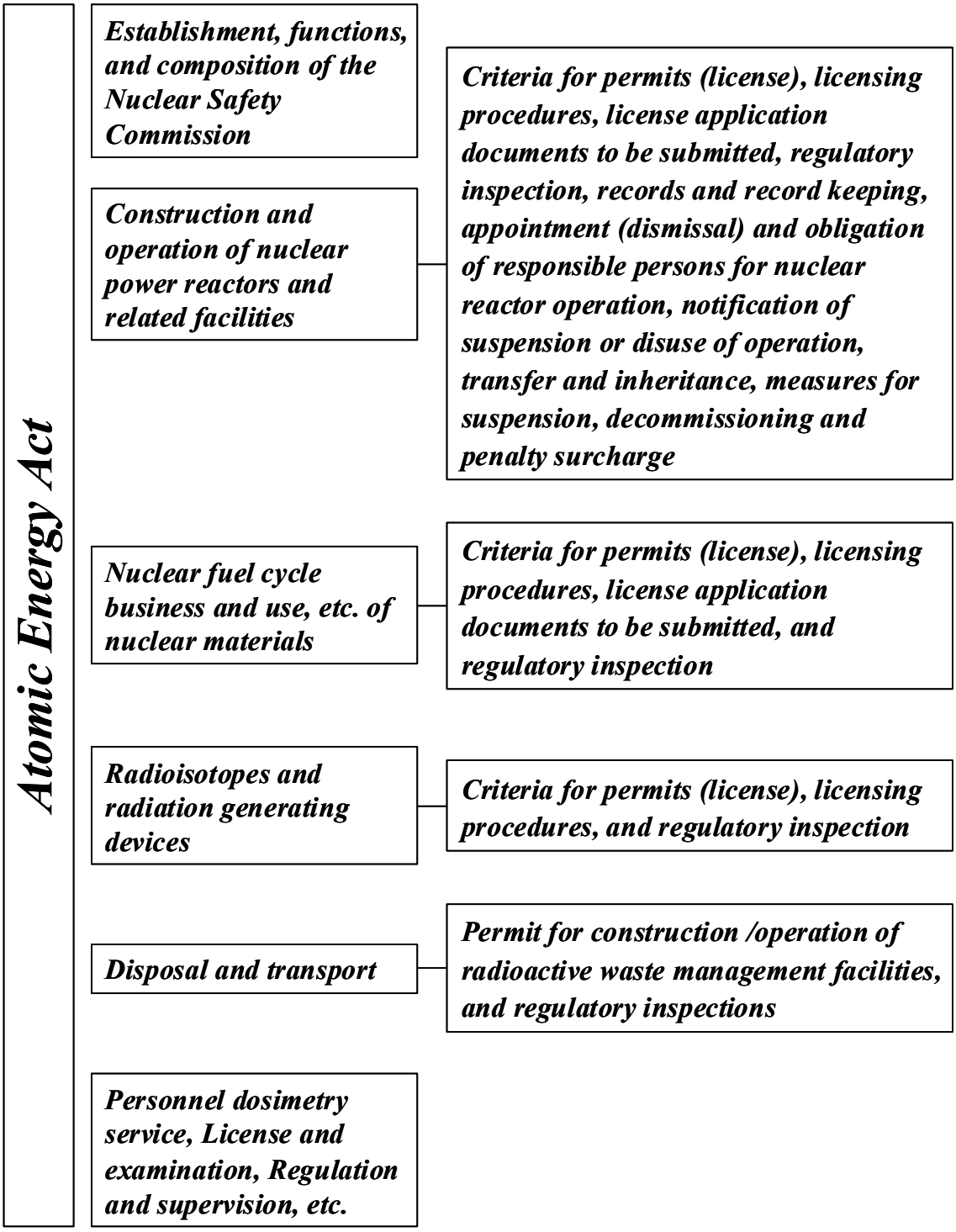


**Figure E.2-2. Contents of the Atomic Energy Act**

- detailed provisions on application for the permit for construction/operation of radioactive waste management facilities and their alterations,
- detailed provisions on conditions of material accounting and security on specific nuclear materials in nuclear safeguard system,
- detailed provisions necessary for implementing the regulatory inspections of preoperational inspection, periodic inspection, disposal inspection, QA inspection applicable for radioactive management facilities, etc.,
- detailed provisions on the procedures and methods of clearance application of very low level radioactive waste,
- detailed provisions necessary for the safe transportation and packaging of radioactive materials, etc.

**Ordinance of the Ministry of Education, Science and Technology (MEST)**

The MEST Ordinance includes the Enforcement Regulations of the AEA, the Regulation Concerning the Technical Standards of Reactor Facilities, etc., and the Regulation Concerning the Technical Standards of Radiation Safety Management, etc., and prescribes detailed procedures and methods necessary for implementing the AEA and the Enforcement Decree of the AEA, and the detailed technical standards thereof.

- detailed provisions on detailed procedures and methods necessary for implementing the AEA and the Enforcement Decree of the AEA, and on the particulars about control and management of radioactive wastes, packaging and transportation of radioactive materials, etc., (Enforcement Regulations)
- detailed provisions on measures related to structure, equipment and performance of radioactive waste processing and storage facilities, etc. for reactor and related facilities, and nuclear fuel cycle facilities, (technical standards of reactors)
- detailed provisions on measures related to radioactive waste management plans in operation for reactor and related facilities, and nuclear fuel cycle facilities, (technical standards of reactors)
- detailed provisions on particulars about facilities, equipments and performance of near surface disposal, geological disposal, spent fuel management facilities, etc. (technical standards of radiation)
- provisions on performance standards for disposal facilities, for example, radiation monitoring, drainage, fire protection, and emergency power systems (technical standards of radiation)

**Notices of the MEST**

The Notices of the MEST present the detailed technical standards of radioactive waste management specified in the AEA, the Enforcement Decree of the AEA, and the

Ordinance of the MEST. Table E.2-2 lists the Notices of the MEST applicable to the safety management of radioactive waste.

**Table E.2-2. Notices of the MEST applicable to radioactive waste management**

| Notice No. | Title |
|---|---|
| 2008-27 | Regulation on Preparation, etc. of Radiological Environmental Report of Nuclear Power Utilization Facilities |
| 2008-28 | Regulation on the Environmental Radiation Survey and Impact Analysis in the Vicinity of Nuclear Facilities |
| 2008-29 | Regulation on the Reporting of Events and Accidents of Reactor Facilities |
| 2008-31 | Standards on Radiation Protection, etc. |
| 2008-52 | Standard Format and Contents of Safety Analysis Report for Low and Intermediate Level Radioactive Waste Repository |
| 2008-53 | Standard Format and Contents of Site Characteristics Report for Low and Intermediate Level Radioactive Waste Repository |
| 2008-54 | Standard Format and Contents of Site Characteristics Report for Spent Fuel Interim Storage |
| 2008-55 | Quality Assurance Criteria for Radioactive Waste Management Facilities |
| 2008-56 | Siting Criteria for Low and Intermediate Level Radioactive Waste Repository |
| 2008-57 | Technical Requirement for the Operation and Control of Low and Intermediate Level Radioactive Waste Repository |
| 2008-58 | Siting Criteria for Spent Fuel Interim Storage Facilities |
| 2008-59 | Criteria for Structure and Equipment of Low and Intermediate Level Radioactive Waste Treatment System |
| 2008-60 | Criteria for Structure and Equipment of Low and Intermediate Level Radioactive Waste Repository |
| 2008-61 | Regulation on Inspection of Radioactive Waste Disposal |
| 2008-62 | Incineration Criteria of Low and Intermediate Level Radioactive Waste |
| 2008-63 | Radiological Protection Criteria for Long-term Safety on Low and Intermediate Level Radioactive Waste Disposal |
| 2008-64 | Regulation on the Clearance Level of Radioactive Waste |
| 2008-65 | Acceptance Criteria for Low and Intermediate Level Radioactive Waste |
| 2008-66 | Acceptance Criteria for Spent Fuel |
| ***2008-67*** | ***Technical Requirement for the Radiation Safety Management of Low and Intermediate Level Radioactive Waste Transport Ships*** |
| 2008-68 | Regulation on Inspection of Manufacture and Use of Radioactive Material Transport Containers |
| 2008-69 | Regulation on the Packaging and Transport of Radioactive Materials, etc. |

Among them, the principal notices related to radioactive waste management are listed as follows:

- Siting Criteria for the Low and Intermediate Level Radioactive Waste Repository
- Acceptance Criteria for the Low and Intermediate Level Radioactive Waste
- Radiological Protection Criteria for Long-term Safety on the Low and Intermediate Level Radioactive Waste Disposal
- Regulation on the Clearance Level of Radioactive Waste, etc.

### E.2.1.2 Electricity business legislative framework

The Electricity Business Act (EBA) establishes a basic system regarding electricity business and stipulates basic information for the promotion of electricity business. The Enforcement Decree of the EBA, the Enforcement Regulations of the EBA, and the Ministry of Knowledge Economy (MKE) Notices provide necessary information for the implementation of standards and procedures entrusted by higher laws.

As in Figure E.2-3, the EBA system consists of 4 levels; the EBA, the Enforcement Decree of the EBA, the Enforcement Regulations of the EBA, and the MKE Notice.

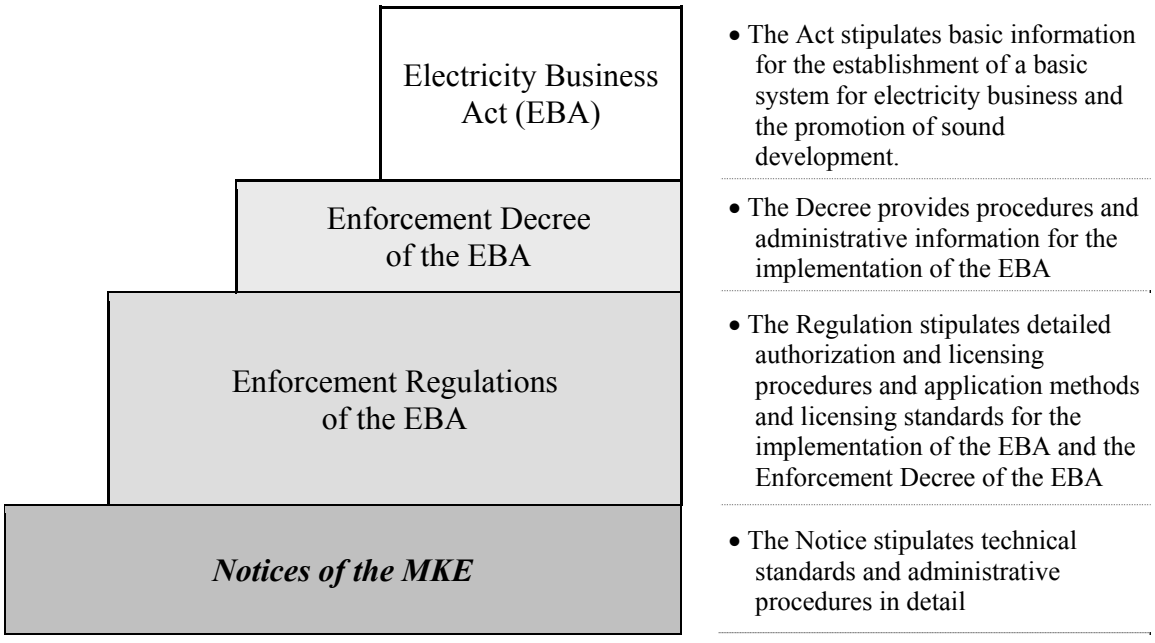


**Figure E.2-3. Legal hierarchy of the EBA System**

**Notices of the MKE**

The MKE Notices provide detailed technical standards on the regulations in the EBA, Enforcement Decree of the EBA, and Enforcement Regulations of the EBA. As for MKE Notices related to radioactive waste, the Regulations on the Delivery and Cost of Radioactive Waste stipulate general requirements to deliver radioactive waste generated by non NPP operators to the Nuclear Waste Management Business Operator.

### *E.2.1.3 Radioactive Waste Management Act*

***The Radioactive Waste Management Act, which integrates and systematically determines all aspects of managing radioactive waste, was legislated and announced on March 28, 2008. The enactment of this law has paved the way for the establishment of the Korea Radioactive Waste Management Organization and the Radioactive Waste Management Fund. The Act is expected to be put into force on January 1, 2009, and subordinate laws are currently being legislated.***

## E.2.2 Nuclear regulatory framework

The governmental organizations concerned with nuclear activities, as shown in Figure E.2-4, are mainly formed of administrative authorities; the MKE supervises the nuclear power program, the Ministry of Environment (MOE) is responsible for regulating issues on the general environment excluding the radiological environment, and the MEST is responsible for nuclear safety regulations including the licensing of nuclear facilities.

There is also the AEC under the jurisdiction of the Prime Minister, as the supreme organization for decision-making on national nuclear policies. And the NSC under the jurisdiction of the MEST is responsible for the deliberation and decision on important matters concerning the safety of nuclear facilities and radioactive waste management.

Nuclear safety regulatory organizations are mainly composed of the MEST and the NSC as safety regulatory authorities, and the KINS as an expert organization of nuclear safety regulation as shown in Figure E.2-5. The MEST established the Nuclear Emergency Division in the Atomic Energy Bureau (AEB) in 2001, and the Off-site Emergency Management Center was founded to direct nuclear emergency cases of nuclear sites, especially NPP in 2003. ***In 2006, Korea Institute of Nuclear Nonproliferation And Control (KINAC) was established as an expert organization for the physical protection, safeguard of nuclear facilities including nuclear materials and for the control of export and import.***

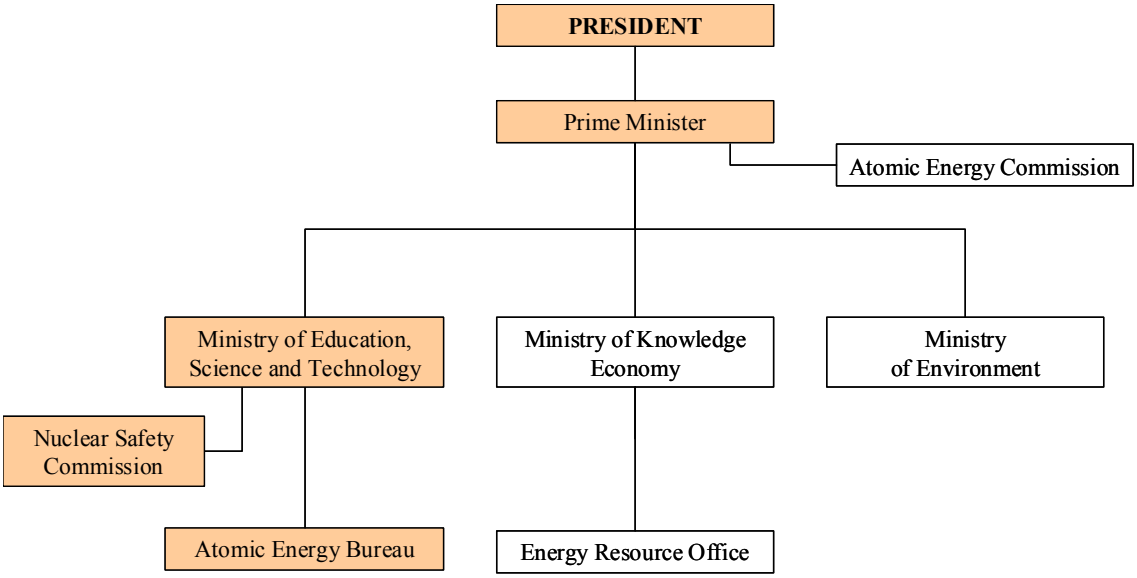


**Figure E.2-4. Governmental organizations related to radioactive waste management**

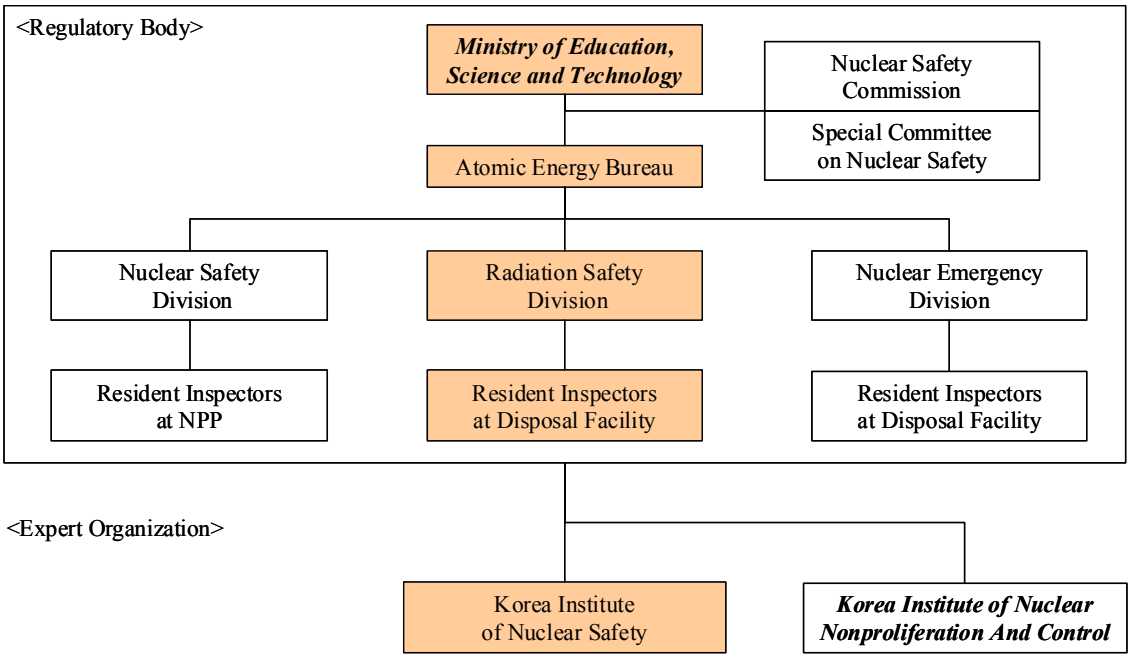


**Figure E.2-5. Nuclear safety regulatory framework**

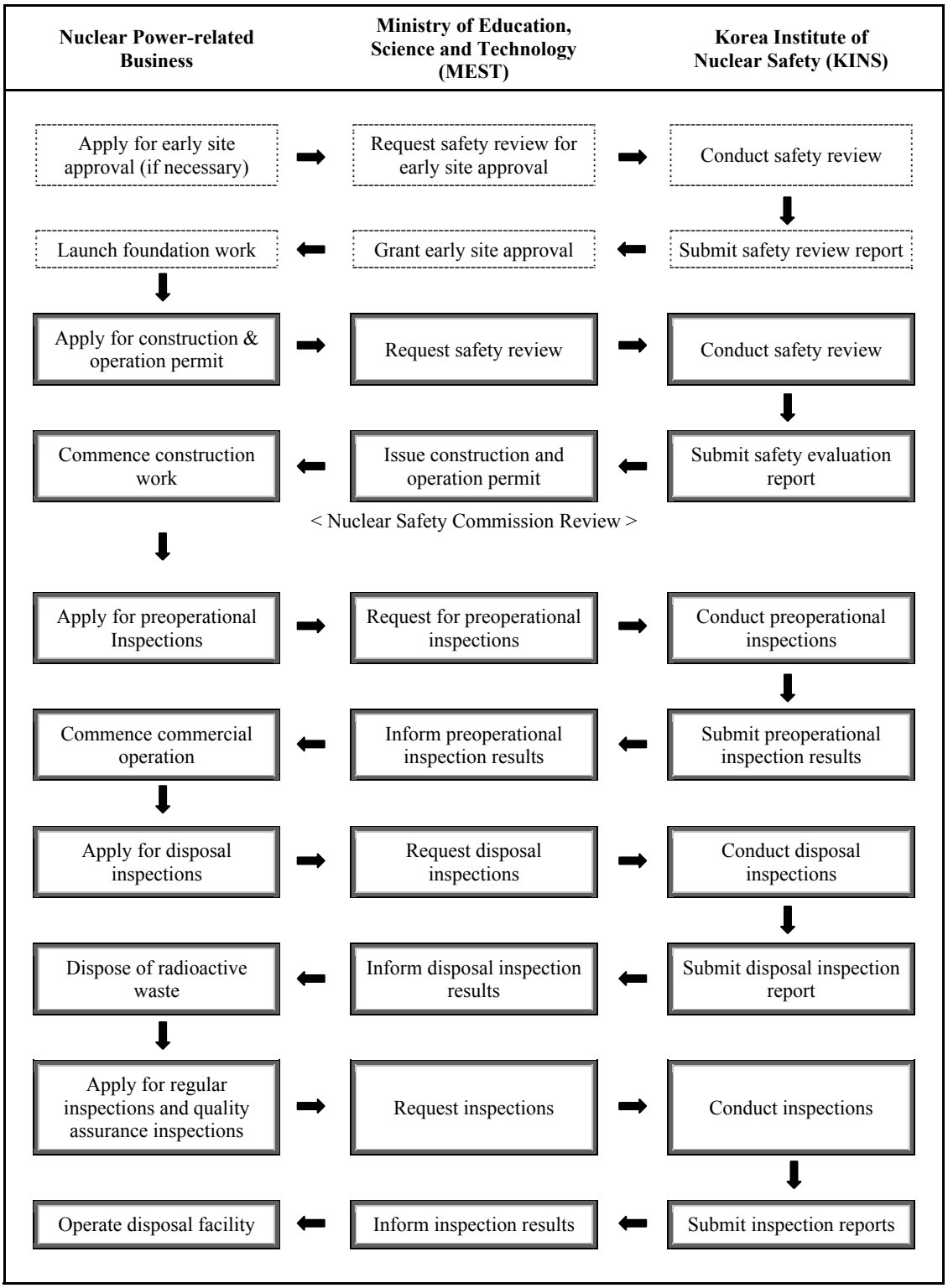


**Figure E.2-6. Licensing procedures for radioactive waste management facilities**

***The safety regulations of radioactive waste are in charge of the Radiation Safety Division of the AEB. On the commencement of radioactive waste disposal, the disposal activity shall be regulated by Office of Resident Inspectors at the disposal facility.***

The details of regulatory organizations are described in Section E.3.

## E.2.3 Licensing system and safety evaluation

The licensing procedure of spent fuel management facilities and radioactive waste management facilities is done as one-step process that combines the construction and operation permit, pursuant to the AEA as shown in Figure E.2-6.

**Early site approval**

In order to begin limited construction work on a proposed site before a construction/operation permit is issued, the applicant for early site approval shall submit an application for approval accompanied by a site survey report and a radiological environmental report to the MEST. Based on the results of the safety review by the KINS of the application for early site approval, the Minister will grant official approval. The KINS reviews to evaluate the adequacy of a site for radioactive management facilities and radiological impacts on the environment adjacent to the site.

**Permission for the construction/operation of a radioactive waste management facility**

In order to obtain permission for the construction/operation of a radioactive waste management facility, the applicant shall submit an application for permission accompanied by a radiological environmental report, a safety analysis report, safety management regulations, specifications of design and work process, and QA program for construction and operation to the MEST. Based on the result of the safety review by the KINS of the application for the construction/operation permit, the Minister of the MEST will issue a permit for construction/operation after deliberation by the NSC.

The safety review of the application for the permit is conducted to confirm that the site and the design of radioactive waste management facility are in conformity with the relevant regulatory requirements and technical guidelines. It includes safety reviews of the principles and concepts of facility design, the implementation of regulatory criteria in due course, the assessment of environmental effects resulting from the construction and operation of the facility, and a proposal for minimizing those effects. The radiological environmental report to be submitted together with the application for

permission as well as for early site approval should contain the public's opinion from the area surrounding the site.

## E.2.4 Regulatory inspections

Regulatory inspections for radioactive waste management facilities under construction or in operation include the preoperational inspection for the construction and performance of facility, radioactive waste disposal inspection, periodic inspections, QA audit, and daily inspection by resident inspectors. General procedures for each inspection are schematically described in Figure E.2-6.

**Preoperational inspection for the construction and performance of a radioactive waste management facility**

The preoperational inspection is conducted to verify whether the radioactive waste management facility is properly constructed in conformity with the conditions of the construction permit. It is conducted for the construction and the performance of facility by means of field inspection, as well as document inspection.

**Radioactive waste disposal inspection**

The radioactive waste disposal inspection is conducted to verify whether radioactive waste is properly disposed of in conformity with all the related technical standards provided in the AEA, before disposal and by means of document inspection and field inspection.

**Periodic inspection of radioactive waste management facilities**

The regular inspection of radioactive waste management facilities is conducted to verify whether the facility is properly operating in conformity with the conditions of the operating license; whether the facility can still withstand the pressure, radiation and other stresses of the operating environment; and whether the performance of the facility maintains its license-based conditions. It is performed by means of document inspection and field inspection.

**Quality assurance audit**

The QA audit is conducted to verify whether all activities affecting quality at every stage of the construction and operation of a radioactive waste management facility are being performed in conformity with the QA program approved by the regulatory body. It is conducted periodically for in-service management facilities.

**Daily inspection by resident inspectors**

The main purpose of the daily inspection by resident inspectors is to check daily the radioactive waste management facility under construction or in operation. It includes field inspection of surveillance tests, investigation of the measures taken when the facility reaches an abnormal state, and the verification of adequacy of the operator's radiation safety control activities.

## E.2.5 Enforcement

In case that the results of a safety review for a permit application meet the relevant requirements, the MEST will issue a permit. The Minister of the MEST may impose minimum conditions therein, if judged necessary to secure safety. If any violation is found as a result of regulatory inspection, the Minister may order the license holder to take corrective or complementary measures in accordance with the AEA.

If it is deemed necessary for the enforcement of the regulations, the MEST is authorized to order the nuclear-related licensee to submit necessary documents on their business and to complement any submitted documents. The Minister may also conduct regulatory inspections to verify that the documents are in conformity with field conditions, and order the operator to take corrective or complementary measures, if any, in accordance with the inspection results.

The Minister of the MEST may order revocation of a license or suspension of business within one year, if the operator of a radioactive waste management facility falls under one of the following cases. ***However, if suspension is likely to cause a grave inconvenience to the users, etc. of the project, or to be detrimental to the public interest, surcharges may be imposed in lieu of the suspension of the business.***

- the operator has modified any matter subject to the permit without approval,
- the operator has failed to meet the criteria for licensing,
- the operator has violated an order of the MEST to take corrective or complementary measures as the result of regulatory inspections for the construction or operation of a radioactive waste management facility, and
- the operator has violated any of the licensing conditions or regulations on safety measures in the operation of a radioactive waste management facility.

It is prescribed in the AEA that any violation of the relevant provisions specified in the same Act shall cause a penalty and/or a fine according to its extent.

### E.2.6 Allocation of responsibility

The AEA and the EBA prescribe definitely where responsibility lies for each stage of radioactive waste management.

Under the AEA, the MEST is responsible for construction/operation permit and the safety-related regulations of radioactive waste management facilities. As technical supporting organization for the MEST, the KINS performs safety-related regulatory activities as entrusted by the MEST.

With regard to the LILW management, the MKE has the responsibility for formulating basic policies regarding radioactive waste management including the projection of radioactive waste generation and repository construction plan, and has the responsibility to designate a Nuclear Waste Management Business Operator. ***At present, the KHNP, as a sole NPP operator in the Republic of Korea, has been designated as the Nuclear Waste Management Business Operator by the MKE, and has carried out the licensing activities for construction and operation of the LILW disposal facility.***

### E.2.7 Clearance

The clearance of the radioactive waste, as shown in Section B.4, is described in the AEA of Korea. The clearance level of the AEA is identical to the levels specified in IAEA Safety Series No. 115 (1996).

## E.3 Regulatory body (Article 20)

**ARTICLE 20. REGULATORY BODY**

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in ARTICLE 19, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.
2. Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation.

## E.3.1 Authority and responsibility of the regulatory body

The authority of the MEST, which is specified in the AEA and the Organization and Enforcement Regulations of the MEST, is as follows:

- to issue, amend and revoke licenses for the construction and operation of nuclear facilities, and to take necessary enforcement actions, where a violation of regulatory requirements has taken place,
- to conclude agreements with other domestic governmental or non-governmental bodies, and to delegate tasks to other organizations, where such delegation is directly essential to the performance of the body's regulatory responsibilities,
- to obtain such documents and opinions from public or private organizations or persons as may be both necessary and appropriate,
- to maintain contact with foreign regulatory bodies and relevant international organizations, and
- to enter, at any time, the premises of any nuclear facility licensed or under review.

The MEST assumes responsibility to develop the licensing criteria for the construction and operation of radioactive waste disposal facilities, to develop technical standards for operational safety measures, and to secure radioactive waste safety management at every stage of the site selection, design, construction, operation, closure, and post-closure of radioactive waste disposal facilities.

## E.3.2 Structure and resources of the regulatory body and supporting organizations

### *E.3.2.1 Ministry of Education, Science and Technology (MEST/AEB)*

***In according to the reorganization of the government, in the end of February 2008, the Ministry of Education, Science and Technology was established as an integration of the Ministry of Science and Technology and the Ministry of Education and Human Resources Development.***

As shown in Figure E.3-1, the NSC, under the jurisdiction of ***the MEST***, is responsible for deliberating and making decision on important matters concerning nuclear safety. The Vice Minister II and the Director General in charge of the Atomic Energy Bureau (AEB) are in a vertical arrangement under the Minister.

The AEB consists of ***5 divisions and 1 team***: the Atomic Energy Policy Division, the

Atomic Energy Cooperation Division, the Nuclear Safety Division, the Radiation Safety Division, the Nuclear Emergency Division ***and the Nuclear Control Team***. Of the 60 staff participating in the nuclear activities, 35 staff members are responsible for safety regulation. The finance of the MEST is totally funded by government budget for the regulatory independence.

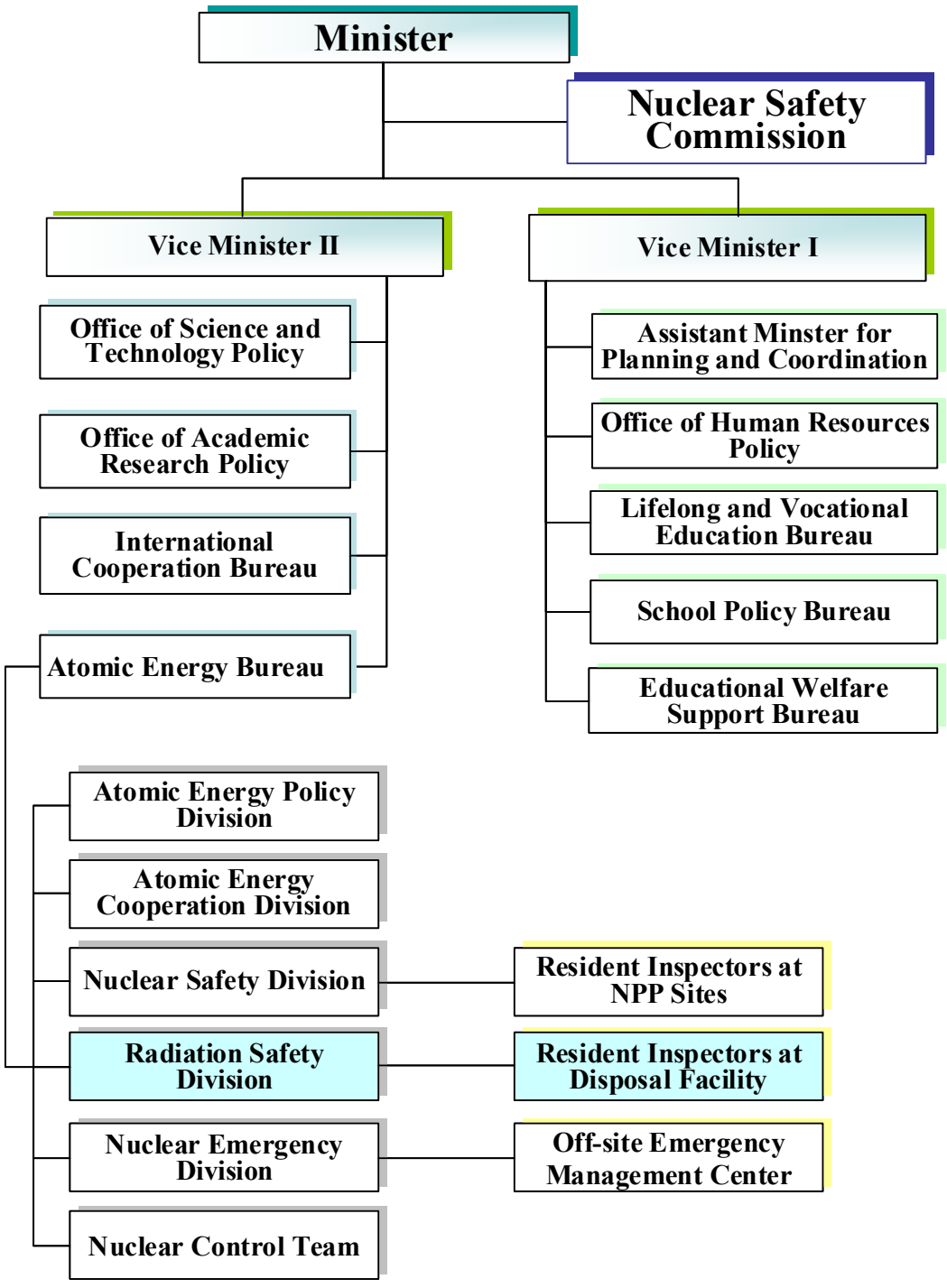


**Figure E.3-1. Organization chart of the MEST**

The functions of each division in the AEB are as follows:

**Atomic Energy Policy Division**

- establishing and coordinating the mid- and long-term comprehensive plans for R&D of atomic energy
- restructuring and supplementing laws and systems in relation to atomic energy
- directing, coordinating, and managing the R&D for atomic energy policies
- developing and supporting the nuclear R&D organizations
- developing and managing the nuclear R&D funds

**Atomic Energy Cooperation Division**

- establishing, synthesizing, and coordinating the international cooperation policies of atomic energy
- agreement and amendment for the cooperation with countries utilizing atomic energy
- cooperation with IAEA and other countries
- cooperation with OECD/NEA

**Nuclear Safety Division**

- establishing and coordinating basic policies on nuclear safety regulation
- compiling, coordinating, and managing nuclear safety regulation activities
- supporting the operation of Nuclear Safety Commission (NSC)
- licensing and implementing the safety regulation to nuclear facilities including reactor and nuclear fuel cycle
- spreading nuclear safety culture
- formulating and general supervising the plans for the technical standards of nuclear safety
- implementing affairs of the Nuclear Safety Conventions
- operating the office of resident inspectors in NPP

**Radiation Safety Division**

- development of technical standards of radiation safety
- licensing and supervising the production, sale, use, and transport of radioisotopes and radiation generating devices
- licensing and supervising the use of nuclear materials
- issuing the construction/operation permit of radioactive waste disposal facilities including centralized spent fuel interim-storage facility
- implementing affairs of the Joint Convention on radioactive waste management
- formulating and coordinating the safety management measures of radiation

sources, and managing the license to RI users
- safety regulation to closure and decommissioning of nuclear facilities
- supervise occupational exposure of the workers employed in the field of handling radioactive materials
- operating the office of resident inspectors in disposal facilities

**Nuclear Emergency Division**

- formulating and coordinating plans for radiological emergency preparedness
- general supervising and evaluating the radiological emergency exercises
- directing and supervising the evaluation of radiological environmental impacts around nuclear facilities
- monitoring and evaluating the national environmental radiation
- overall management of the radiological disaster circumstance
- developing laws related to physical protection and radiological emergency of nuclear facilities
- establishing physical protection system for nuclear facilities
- operating Off-site Emergency Management Center

***Nuclear Control Team***

- ***establishment and implementation of plans regarding the international non-nuclear proliferation system***
- ***management of laws and institutions regarding the national atomic energy control system***
- ***establishment and implementation of policies regarding safety measures of the IAEA***
- ***tasks related to the regulation of the export/import of materials and technology related to atomic energy***
- ***tasks related to the quantitative management of nuclear materials***
- ***tasks related to the Comprehensive Test Ban Treaty (CTBT)***
- ***tasks related to the detection and analysis of the nuclear activities of North Korea and other surrounding countries***
- ***creation and implementation of a comprehensive manual in response to North Korean nuclear experiments***

### E.3.2.2 Nuclear Safety Commission (NSC)

The NSC is established under the jurisdiction of the MEST in order to deliberate and decide on important matters concerning nuclear safety, pursuant to the AEA. The Commission deliberates and decides on the following:

- synthesis and coordination of matters concerning nuclear safety management
- matters concerning the regulation of nuclear materials and reactors
- matters concerning protection against hazards due to radiation exposure
- matters concerning plans for the estimation and allocation of expenditures for nuclear safety management
- matters concerning the formulation of tests and research for nuclear safety management
- matters concerning the fostering and training of researchers and engineers in the area of nuclear safety management
- matters concerning the safety of radioactive waste management
- matters concerning measures against radiological emergency
- other matters deemed important by the Chairman

The NSC, which is chaired by the Minister of MEST, consists of 8 members including 7 members appointed or commissioned by the Minister. In order to strengthen nuclear regulatory independence, the MEST stipulates that any person who is engaged in the operation of nuclear facilities should not be commissioned to be a member of the Commission.

The NSC organized the Special Committee on Nuclear Safety to technically investigate and deliberate matters under its jurisdiction. This Committee is composed of 25 experts or less, and for its effective operation, it is divided into 5 Sub-committees, as shown in Figure E.3-2, of the Reactor System Subcommittee, the Radiation Protection Subcommittee, the Nuclear Emergency and Environment Subcommittee, the Site and Structure Subcommittee, and the Regulatory Policy Subcommittee.

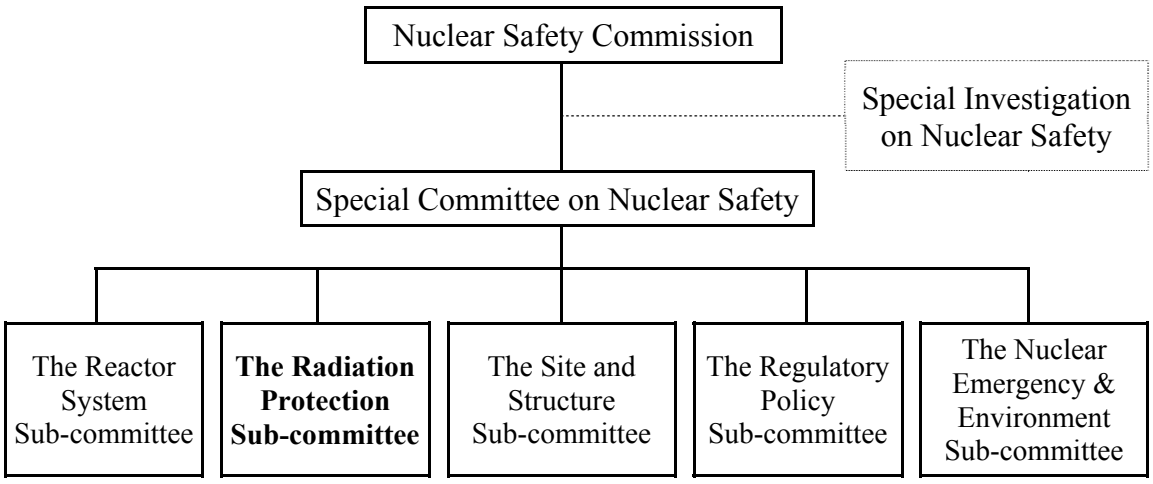


**Figure E.3-2. Organization chart of the NSC**

The NSC may also organize and operate the Special Investigation Committee if any nuclear and/or radiation accidents occur.

### E.3.2.3 Korea Institute of Nuclear Safety (KINS)

The KINS was established in December 1981, and was initially operated under the name of the "Nuclear Safety Center" as an internal organization of the KAERI. It started functioning as an independent expert organization in February 1990, according to the "Korea Institute of Nuclear Safety Act", and conducts matters on nuclear safety regulation as entrusted by the MEST in accordance with the Atomic Energy Laws.

Its major functions relevant to nuclear safety regulation are as follows:

- to conduct safety reviews in relation to the licensing and approval of nuclear facilities,
- to conduct regulatory inspections during the manufacturing, construction and operation of nuclear facilities,
- to perform the research and development of the technical standards of safety regulations for nuclear facilities,
- to conduct license examinations for the operation of nuclear facilities and the handling of nuclear materials, and the national technical qualification examinations in relation to nuclear engineering,
- to receive and process notifications relevant to licensing formalities, and
- to conduct the QA examinations and inspections.

The KINS also has responsibility for activities such as the development of nuclear safety regulation technology, technical support to the MEST for policy development and radiation protection, information management regarding safety regulations, and the monitoring and evaluation of environmental radioactivity.

The KINS consists of ***2 headquarters***, 6 divisions***, 1 school and*** 38 sections, as shown in Figure E.3-3, and operates the Advisory Committee on Nuclear Safety, a consultative body for technical matters on safety regulations, which is composed of experts from the KINS and other external organizations. ***As of the end of May 2008, the KINS has a total of 386 staff members, of which 332 members are technical experts. To share its safety regulation technology and experience with the international community, the KINS opened the International Nuclear Safety School in January 2008, which has also functioned as the IAEA's Asian training center since its conclusion of a Nuclear Safety Cooperation Agreement with the IAEA.***

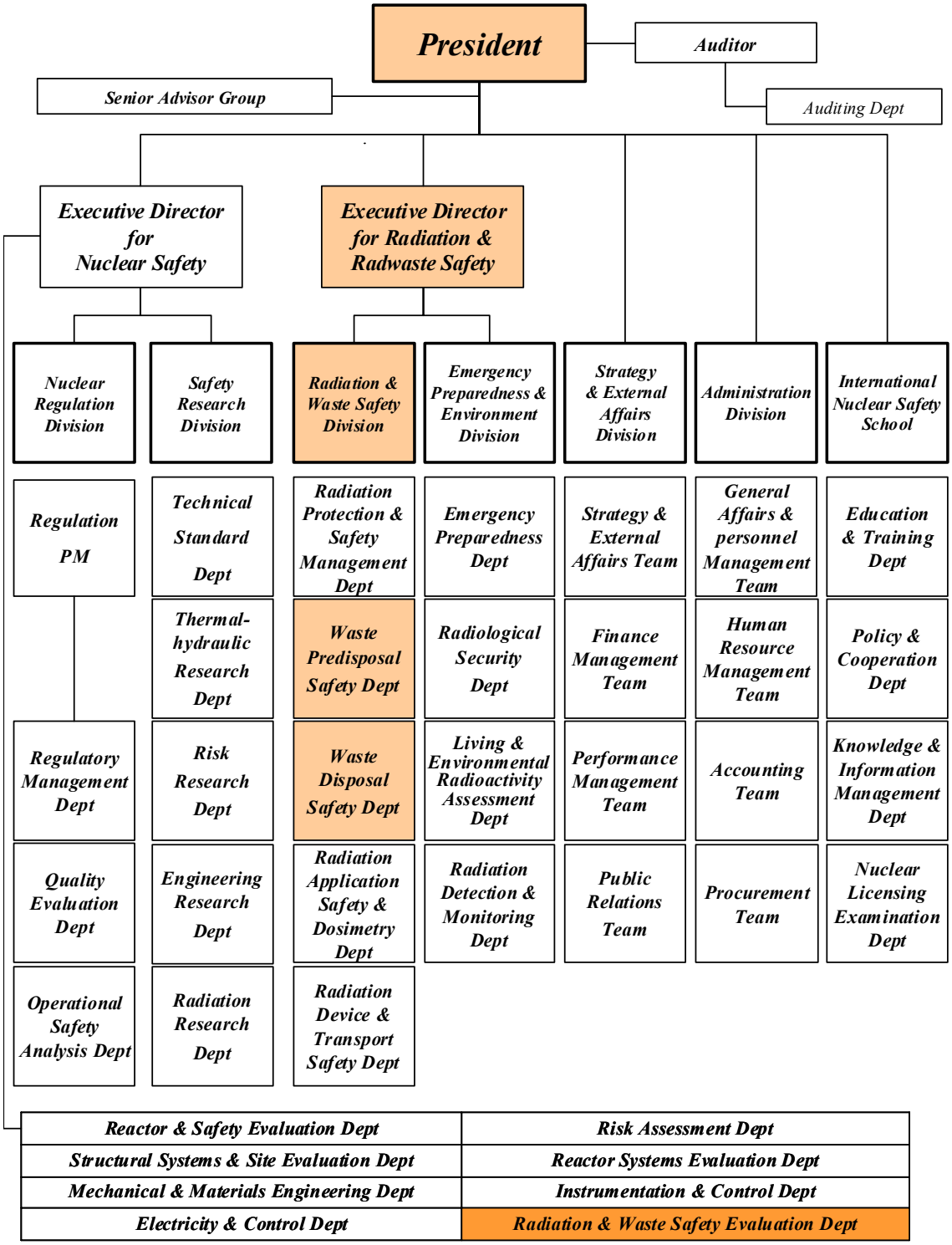


**Figure E.3-3. Organization chart of the KINS**

***The safety regulation of radioactive waste management facilities is under the responsibility of the "Radiation and Waste Safety Division" in the KINS. The budget of the KINS, a sole expert organization of nuclear safety regulation, is mainly financed by the government budget and partially appropriated by regulation fees from licensees.***

The KINS has concluded agreements with China, Finland, France, Germany, Japan, Romania, UK and the USA, etc. (in alphabetic order) for bilateral cooperation in radiological emergency preparedness and to broaden the techniques and knowledge of nuclear safety regulation through international collaboration with regulatory agencies in the cited countries.

## E.3.3 Regulatory independence

The MEST, the regulatory body for nuclear and radioactive waste safety, implements safety regulation. Its authority of the MEST is completely independent from the MKE by law. Under the AEA, the MEST has complete responsibility and authority for the safety regulation including construction/operating licenses of spent fuel and radioactive waste management facilities.

The NSC and the Special Committee on Nuclear Safety are established under the jurisdiction of the MEST to deliberate and decide on important matters concerning nuclear safety. Both commission and committee members comprise civilian experts to enhance the objectivity and fairness in the safety regulation.

The KINS conducts the safety-related regulations on the radioactive waste management facilities, as entrusted by the MEST.

In accordance with the EBA, the MKE has the responsibility for formulating basic policies regarding radioactive waste management including the projection of radioactive waste generation and repository construction plan.

# F. Other General Safety Provisions

## F.1 Responsibility of the license holder (Article 21)

**ARTICLE 21. RESPONSIBILITY OF THE LICENCE HOLDER**

1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

2. If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.

### F.1.1 Mechanism for the regulatory body to ensure that the license holder will meet its primary responsibility for safety

To verify compliance with the requirements in permit or license conditions by the AEA, during the construction and lifetime of the nuclear facility for the installer or operator of nuclear facilities, the MEST carries out the regulatory inspections described in Subsection E.2.4. If violations occur, the Minister of the MEST immediately orders the installer or operator of nuclear facilities to take corrective actions and complementary measures so as to secure the safety of the nuclear facilities.

The operator of the nuclear facility holds the responsibility for the safe management of generated spent fuel and radioactive wastes in compliance with related activities before these materials are transferred to the licensee of the treating, storage, or disposal facility.

The operator of the radioactive waste management facility should accept the radioactive wastes from the nuclear industries, and then treat, store, and/or dispose of them safely.

### F.1.2 Ultimate responsibility

According to the 249th meeting of the AEC, the Government of the Republic of Korea adopted the State's ultimate responsibility of radioactive waste management in the light of the importance that these wastes are needed and required long-term safe management. Based upon this principle, the MKE carries out the management policies regarding to radioactive waste treatment, storage, and disposal, which are prepared by the MKE in consultation with the MEST and deliberated by the AEC.

According to the "Nuclear Safety Policy Statement", the ultimate responsibility for the safety of a nuclear installation rests with the operating organization and is in no way diluted by the separate activities and responsibilities of designers, suppliers, constructors and regulators. The Government has an overall responsibility for ensuring the protection of the public health and the environment from radiation hazards that may occur in the development of nuclear energy.

# F.2 Human and financial resources (Article 22)

**ARTICLE 22. HUMAN AND FINANCIAL RESOURCES**

Each Contracting Party shall take the appropriate steps to ensure that:

(i) qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;
(ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning;
(iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

## F.2.1 Nuclear power plants

KHNP is a sole nuclear power generating company in Korea. It has 4 divisions in the headquarters and 4 nuclear power sites, Radwaste Site Construction Office, Nuclear Engineering and Technology Institute, 26 hydro power plants and others as shown in Figure F.2-1.

**Organization and human resources**

The Safety and Technology Department of the KHNP headquarters includes the Radiation Safety Office, which is consists of 16 persons and working for the safe management of radioactive waste and radiation safety.

Each NPP has a Radiation Safety Section with approximately 25 engineers tasked for the occupational radiation protection and to treat radioactive waste generated from its nuclear facility. There are usually 6 staff members among them that treat and manage

radioactive waste. As a collaborative company, Korea Plant Service and Engineering Co., Ltd. (KPS) supports the maintenance of radioactive waste treatment facilities. In addition, some radiation safety management service companies provide technical support of the radiation safety related activities. Figure F.2-2 shows the NPP operational structure.

For the nuclear safety review and decision making, the KHNP has the KHNP Nuclear Review Board (KNRB) at the headquarters and the Plant Nuclear Safety Committee (PNSC) at each nuclear plant.

The Radwaste Project Division in the KHNP headquarters is in charge of overall radioactive waste management projects. In addition, the Radwaste Site Construction Office has undertaken works construction for the LILW disposal facility. Nuclear Engineering and Technology Institute in the KHNP is in charge of R&D, technical support, management of RI waste from hospitals and industries, etc.

**Financial resources**

According to the EBA, the NPP operator should deposit the cost of plant decommissioning, disposal of LILW and spent fuel management as a yearly basis. The KHNP has accumulated these costs as an in-house liability since 1983.

***In accordance with Notices of the MKE, as an in-house liability, the initial estimated cost is calculated, then estimated cost at the time of dismantling or prospective disposal is calculated to reflect the inflation rate and converted into the current value, and the value of the annual interests are conserved. In accordance with such calculation standards, nuclear power generation licensees supply the reserve funds for each category to be calculated. The Minister of the MKE recalculates and announces the calculated variables every 5 years.***

***According to the Radioactive Waste Management Act legislated in 2008, the in-house liability are scheduled to be converted into the Radioactive Waste Management Fund and managed starting on January 1, 2009. According to the Radioactive Waste Management Act, when those who have generated radioactive waste transfer the cost of maintaining radioactive waste to the soon to be established the Korea Radioactive Waste Management Corporation (KRMC), the Corporation will pay this maintenance cost to the fund. However, as for the spent fuel generated by nuclear power generation licensees, to implement projects related to the management of spent fuel smoothly, the cost of managing such fuel will be imposed on nuclear power generation licensees as the spent fuel management costs and reverted to the fund.***

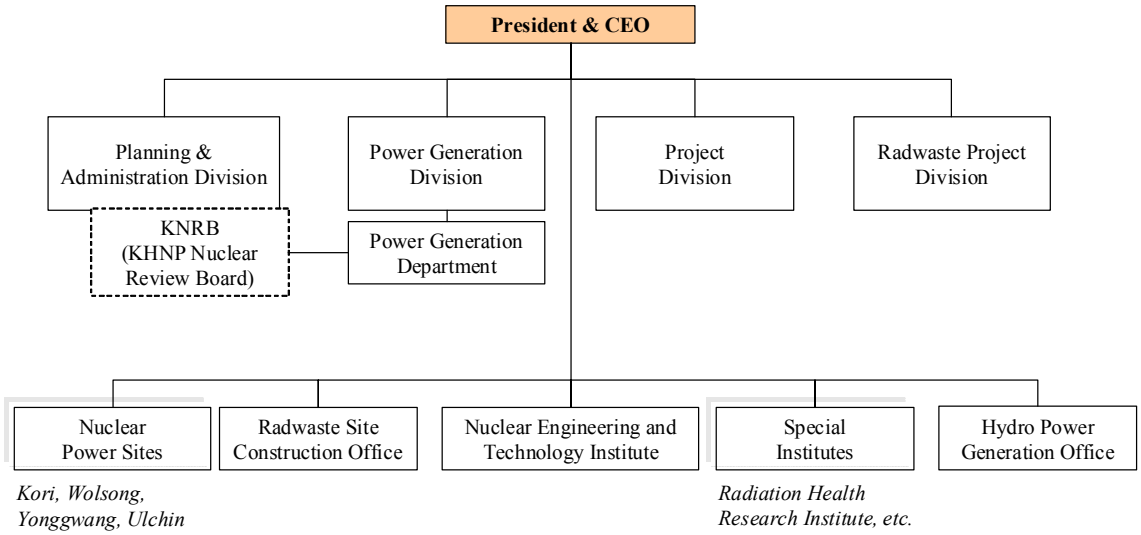


**Figure F.2-1. Organization chart of the KHNP**

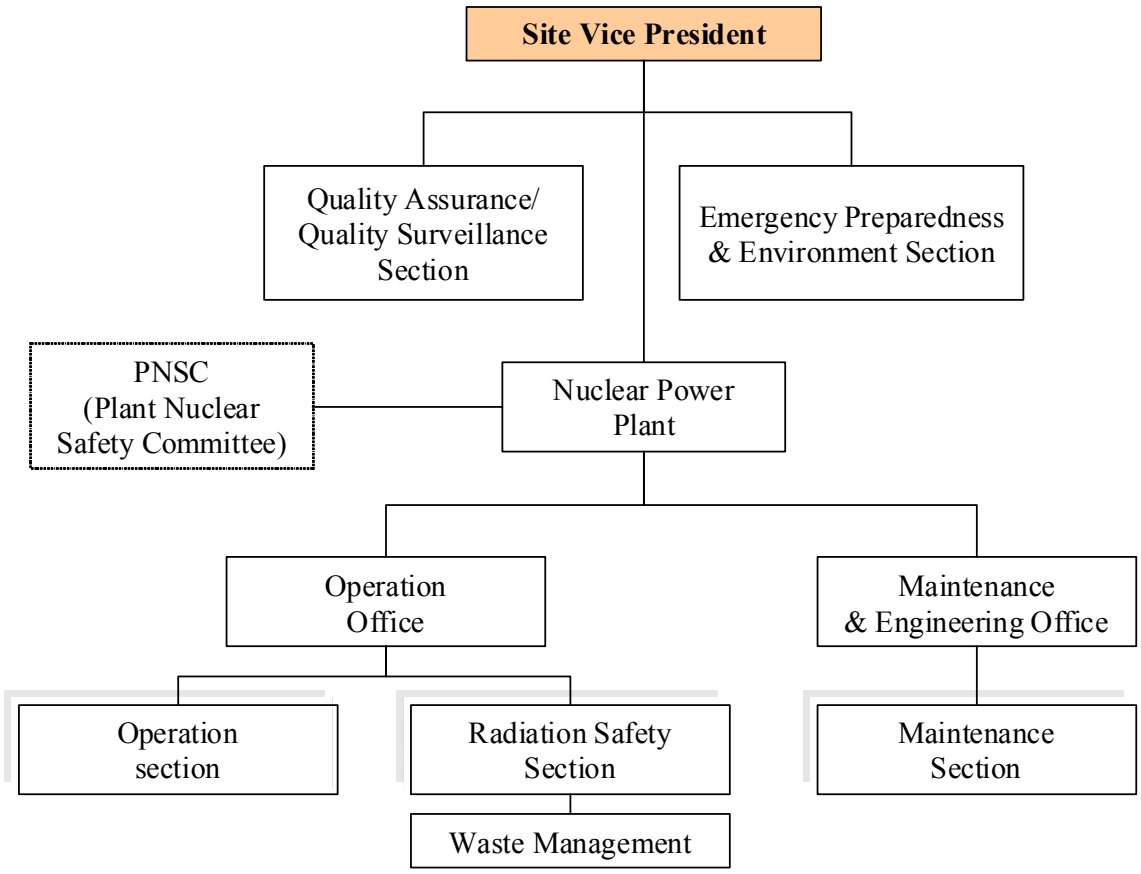


**Figure F.2-2. Organization chart of nuclear power site**

## F.2.2 Research facilities

***In the KAERI, there are several facilities related to the management of spent fuel and radioactive waste such as HANARO facility, post-irradiation examination facility (PIEF), radioactive waste treatment and storage facility, and so forth. Figure F.2-3 represents the organization for spent fuel and radioactive waste management at the KAERI.***

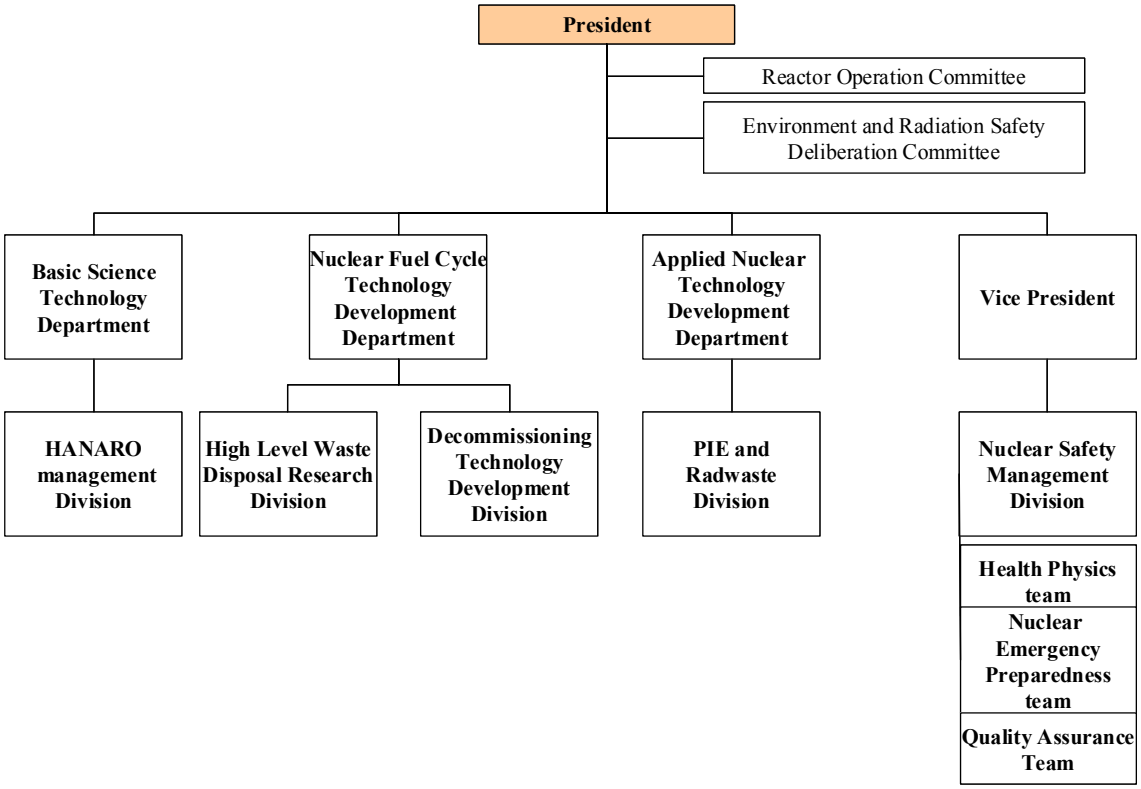


**Figure F.2-3. Organization chart of the KAERI**

**<u>Human resources</u>**

### 1) HANARO research reactor

With 40 staff members, the HANARO Management Division of the Basic Science and Technology Department operates the research reactor and carries out the maintenance work. Radioactive waste generated from the HANARO has been transferred to the radioactive waste treatment facility, and stored at the storage facilities. The spent fuels generated from the reactor are managed by the HANARO Management Division.

**2) Post-irradiation examination facility**

The PIE and Radwaste Division of the Applied Nuclear Technology Development Department in the KAERI operates the PIEF. This facility is operated and maintained by 9 operating and examining/managing staff members whose work scopes are divided by their specialties and backgrounds. The operating staff members are responsible for the operation of the utilities and supporting equipment, internal and external inspections including nuclear material accountancy and licensing, while the examining/managing staff are in charge of post-irradiation examination for spent fuels, with the management of the relevant examination facilities. Additionally, they conduct radiation safety management, environmental radiation monitoring, water supply control, nuclear material safeguards and management in cooperation with the related expert departments within the KAERI.

**3) Radioactive waste treatment and storage facility**

***Twelve staff members of the PIE and Radwaste Division of the Applied Nuclear Technology Development Department in the KAERI operate the radioactive waste treatment facility and the storage facilities.*** They operate the equipment related to evaporation, bituminization, solar evaporation, and compaction (only for solid waste), cementation and decontamination, ***and the facilities for a radioactive waste form examination*** and a ventilation, and the storage facilities for LILW. The radiation safety management, environmental radiation monitoring and quality assurance are performed with the support of related expert departments in the KAERI.

**Financial resources**

***All the facilities for the spent fuel management, radioactive waste treatment and waste storage in the KAERI are in operation with the organizational project fund provided by the government budget.***

## F.2.3 Nuclear fuel fabrication facility

**Human resources**

The KNF has the Radiation and Environment Management Department for the management of radiation safety, radioactive waste and nuclear material under the Fuel Production Division. Radiation and Environment Management Dept. consist of the Radiation & Environment Safety Team and Safeguards Team as shown in Figure F.2-4.

The Radiation and Environment Safety Team consists of 16 staff members responsible for the management of radiation safety and radioactive waste generated form the nuclear

fuel fabrication facility. They include health physics, environmental radiation measurement and transport of radioactive material. In addition, the Safeguards Team has 6 staff members responsible for nuclear material accountancy and physical protection. The operation and maintenance of radioactive waste treatment facilities is made with the support of 16 experts belonging to a subsidiary company.

**Financial resources**

Under the EBA, the radioactive waste generator shall pay radioactive waste management expenses at the delivery point of radioactive waste to the disposal site. In order to reduce the economic burden to pay the increased waste management at the time, KNF has been quarterly reserving expenses for radioactive waste.

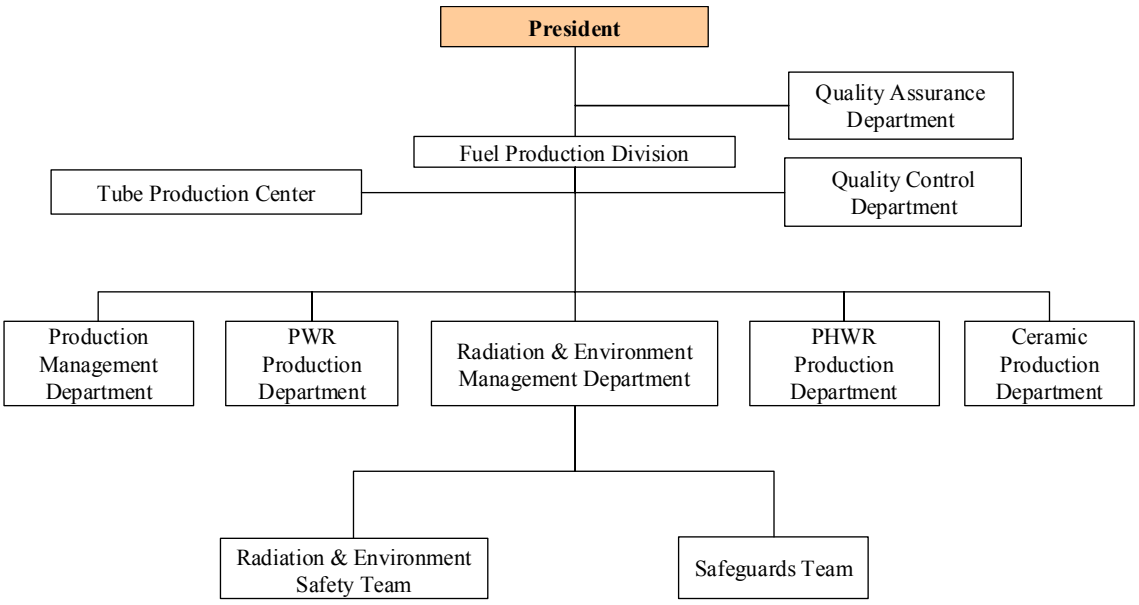


**Figure F.2-4. Organization chart of the KNF**

## F.2.4 Radioisotope waste management facility

**Human resources**

NETEC is an affiliate of the KHNP and consists of 5 offices, 1 center, and 41 departments/groups, as shown in Figure F.2-5. There are about 200 employees at NETEC, including 14 persons engaged in duties related to the operation of the RI waste management facility.

RI Technology team and Radiation Environment team, who operates and manages the RI waste management facility, is in charge of safe storage and management of all RI waste with the cooperation of the other sections.

**Financial resources**

The EBA requests that the RI waste generator bear incurring management expenses related to waste treatment and disposal at the point of delivering waste to the disposal licensee, the KHNP.

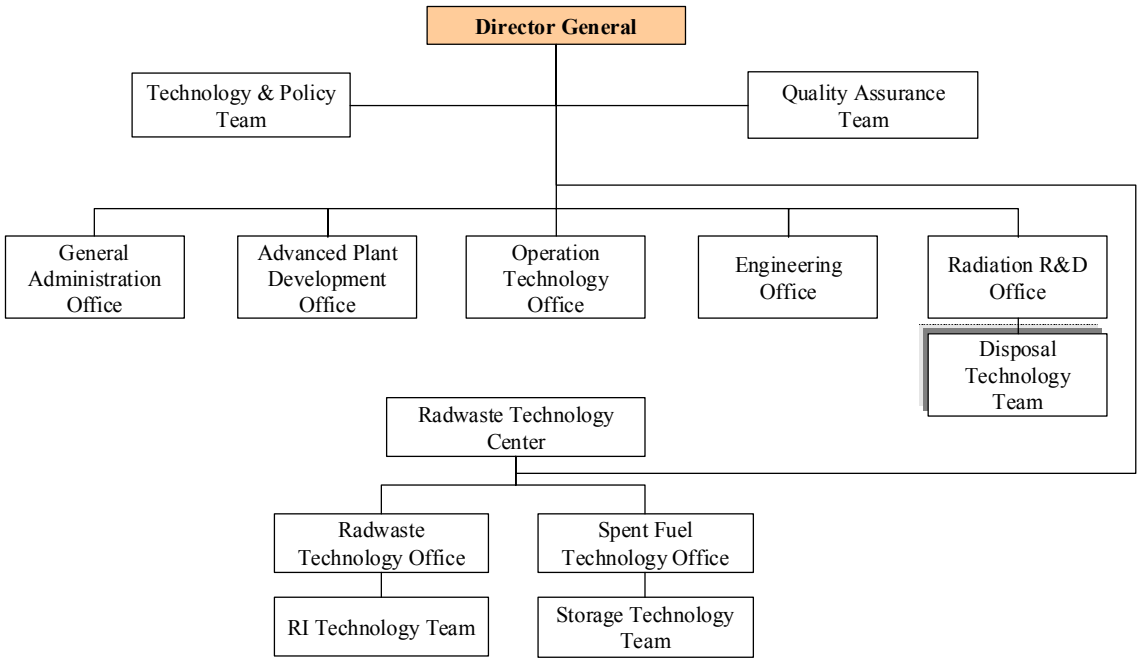


**Figure F.2-5 Organization chart of the NETEC**

## F.2.5 Securing of financial resources for management after the closure of a radioactive waste disposal facility

The long-term management for the post-closure of radioactive waste disposal facility is essential and the cost for the post-closure of repository must be assured. In this regard, the Enforcement Decree for the EBA demands that the scope of the Nuclear Waste Management Business includes the post-closure management and mandates cost be assured.

# F.3 Quality assurance (Article 23)

**ARTICLE 23. QUALITY ASSURANCE**

Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

## F.3.1 Quality assurance policies

The Atomic Energy Act stipulates that a licensee of radioactive waste storage, treatment, and disposal facilities and auxiliary facilities shall establish and implement a QA program, so as to ensure planned and systematic quality assurance activities at the stages of ***site characterization,*** design, construction, operation, closure, ***and post-closure monitoring.***

The MEST Notice No. 2008-55 (Quality Assurance Criteria for Radioactive Waste Management Facilities) shall be applied to establish a QA system of the LILW disposal facility. Another MEST Notice No. 2008-57 (Technical Requirement for the Operation and Control of the LILW Repository) also specifies overall QA requirements to be observed by the licensee for the operation and management of the LILW disposal facility.

According to this provision, the applicants of the construction/operation permit of disposal facilities shall submit a QA program for the construction and operation of radioactive waste disposal facilities. The applicant has the ultimate responsibility to comply with the QA program during the construction and operation of each facility.

## F.3.2 Framework of quality assurance programs

As for the framework of the QA programs applicable to radioactive waste disposal facilities, the Enforcement Regulation Concerning the Technical Standards of Reactor Facilities and the MEST Notice No. 2008-55 (Quality Assurance Criteria for Radioactive Waste Management Facility) stipulate 18 criteria including from the Organization to the Audit as follows:

***1) organization, 2) QA Program, 3) design control, 4) procurement document control, 5) instructions, procedures, and drawings, 6) document control, 7) control of purchased items and services, 8) identification and control of items, 9) control of***

***special process, 10) inspection, 11) test control, 12) control of measuring and test equipment, 13) handling, storage, and shipping, 14) inspection, test, and operating status, 15) control of nonconforming items, 16) corrective action, 17) QA records, and 18) audits.***

## F.3.3 Implementation and assessment of quality assurance programs

The licensee (i.e. KHNP), a constructor and operator of the LILW repository, and all contractors participating in the site characterization, design, manufacturing, construction, commissioning, operation, maintenance, closure, ***and post-closure monitoring*** are required to prepare and implement a QA program pursuant to the AEA. The licensee is responsible for establishing an integrated system for all participants to implement the QA program.

All contractors involved in the LILW Repository projects, including the design, manufacturing, construction, maintenance, etc., are required to implement the specific quality assurance procedures prepared in accordance with the regulatory requirements.

The evaluation for the implementation and effectiveness of the QA program is periodically conducted by the licensee to verify whether QA activities are properly implemented by the licensee itself, as well as by the contractors and sub-contractors, in accordance with the approved QA program.

***The method to assess the implementation of a QA program includes quality control inspection, QA audit, QA trend analysis, and effectiveness evaluation of the QA program.***

- ***Quality control inspection is conducted by a qualified inspector on the basis of the pre-established inspection plan. Before starting the quality control inspection, the inspector selects the inspection points (witness point and hold point) in the inspection plan and then executes the inspection.***
- ***Quality assurance audit is periodically conducted by a qualified auditor for both the internal organizations and external contractors considering the characteristics of activities.***
- ***Quality trend analysis is conducted to revise the quality assurance program and to improve the quality assurance system. This is achieved by establishing recurrence-preventive measures and improvement plans from investigation on the causes of conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and non-conformances that are identified during the quality control inspection and***

***quality assurance audit.***

- ***Assessment for a quality assurance program effectiveness is periodically conducted by the quality assurance organization to maintain the quality assurance program suitable for the features of nuclear installations. Major considerations given to the assessment for quality assurance programs include the issuance and amendment of related regulatory requirements, corrective actions or recommendations made by the regulatory body, changes in quality assurance policy, the revision of the applied technical standards, and the results of a self-quality assurance audit.***

The responsible person of the QA organization should take proper measures in a timely manner by reporting to the top management the important issues resulting from the evaluation of the implementation and effectiveness of the QA program. Further efforts should be made to maintain the QA program as a valid document by revising the corresponding QA program, if necessary, after in-depth evaluation of effectiveness.

## F.3.4 Regulatory activities

The regulatory activities concerning QA of radioactive waste disposal are conducted through safety reviews and regulatory inspections by the KINS, as entrusted by the Government. The main objectives of regulatory activities for radioactive waste disposal project are to verify whether each organization participating in the design, manufacturing, construction, and operation of related facilities has performed quality activities in accordance with the QA program, and whether the program has effectively been implemented so as to ensure the safety and reliability of related facilities. These activities are performed based on the Atomic Energy Act, the safety review guidelines on the safety analysis report (SAR) of radioactive waste disposal and the QA guidelines prepared by the KINS for nuclear facilities.

The safety review of quality activities is conducted to verify whether the QA system of the licensee and major contractors is adequate to implement the QA program in accordance with the Atomic Energy Act and the safety review guidelines. It also verifies whether the QA procedures for the implementation of the QA program are properly established and practicable.

The KINS has performed the periodic inspections to confirm the adequacy of implementation of the QA program of radioactive waste treatment, storage, and disposal facilities in the NPP and the radioactive waste management facilities in the research reactor facility or in the fuel fabrication facility. In the same manner, equivalent regulations will be conducted to the LILW disposal facility under construction.

In order to encourage voluntary performance-based QA activities from the licensees, the KINS has developed and utilized the inspection guidelines for verifying the adequacy of licensee's QA program and the appraisal instructions for assessing the appropriateness of licensee's QA activities. Under the "Quality Assurance Auditor Qualification Program" for regulatory personnel which was established by the KINS, qualified auditors who have completed the specified educational and training courses, conducts the QA inspections.

***Introduction of quality management system within regulatory body***

***KINS has established a quality management program, based on the IAEA Safety Standards Series No. GS-R-3 "The management system for facilities and activities", in order to improve the public trust and the reliability of the regulatory body. The quality management program describes the policy, purpose, and responsibility of the quality of regulatory activities according to the nuclear regulatory policy of the government, including a comprehensive quality management system to carry out standardized tasks such as quality planning, management, evaluation, and improvement.***

***The comprehensive document system for quality management of regulatory activities is arranged in four sections as:***

- ***quality management plan describing the quality management system according to the quality policy of regulatory body,***
- ***work standards to identify the operation provisions of the entrusted assignments obtained the government's permission according to the Atomic Energy Act,***
- ***detailed and standardized guidelines for implementing regulatory activities, and,***
- ***procedures describing how to conduct regulatory activity.***

***The independent quality expert team which has organizational freedom performed the evaluations for quality management system of the KINS twice in 2006. Through the first evaluation, some parts of the quality management plan, relevant guidelines and procedures were revised and complemented according to the results of the evaluation on the structure and contents of the quality management system. In the second evaluation, corrective actions and recommendations were identified for improving the efficiency of regulatory activities by evaluating the performance in tasks entrusted by the government. They include the main consideration that should be addressed by the concerning regulatory organization in order to conduct proper quality management. In 2007, the third evaluation for quality management system of***

***KINS was performed as the annual basis by the independent quality expert team which has organizational freedom.***

# F.4 Operational radiation protection (Article 24)

**ARTICLE 24. OPERATIONAL RADIATION PROTECTION**

1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility:

   (i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;
   (ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection; and
   (iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.

2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:

   (i) to keep exposure to radiation as low as reasonably achievable, economic and social actors being taken into account; and
   (ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.

3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

## F.4.1 Regulations and requirements

The regulations and requirements related to radiation protection applicable to nuclear facilities which generate spent fuel and radioactive waste are specified in the AEA, the Enforcement Decree of the AEA, the Ordinance of the MEST and the Notices of the MEST. These Regulations and requirements meet IAEA standards and are summarized as follows:

**Atomic Energy Act**

The AEA prescribes basic matters on radiation protection to be applied to nuclear facilities, as follows:

- provisions on protective measures against radiation hazards that maintain radioactive material release and occupational radiation exposure as low as is reasonably achievable (ALARA),
- provisions on safety measures related to operations stipulating the necessary actions to be taken for protecting human body, materials, and the public from radiation hazards which may accompany the operation of nuclear facilities,
- provisions on the designation of exclusion areas to protect human body, materials, and the public from possible radiation hazards, in establishing nuclear facilities,
- criteria for the registration of businesses related to personnel dosimetry services for any person who is employed or who has access to NPP, and
- requirements for the education and training of the human resource involving radiation exposure.

**Enforcement Decree of the Atomic Energy Act**

The Enforcement Decree of the AEA specifies the detailed requirements for implementing basic matters on radiation protection referred to in the same Act, as follows:

- radiation dose limits related to radiation protection (The dose limits defined are as shown in Table F.4-1)
- detailed provisions on safety measures related to operation, stipulating the necessary action to be taken for protecting human body, materials, and the public from radiation hazards, which may accompany the operation of nuclear facilities,
- provisions to minimize the exposure of workers employed in nuclear facilities, persons who have frequent access to the said installations, and the public living in nearby regions,
- physical examination and exposure control for people who have access to nuclear facilities,
- provisions on the measurement of radiation dose and contamination levels for any place, which is in a radiation hazard area within nuclear facilities, and the functional testing of dosimetry service providers,
- detailed provisions necessary for implementing protective measures against radiation hazards, such as actions to be taken for any person suffering from radiation hazards, relevant reports, etc., and

- detailed provisions on the education and training of persons engaged in radiation work or who have access to controlled areas.

**Table F.4-1 Dose limits**

| Item | Radiation Worker | Frequent Access Personnel / Worker for Transport | Public [2)] |
|---|---|---|---|
| Effective dose limit | 100 mSv for five consecutive years[1)] and not exceeding 50 mSv/y | 12 mSv/y | 1 mSv/y |
| Equivalent dose limit<br>– lens of the eye<br>– skin, feet, and hands | <br>150 mSv/y<br>500 mSv/y | <br>15 mSv/y<br>50 mSv/y | <br>15 mSv/y<br>50 mSv/y |

1) "Five consecutive years" means the 5-year period from any given year (for example, 1998～2002). This calculation is not applicable to any period before 1998.
2) As for the general public, the value of over 1 mSv in a single year is acceptable within the limit of not exceeding 1 mSv per year for the average of values for five consecutive years.

※ Concerning a person who is proven to be pregnant among radiation workers and persons who restrictively or temporarily use any radioactive isotope among the public, it is necessary to comply with the standards prescribed and notified by the MEST.

**Ordinance of the Ministry of Education, Science and Technology (MEST)**

The MEST Ordinance includes the Enforcement Regulations of the AEA, the Regulation Concerning the Technical Standards of Reactor Facilities, etc., and the Regulation Concerning the Technical Standards of Radiation Safety Management, etc., and prescribes detailed procedures and methods necessary for implementing the AEA and the Enforcement Decree of the AEA, and the detailed technical standards thereof.

- detailed provisions on radiation protection equipment for protection against radiation exposure in the reactor and related facilities, and nuclear fuel cycle facilities, (technical standards of reactors)
- detailed provisions on the particulars about and the actions taken for controlled areas within nuclear facilities, (technical standards of reactors; technical standards of radiation)
- detailed provisions on radiation protection for persons who are engaged in radiation work, and persons who have frequent access to nuclear facilities, (technical standards of reactors)
- detailed provisions on measures related to radiation protection plans for reactor and related facilities, and nuclear fuel cycle facilities, (technical standards of

reactors)
- detailed provisions on the assessment and control of radiation dose for persons who are engaged in radiation work, and persons who have frequent access to nuclear facilities, (Enforcement Regulations)
- detailed provisions on the place and personnel for measuring radiation dose and contamination level, (Enforcement Regulations)
- provisions on technical capabilities for personal dosimetry, (Enforcement Regulations)
- detailed provisions on the substance and duration of education and training for persons who are engaged in radiation work, and persons who have access to controlled areas, (Enforcement Regulations)
- details of physical examination for persons who have access to nuclear facilities. (Enforcement Regulations).

**Notices of the Ministry of Education, Science and Technology**

Notices of the MEST present the detailed technical standards of radiation protection specified in the AEA, the Enforcement Decree of the AEA, and the Ordinance of the MEST, and the principal Notices related to radiation protection as follows:

- Standards on Radiation Protection, etc.
- Notice on Materials exempted from Radioisotopes, etc.
- Notice on Uses and Capacity exempted from Radiation Generating Devices
- ***Radiological Protection Criteria for Long-term Safety on Low and Intermediate Level Radioactive Waste Disposal***
- Regulation on Assessment and Management of Personnel Dose
- Regulation on Registration Standard and Inspection of Dosimeter Reading Service Provider
- Regulation on the Education and Training for Radiation Safety Management, etc.
- ***Technical Standards on Radiation Safety Management of Low and Intermediate Level Radioactive Waste Transport Ships, etc.***

The standards on radiation protection, etc. concretely define not only the constraints and limits in radiation protection such as the allowable surface contamination level, release control standards, annual limit on intake (ALI), derived air concentration (DAC), and design dose standards of shields, but also the details of the method to apply dose limits and the dose limitation and working procedures in emergency radiation work. Additionally, in order to prevent any environmental hazard, the criteria applicable to the design of corresponding facilities are specified.

## F.4.2 Radiation protection framework by stages of nuclear facility management

**ALARA activities for workers and the public**

The KHNP incorporates the following radiation protection principles in the design and construction of nuclear facilities, for assuring ALARA and maintaining the radiation doses to workers and the general public within the applicable limits:

- radioactive equipment to be installed separately in a shielded room with a partition,
- installation of shields to fully attenuate radiation from pipes and equipment containing large amounts of radioactivity,
- use of remote controlled equipment and automatic equipment,
- installation of ventilation facilities in areas of potential air contamination,
- installation of a continuously operating radiation monitoring system in nuclear facilities, and
- ***appropriate zoning*** and access control.

**1) Radiation protection training**

The Procedure prescribes that radiation workers and the personnel having frequent access to nuclear facilities should take appropriate radiation protection training courses in both the theoretical and practical aspects to acquire radiation-handling skills needed for radiation work, or for access to controlled areas. The curriculum is classified into the following courses:

- a course for radiation workers (first 20 hours),
- a course for personnel of frequent access (first 4 hours), and
- a refresher course (Radiation workers: 6 hours, Personnel of frequent access: 4 hours respectively).

The training duration is different for each course in consideration of the specialty of each course. Educational subjects include fundamentals of radiation protection, health effects of radiation, access procedures to controlled areas, and emergency preparedness. Additional subjects include radiation exposure control, contamination control, waste management, and the use of instruments and protective equipment. Personnel who have taken the training courses shall be evaluated by proper means including a written examination. If the results of the evaluation are above the pre-established level, personnel will be qualified.

**2) Radiation work management**

It is provided that any person who intends to have access to controlled areas and to perform radiation work should obtain approval in advance in the form of a radiation work permit. This is prepared separately in consideration of the radiation work type, the radiation level, and the working area conditions. For the issuance of a radiation work permit, the radiation safety control personnel evaluates the expected dose in consideration of the working environment and conditions if there is no problem in the result of checking the work applicant's records of radiation dose, protection training, and physical examination. In addition, the radiation safety control personnel can further impose special conditions on the work applicant if necessary, giving work permission. Mock-up training is conducted for specified radiation work in which high radiation exposures are expected.

**3) Dose reduction**

The KHNP establishes and operates target values for reducing occupational radiation exposure according to classified categories, such as annual collective dose, collective dose during the planned preventive maintenance period, and job-specific collective dose. It is provided that any radiation work should be conducted following the plan, as established before undertaking the work, and causal analysis for excesses over the expected dose, if any, should be performed through ALARA post-examination after the work is completed, so that its result can be applied to any similar work in the future.

**Individual dose control**

**1) Personnel dose control**

The KHNP established a target dose limit for radiation workers at 80 % of the legal limit, and controls radiation doses to maintain the target dose limit. It is prescribed in the procedures that any person whose annual dose reaches the target value shall not perform any more radiation work during which said worker is expected to be additionally exposed above the target value, unless the approval of the person responsible for the operation of the facility is given or proper measures are taken.

**2) Personnel dosimetry service and performance testing**

All persons engaged in personnel dosimetry services, including the KHNP, transacts dosimetry services with approval of the MEST, and monthly or quarterly distribution, collection, and reading of thermo-luminescence dosimeters (TLDs). The results should be given to the individuals in question and reported to the government on a quarterly basis, and the calibration and performance verification for TLD reader are conducted every 6 months. TLD periodically undergoes a standardized performance inspection and

a periodic inspection that meets the international criteria in order to secure objectivity and reliability in personnel dosimetry.

**3) Operation of the national safety management center for radiation workers**

As the number of radiation workers continuously increases with the expansion of nuclear facilities and radiation related industries in Korea, it has become necessary to systematically control occupational exposures with the ALARA principle. Thus, ***the KRA (Korea Radioisotope Association) is in charge of managing exposure history of radiation workers and based on the records, online information system, RIS (Radiation workers Information System), began to operate since August, 2005.*** The KINS established the National Safety Management Center for Radiation Workers, on November 27, 2002, with support of the MEST.

The center operates the Korea Information System on Occupational Exposure (KISOE), which is an internet-based expert system that enables analysis and evaluation of occupational exposures and lifetime tracking of individual worker dose. The main functions of the KISOE are as follows:

- production of basic data on optimization of occupational exposure by analysis of the individual exposure dose,
- feedback of matrix information on radiation dose into regulatory activities,
- derivation of quantitative indicators for radiation safety management according to the type of radiation usage,
- establishment of an information network system related with international databases such as ICRP, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and Information System on Occupational Exposure (ISOE) of OECD/NEA.

**Preventive measures for unplanned/uncontrolled release**

**1) Legal requirements**

The MEST stipulate that direct or indirect measuring equipment that can monitor the concentration of radioactive materials, shall be installed in the drainage and air vents of nuclear reactor, related facilities and nuclear fuel cycle facilities. When the concentration of the radioactive materials released exceeds the established set points, alarm devices must automatically trigger, thus making appropriate countermeasures possible. Regarding radioactive effluent controls, airborne or liquid radioactivity concentration at site boundary must be equal to or less than the legal limits such as the ECL and radioactive waste must not be released in restricted areas other than air vents or drainage.

**2) Measures in the design stage**

In the design stage for the implementation of legal requirements to prevent any unplanned/uncontrolled release, it is necessary to classify each system as a radioactive system, non-radioactive system, or potential radioactive system, and to install a process radiation monitor for checking radioactivity levels or leakage by systems. The effluent radiation monitor and sampling equipment shall be furnished in the main release path, if any, and the environmental release of effluents that hold radioactivity exceeding the legal limit shall be controlled through the securing of an interlock function to automatically suspend release in alarming. Additionally, in the design stage, there is a need to check every effluent release path and spot, and to create a design that permits the prevention of possible effluent release in any other path and spot than that intended, during the operation of a nuclear facility.

**3) Measures in the operation stage**

Before starting operation of a nuclear facility, the operator formulates an effluent management plan, with due regard to the characteristics of the facility, which includes detailed procedures of effluent monitoring and management, sampling planning, etc. Nuclear facilities must release all liquid and gaseous effluents according to the pre-arranged plan.

According to the Notice of the MEST, when radioactive materials are released under unplanned and uncontrolled conditions due to equipment malfunction or human error, operators must report the incident to the regulatory body within 4 hours and submit detailed reports to regulatory body within 30 days. When radioactivity released into the environment from the facilities concerned exceeds the ECL, operators likewise must report the incident to the regulatory body within 8 hours and submit reports to regulatory body within 30 days. Information on such unplanned/uncontrolled release must also be included in regular quarterly reports submitted to the regulatory body.

## F.4.3 Release restriction system for nuclear facilities

The AEA prescribes that the permission for construction and operation of nuclear facilities should be given on condition that the prevention of radioactive hazards to the public health and the environment is ensured. According to this, the Enforcement Decree of the AEA provides that the concentration of radioactive materials released from nuclear facilities should meet not only the limits defined by the MEST but also the limits defined by the said Ministry for other radioactive hazard prevention. In the Ordinances of the MEST, it is provided that the volume of radioactive material released should be minimized with the formulation of the radioactive waste management plan,

and environmental impacts should be controlled to remain as low as is reasonably achievable.

Accordingly, the Enforcement Decree of the AEA stipulates that the concentration of radioactive materials released from nuclear facilities ***including the LILW disposal facility*** should meet not only the limits defined by the MEST but also the limits defined by the said Ministry for other radioactive hazard prevention. In the Ordinances of the MEST, it is stipulated that the volume of radioactive material released should be minimized with the formulation of the radioactive waste management plan, and environmental impacts should be controlled to maintain as low as is reasonably achievable.

The Enforcement Decree of the AEA and the MEST Notice No. 2008-31 (Standards on Radiation Protection, etc.) prescribe discharge limits of gaseous and liquid radioactive effluents to be released from nuclear facilities into the environment, along with annual dose constraints of the population living around nuclear facilities.

**Annual dose constraints for gaseous effluents on the restricted area boundary by a unit of nuclear facilities are as follows:**

- air absorbed dose by gamma rays: 0.1 mGy/y
- air absorbed dose by beta rays: 0.2 mGy/y
- effective dose from external exposure: 0.05 mSv/y
- skin equivalent dose from external exposure: 0.15 mSv/y
- organ equivalent dose from internal exposure to particulate radioactive substances, etc.: 0.15 mSv/y

**Annual dose constraints for liquid effluents on the restricted area boundary by a unit of nuclear facilities are as follows:**

- effective dose: 0.03 mSv/y
- organ equivalent dose from internal exposure: 0.1 mSv/y

**Annual dose constraints on the restricted area boundary per site where multiple units are operating are as follows:**

- effective dose: 0.25 mSv/y
- thyroid equivalent dose : 0.75 mSv/y

In practice, nuclear facilities operate with targets which are more restrictive than the discharge limits. In addition, some facilities also apply the derived release limits based on a small fraction of the dose limits in consideration of convenience in a field application. Whether related limits are met is verified with periodic inspection or the

examination of regular reports submitted to the regulatory body. Tables F.4-2 and F.4-3 represent the annual release of gaseous and liquid effluents recently generated from nuclear plants and fuel fabrication facilities, and their off-site dose estimations, respectively.

The radiation dose and its effect on the individual around nuclear facilities are assessed monthly by using the Off-site Dose Calculation Manual (ODCM). The assessments are based on the radioactivity of released liquid and gaseous effluents, atmospheric conditions, metabolism, and social data including agricultural and marine products of the local community within a radius of 80 km.

**Table F.4-2. Annual radioactivity in liquid and gaseous radioactive effluents released from NPP sites and calculated off-site dose**

| Site / Type of Effluent \ Year | | 2003 | 2004 | *2005* | *2006* | *2007* |
|---|---|---|---|---|---|---|
| **Kori** | **Liquid (TBq)** | 1.03E-04 | 3.35E-05 | ***2.42E-05*** | ***2.80E-05*** | ***2.83E-05*** |
| | **Gaseous (TBq)** | 1.06E+01 | 6.02E+00 | ***3.71E+00*** | ***6.58E+00*** | ***4.77E+00*** |
| | **Annual dose (mSv/y)** | 2.08E-03 | 5.22E-03 | ***5.12E-03*** | ***6.64E-03*** | ***1.51E-02*** |
| **Yong -gwang** | **Liquid (TBq)** | 3.92E-03 | 2.55E-02 | ***1.82E-02*** | ***1.17E-02*** | ***7.56E-04*** |
| | **Gaseous (TBq)** | 1.55E+01 | 5.19E-01 | ***2.48E-02*** | ***2.72E-02*** | ***9.82E+00*** |
| | **Annual dose (mSv/y)** | 5.98E-03 | 5.77E-03 | ***2.85E-03*** | ***4.85E-03*** | ***6.04E-03*** |
| **Ulchin** | **Liquid (TBq)** | 2.07E-05 | 1.89E-04 | ***1.05E-03*** | ***7.20E-04*** | ***5.82E-04*** |
| | **Gaseous (TBq)** | 1.71E+00 | 2.68E+00 | ***1.22E+00*** | ***1.84E-01*** | ***6.73E-02*** |
| | **Annual dose (mSv/y)** | 3.37E-03 | 2.42E-03 | ***3.38E-03*** | ***1.65E-03*** | ***2.09E-03*** |
| **Wolsong** | **Liquid (TBq)** | 4.88E-04 | 5.29E-04 | ***3.93E-04*** | ***4.47E-04*** | ***6.85E-04*** |
| | **Gaseous (TBq)** | 4.36E+01 | 3.38E+01 | ***2.09E+01*** | ***3.65E+01*** | ***5.10E+01*** |
| | **Annual dose (mSv/y)** | 5.32E-04 | 4.61E-03 | ***3.01E-03*** | ***3.48E-03*** | ***5.79E-03*** |

* Annual released radioactivity data do not include tritium release
* Off-site dose calculation includes tritium effect

**Table F.4-3. Annual radioactivity in liquid and gaseous radioactive effluents released from non-NPP site and calculated off-site dose**

| Site / Type of Effluent \ Year | | *2003* | *2004* | *2005* | *2006* | *2007* |
|---|---|---|---|---|---|---|
| **Daedeok site** | **Liquid (MBq)** | ***2.70E-05*** | ***2.42E-05*** | ***3.33E-05*** | ***4.77E-05*** | ***1.87E-05*** |
| | **Gaseous (MBq)** | ***6.03E+00*** | ***2.60E-01*** | ***4.77E+00*** | ***1.85E+00*** | ***2.62E+00*** |
| | **Annual dose (mSv/y)** | ***2.08E-02*** | ***3.67E-02*** | ***1.03E-02*** | ***1.03E-02*** | ***5.88E-04*** |

**** The gaseous radioactivity in this table is the sum of radioactivity in the gaseous effluents released from HANARO, PIEF, KNF's fuel fabrications facility, and NETEC's RI waste management facility, all of which are located at Daedeok site. On the other hand, the liquid effluent is released only from KNF's fuel fabrication facility at the same site.***

### F.4.4 System of implementing complementary measures against unplanned/uncontrolled release from nuclear facilities

**Monitoring plan**

Radioactive effluents from nuclear facilities undergo monitoring to keep a release within the limits specified by the Enforcement Decree of the AEA (concerning the general public's dose limit) and the Notices of the MEST (concerning the prevention of hazards to the environment), through sampling, sample analysis, and environmental impact assessment before its release.

**Action plan**

The radioactive waste management facility in nuclear installation, which is furnished with a proper radiation monitoring system in the expected release path of radioactive material, is subject to formulate and implement various programs to take appropriate measures suitable in the event that an uncontrolled release of radioactive materials occurs. The facility shall make reports under the incidents reporting scheme, if any unplanned/uncontrolled release from facilities occurs, and take proper action with the support of the facility operator and the emergency response organization. Subsequently, necessary actions shall be taken after assessments for individuals/public dose and released amount of radioactive effluents according to radiological data from the process radiation monitoring and environment radiation monitoring system, and a reasonable scenario. The existing action procedures must be complemented through analysis of the path and cause of the uncontrolled/unplanned radioactive material release.

## F.5 Emergency preparedness (Article 25)

**ARTICLE 25. EMERGENCY PREPAREDNESS**

1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.

2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

## F.5.1 Regulations and requirements

Radiological emergency preparedness is based on the "Physical Protection and Radiological Emergency Act" and the "Basic Law for Disaster and Safety Management" which stipulates a national preparation against radiological accidents. Under the above law, the MEST is responsible for formulating a master plan every 5 years and a yearly implementation plan based on the master plan. The local governments and agencies concerned make detailed implementation plan of their own, according to the master plan and the yearly implementation plan.

The emergency plan for facilities related to spent fuel and radioactive waste is made based upon the emergency plan devised by the operator of the nuclear facility as above.

## F.5.2 National radiological emergency response system

The radiological emergency response scheme is composed of the National Emergency Management Committee (NEMC) which is chaired by the Minister of MEST, Off-site Emergency Management Center (OEMC), the Local Emergency Management Center (LEMC), the KINS-Radiological Emergency Technical Advisory Center, Korea Institute of Radiological and Medical Science (KIRAMS)-Radiological Emergency Medical Center, and the KHNP-Emergency Operation Center. This is shown in Figure F.5-1.

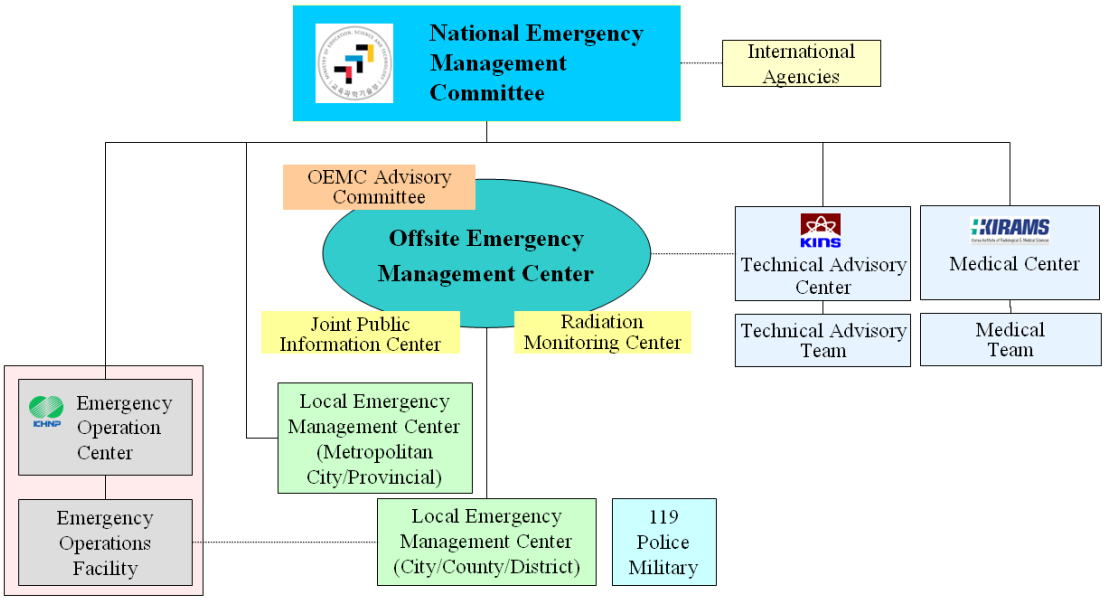


**Figure F.5-1. National Radiological Emergency Response Scheme**

The central government has the responsibility to control and coordinate the countermeasures against radiological disaster. Especially, the OEMC, which consists of experts dispatched from the central government, local governments and designated administrative organizations, has responsibility to perform coordination of management of radiological disaster and decision-making on public protective actions (sheltering, evacuation and food restriction, etc.). The OEMC consists of 7 actual groups including Joint Public Information Center, which is in charge of providing accurate and unified information about radiological disasters and the OEMC Advisory Committee for the director of the OEMC.

The LEMC, established by the local governments concerned, implements the OEMC's decisions concerning public protective actions.

When an accident occurs, KHNP, an operator of nuclear installation, is responsible for organizing an Emergency Operation Center and for taking measures to mitigate the consequences of the accident, to restore the affected installations, and to protect the on-site personnel.

In addition, the central government establishes the national radiological emergency medical system for coordination and control of radiological medical services. It consists of the Nation Radiological Emergency Medical Service Center and the primary and secondary radiological emergency medical hospitals designated by the region. The KIRAMS established the Radiological Emergency Medical Center and administers national radiological emergency medical system in radiological disasters.

If any accident occurs in the nuclear facilities, the operator shall immediately report the emergency situation to the MEST and the local government, in accordance with the MEST Notice No. 2008-71 (Radiological Emergency Preparedness for the Nuclear Related Enterprisers).

The operator is also responsible for providing the local government with advice and information on protective measures for the public in radiological emergencies. The operator maintains contracts with designated hospitals near the site of the nuclear facility to provide systematic emergency medical services to the staff and the population of the vicinity region.

The KHNP Radiation Health Research Institute performs research in radiation and health physics, along with the physical examination of persons engaged in a nuclear facility and the local people of the nearby region of plants, and provides a specialized radiation emergency medical service in radiological emergencies.

## F.5.3 Training and exercises

The operator of nuclear installations shall periodically conduct training and exercises for the emergency personnel to qualify them by providing thorough knowledge of emergency duties. The Nuclear Training Center of the KAERI and the Nuclear Education Institute of the KHNP operate training courses on emergency preparedness for personnel involved in an emergency response. The head of the local government formulates and implements an independent training program, considering the specialty of radiological accidents, to the personnel engaged in an emergency response.

In accordance with the Physical Protection and Radiological Emergency Act that came into effect in February 2004, the central government manages the radiological emergency training.

Emergency exercises, in which on-site and off-site emergency preparedness organizations must participate, are held as follows:

- Partial drills must be conducted for two plants at least once each quarter with the participation of emergency organizations in nuclear reactor facilities.
- United drills must be conducted for two plants at least once each year with the participation of all emergency organizations in nuclear reactor facilities.
- Initial joint drills must be conducted for new nuclear reactor facilities constructed on the same sites as nuclear reactor facilities currently in operation to verify emergency response ability before initial rated thermal power of 5%.
- Joint drills must be conducted once every 4 years with the participation of all emergency organizations in nuclear facilities, the MEST, local governments, and all radioactive disaster prevention-related organizations.
- Combined drills must be conducted once every 5 years with the participation of all domestic radioactive disaster prevention-related response organizations including central administrative organizations.

During drills, the appropriateness of the emergency plans and their procedures, emergency equipment and networks, resident notification systems, emergency personnel's expertise in the tasks and emergency response ability, practicability of emergency plans, and a cooperative system among the related organizations are reviewed. During united, joint, and combined drills, drill scenarios that hypothesize accidents requiring evacuation and the evacuation of residents in emergency areas are established and radioactive disaster preparedness drills are performed.

## F.5.4 International arrangements

The notification of an accident and the request of assistance from international organizations and nations concerned, are made in accordance with the procedures specified in the "Convention on the Early Notification of Nuclear Accidents" and the "Convention on the Support in Nuclear Accidents or Radiological Emergencies".

The MEST and the USNRC maintain a radiological emergency cooperation scheme, by mutual consent, pursuant to the "Arrangement between USNRC and MEST for the Exchange of Technical Information and Cooperation in Regulatory and Safety Research Matters".

***Also, the MEST and the Federal Agency for Atomic Energy of Russian Federation (ROSATOM) maintain a radiological emergency cooperation plan, on a mutual agreement basis, pursuant to the "Arrangement between ROSATOM and MEST for the Exchange of Technical Information and Cooperation in Regulatory and Safety Research Matters".***

Between the MEST and the Ministry of Economics, Trade and Industry, and the Ministry of Education, Culture, Sports, Science and Technology of Japan, there are inter-governmental agreements to maintain an early notification network to provide prompt notification when a nuclear accident occurs.

In December 2002, the KINS and the Radiation Monitoring Technical Center (RMTC) of China concluded a Memorandum of Understanding (MOU) to exchange experts and information on environmental radiation monitoring, etc. ***Also, the MEST and the National Nuclear Safety Administration (NNSA) maintain a radiological emergency cooperation plan, on a mutual agreement basis, pursuant to the "Arrangement between NNSA and MEST for the Exchange of Technical Information and Cooperation in Regulatory and Safety Research Matters".***

# F.6 Decommissioning (Article 26)

**ARTICLE 26. DECOMMISSIONING**

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

(i) qualified staff and adequate financial resources are available;
(ii) the provisions of ARTICLE 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;
(iii) the provisions of ARTICLE 25 with respect to emergency preparedness are applied; and
(iv) records of information important to decommissioning are kept.

The facilities, which are being decommissioned, are the Korea Research Reactor Units 1 and 2 (KRR-1 and 2) and the Uranium Conversion Facility. The research reactors are located in Seoul and the uranium conversion facility in Daejeon. Their characteristics are shown in Annex C.

A project for the decommissioning of KRR-1 and 2 was launched in January 1997 and is ongoing. ***In 2007, it was decided that KRR-1 would be reserved as a monument commemorating the onset of nuclear energy in the Republic of Korea.*** The decommissioning of the reactor core of KRR-1 and its concrete shielding structure was suspended while all of the equipment outside the core, such as the cooling system and the control rod driving unit, were dismantled.

The Uranium Conversion Facility (UCF), which is located at the Daejeon KAERI site, was constructed in 1982 for the development of the fuel fabrication technologies for the PHWR and its capacity was 100 tons of uranium oxide per year. Its decommissioning plan was submitted to the MEST and was approved in July 2004.

## F.6.1 Regulations and requirements

In the AEA and the Enforcement Regulations of the AEA, it is clearly defined that the decommissioning of a nuclear facility is the responsibility of the operator of the facility. The operator, with the intention to decommission a nuclear facility, shall submit a decommissioning plan and obtain approval of decommissioning from the MEST.

A decommissioning plan shall include the following:

- methods of decommissioning the nuclear facilities, and a work schedule
- methods of removing radioactive materials and methods of decontamination

- radioactive waste treatment and disposal methods
- necessary measures against radioactive hazards
- assessment of the environmental impact and measures for its minimization
- a QA program with regard to decommissioning
- others, as specified by the MEST

## F.6.2 Human and financial resources

**Nuclear power plants**

**1) Human resources**

There is no power reactor yet that requires decommissioning, therefore, no specific organization for the decommissioning of NPPs exists in Korea. The NPP operators plan to create an organization with the operating staff members for the decommissioning of NPPs in the future.

**2) Financial resources**

In order to secure stable resources for the decommissioning and the safe management of decommissioning waste, the NPP operators have now been accumulating expenses in accordance with the EBA.

**Research reactors and uranium conversion facility**

**1) Human resources**

***The KAERI, as a responsible operator of the facilities, has carried out the projects for decommissioning of KRR-1, 2 and the UCF, along with development of related technologies and demonstration studies. To do this, the KAERI organized the "Division of Decontamination and Decommissioning Technology Development", comprised of 20 members. Additionally, retirees from the KAERI with ample experience in reactor operation have been entrusted with the safe dismantling of the reactor.***

**2) Financial resources**

***KRR-1 and 2 and the UCF were constructed and had been operated by the KAERI as funded by the Government of the Republic of Korea. As such, the Government provides all financial resources required for safe decommissioning of the facilities.***

## F.6.3 Radiation protection

In the decommissioning of the KRR-1 and -2 and uranium conversion facility, the same regulations for the operation of the corresponding facilities, described in Article 24 of the Joint convention, are applied for the radiation protection and safety. In the decommissioning plan of the facilities, the status of facilities, radiological conditions, and anticipated waste are considered. Required human resource are described and dose rate of workers at normal and abnormal conditions, and radiation protection measures were evaluated in accordance with the MEST radiation safety regulations. At the actual worksite where the decommissioning works take place, the radiation protection is controlled according to the detailed plan specific to working conditions.

The regulations applied to the decommissioning site are Notices on the Standards for Radiation Protection, etc., the Regulation on the Packaging and Transport of Radioactive Materials, etc., the Regulations on Preparation, etc. of Radiological Environmental Report of Nuclear Utilization Facilities, and the Regulations on the Environmental Radiation Survey and Impact Analysis in the Vicinity of Nuclear Facilities.

## F.6.4 Emergency response

In the decommissioning of the KRR-1 and 2 and uranium conversion facility, the exposure rate for workers was estimated for several scenarios of plausible accidents and the highest exposure rate was expected in the case of a drop of equipment, which was highly radioactive because of the activation by neutrons during reactor operation. But even in this case, it was evaluated that the exposure rate could be minimized with securing sufficient times enough to take a shelter.

In the guideline for coping with such radiation accidents, it is defined that all work should be suspended and all workers should be evacuated from the working area without a delay. Further, the radiation safety control personnel must control access to the working area and take necessary measures for preventing radioactive materials from spreading.

All decommissioning work is conducted within the building, and indoor air is released through a filter set as part of the building ventilation system even in the case of radiation accident, to eliminate spreading of radioactive materials outside the reactor building. Thus it is not necessary for the public around the KRR-1 and 2 and uranium conversion facility to evacuate when such an accident occurs. ***Most of dismantling works have been finished, and the assessment of residual radioactivity is currently***

***being carried out.***

## F.6.5 Record keeping

Under the Enforcement Regulation of the AEA, records of the operation of the nuclear facilities are to be kept until the decommissioning of the facilities for the application of the records to the planning and implementing of the decommissioning. The records include documents related to the reactor design and construction, data on radiation protection, abnormal operation conditions and their remedy works, etc.

***Information related to the decommissioning of the research reactors and the uranium conversion facility has been collected by the Division of Decontamination and Decommissioning Technology Development at the KAERI. The information includes data concerning the condition and radiological state of the facilities, the nature and duration of each activity, the input of the workforce and equipment for each activity involved, the radiation dose to each worker, inventory of each class of radioactive waste generated and major radionuclides, the amount of liquid waste treated, and other related information. This information is to be preserved for a period as specified in the decommissioning plan.***

***The database system, named DECOMMIS, 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 to manage the decommissioning waste in a systematic way and to report safety information to the WACID, which is a DB system developed and operated by the KINS for managing the nationwide safety information on radioactive waste management.***

# G. Safety of Spent Fuel Management

## G.1 General safety requirements (Article 4)

**ARTICLE 4. GENERAL SAFETY REQUIREMENTS**

1. Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed;
(ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;
(iii) take into account interdependencies among the different steps in spent fuel management;
(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;
(v) take into account the biological, chemical and other hazards that may be associated with spent fuel management;
(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;
(vii) aim to avoid imposing undue burdens on future generations.

### G.1.1 Design criteria and requirements

In accordance with the AEA, a comprehensive and systematic safety evaluation shall be performed before the commencement of construction, which provides reasonable assurance that the public health and the environment will be protected against radiation hazard due to the construction and operation of a spent fuel management facility. The evaluation results shall be reported to the MEST as a safety analysis report and radiological environmental report. Principal design criteria and requirements to be considered to ensure the safety of the facility are as follows:

The major design criteria and requirements to enhance the safety of the facility are defined in the Notices of the MEST (the Siting Criteria for Spent Fuel Interim Storage Facilities, the Standard Format and Contents of Site Characteristics Report for Spent Fuel Interim Storage Facilities, the Acceptance Criteria for Spent Fuel, the Regulation

on Preparation, etc. of Radiological Environmental Report of Nuclear Power Utilization Facilities, and Standards on Radiation Protection, etc). The major design criteria and requirements are as follows:

**Site suitability**

The location of the spent fuel management facility shall be determined in accordance with consideration of meteorological conditions, hydro-geologic features, earthquakes, ecological characteristics, and the availability of existing water resources.

**Safety evaluation**

The spent fuel management facility shall be designed so that the leakage of radioactive materials into the environment is restricted by ALARA under the conditions of normal operation and abnormal situations, and that radiation exposure due to accidents including natural disasters can be efficiently mitigated.

**Fire and explosion**

The spent fuel management facility shall be designed to efficiently maintain its safety function even in fire and explosion accidents.

**Prevention of heavy loads from *dropping***

***The spent fuel management facility*** shall be kept safe from detriment due to the ***dropping*** of any heavy loads such as a shipping cask.

**Nuclear criticality safety**

All equipment of the spent fuel management facility shall be designed to maintain a sub-critical state under any circumstances.

***Cooling capacity***

***The spent fuel management facility shall be designed to have sufficient cooling capacity to keep the temperatures of the fuel cladding, cooling water and/or concrete below design limits with appropriate safety margin.***

***Structural and seismic design***

***Structures, systems and components shall be designed to maintain their structural stability for all loading combinations including normal operating, abnormal operating and accident loads, and to maintain the confinement of the radioactive materials without impairing capability.***

**Testing and inspection**

The spent fuel management facility shall be designed and constructed to permit periodic testing and inspection to check the reliability of its use with a safety margin.

## G.1.2 Additional requirements to be considered

**Minimization of spent fuel generation**

The generation of spent fuel is decreasing due to long-term operation accompanied with the utilization of more highly enriched fuel.

**Requirements for protection from and prevention of radiological hazards**

In accordance with the AEA, the spent fuel management facility shall maintain radiation-shielding capacity to sufficiently protect against dose rate due to the handling and storage of spent fuel. The facility shall also prevent the stored fuel from any severe damage, such as criticality.

**Biological, chemical, and other hazards**

In accordance with the AEA, the spent fuel management facility shall have enough capability to prevent itself from any impact of fire or explosion, etc.

**Requirements for restricting the effects on future generations**

The potential risk of radiation exposure, to future generations, in the spent fuel management facility shall be restricted within the radiation protection level of current application, in accordance with international technical standards.

**Abatement of undue burden on future generations**

The spent fuel shall be safely managed so that future generations may not be hazarded at a higher level of risk than those imposed upon the present generation, and the waste generators reserve funds for the payment of expenses incurred at the point of generating waste in order not to impose any financial burdens on future generations.

## G.2 Existing facilities (Article 5)

**ARTICLE 5. EXISTING FACILITIES**

Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

The independent storage facility for spent fuel does not exist in the Republic of Korea as of today. The spent fuel storage facilities in the nuclear power and research reactor (AR storage) are licensed and inspected for the safety management, as a part of the nuclear facilities.

The spent fuel storage facilities at the reactor sites can be constructed and operated after the safety review in accordance with the AEA. The design performance of these facilities is also confirmed through the regulatory inspection. The alteration of the licensed matters of significance and the minor changes of the operating facilities shall follow the same licensing procedure of the AEA.

The status, operating history, major events, any maintenance records, etc. of the operating spent fuel storage facilities in the Republic of Korea at the time the Convention enters into force were reviewed thoroughly; no abnormal safety cases were identified.

**Safety assessment**

As a result of safety assessment of facilities, the SAR shall be submitted to the regulatory body, and an appropriate examination and verification as to whether such results fulfill the related regulations and design criteria should be performed.

**Safety improvement**

The spent fuel management facility shall be subject to a comprehensive evaluation for its safety and performance through regulatory inspections by the MEST, and proper action shall be taken within a specified time according to the procedure, if there is any abnormality in safety and performance as a result of the safety evaluation.

## G.3 Siting of proposed facilities (Article 6)

**ARTICLE 6. SITING OF PROPOSED FACILITIES**

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:
   (i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;
   (ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;
   (iii) to make information on the safety of such a facility available to members of the public;
   (iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of ARTICLE 4.

The siting of the spent fuel storage facility shall be made in accordance with the Notice of the MEST No. 2008-58 (Siting Criteria for the Spent Fuel Interim-Storage Facilities), and technical standards of the site in which the facility is located, including various conditions such as demographic, geological and seismological characteristics, the hazard of man-made events induced by flying objects, industry, military activities and hazardous objects. It should also include data on atmospheric diffusion and dilution, natural phenomena such as rainfall, snowfall, lightning, tidal waves and typhoons, river flooding, and other hydrologic characteristics.

***Any person who intends to obtain permit for construction and operation of spent fuel storage facility shall collect opinions of the residents, through making a "draft" radiological environmental report (RER) accessible to the public and/or holding public hearings, within the scope prescribed by the MEST. The gathered resident's opinions shall be incorporated into the RER, which is to be submitted to the MEST as a part of permit application documents.***

# G.4 Design and construction of facilities (Article 7)

**ARTICLE 7. DESIGN AND CONSTRUCTION OF FACILITIES**

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;

(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.

**Prevention of the release and uncontrolled effluent**

In order to ensure the safety of spent fuel management facilities, a multi-barrier concept based on the defense-in-depth principle is applied to the design of such facilities. Several basic concepts, particularly, of securing sufficient design margins, the interlock concept, and the multiple barriers concept are being considered to back-up the defense-in-depth principle.

The spent fuel management facility shall be designed to have a capability of properly controlling gaseous and liquid radioactive materials generated in normal operation including the anticipated operational transients, and inhibiting the release thereof, and to restrict the effects to the external environment with the limitation of gaseous and liquid effluent releases to the effluent control limits.

***Provisions for decommissioning***

***The spent fuel management facility shall be designed for decommissioning in accordance with regulations. Provisions shall be made to facilitate decontamination of structures and equipment, to minimize the quantity of radioactive wastes and contaminated equipment, and to facilitate the removal of radioactive wastes and contaminated materials at the time the facility is permanently decommissioned.***

**Application of proven technologies**

The spent fuel management facility shall be designed and constructed on the basic principle that technologies incorporated in a design shall be duly proven by experience or qualified by testing or analysis.

# G.5 Assessment of safety of facilities (Article 8)

## ARTICLE 8. ASSESSMENT OF SAFETY OF FACILITIES

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

**Safety and environmental impact assessment for facilities**

It is necessary to prepare a SAR and a radiological environmental report after assessment of safety and radiological environmental impacts for the period of operation for the spent fuel management facility. The safety analysis report contains the results of a comprehensive safety evaluation for the said facility, particularly, the design features of structures, systems and equipment in the facility, radiation protection, and site characteristics.

The radiological environmental report contains the effects of radiation or the release of radioactive materials from the spent fuel management facility on the population and the environment.

**Supplementation of safety assessment**

The examination and verification as to whether the safety assessment and environmental impact assessment conform to regulatory requirements and technical standards, etc. should be performed and matters needing amendment, if any, should be properly modified before the start of operation. The results should be reported to the regulatory body.

# G.6 Operation of facilities (Article 9)

**ARTICLE 9. OPERATION OF FACILITIES**

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the license to operate a spent fuel management facility is based upon appropriate assessments as specified in ARTICLE 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;
(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in ARTICLE 8, are defined and revised as necessary;
(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;
(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;
(v) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;
(vi) programs to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;
(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

## G.6.1 Technical requirements

The criteria for operating license for a spent fuel management facilities are specified in the AEA as follows:

- Technical and economical capabilities necessary for the construction and operation of the facilities, etc. shall be secured;
- The location, structure, equipment and performance of the facilities shall conform to technical requirements, as prescribed by the Ordinance of the MEST, in such a way that there may not be any impediment to the protection of human body, materials, and the public against radiation hazards caused by radioactive materials;
- There shall be no impediment to the protection of the public health and the environment against danger and harm due to radioactive materials, which may accompany the construction and operation of the facilities, etc.; and
- The equipment and manpower prescribed by the Presidential Decree shall be secured.

The spent fuel management facility shall be operated with the verification of its conformity to the design requirements through a startup operation, in accordance with license conditions.

The technical requirements newly amended during the operation of spent fuel management facilities shall come to be reflected in the operation of those facilities.

## G.6.2 Determination of operation limiting conditions

The determination of operation limiting conditions for spent fuel management facilities shall be described in the operational technical specifications, in accordance with the related laws and regulations.

## G.6.3 Operating procedures

The operation, maintenance, monitoring, inspection and testing of facilities shall be made after an operating procedure is prepared on the basis of the operational technical specifications.

## G.6.4 Engineering and technical support

The operator of a spent fuel management facility will cooperate with several organizations, which administer engineering and technical support according to facility features in all safety-related fields during its operational lifetime. The KHNP, which is responsible for the construction and operation of the spent fuel management facility, receives support in engineering, maintenance, and facility operation from the KOPEC, the KPS and Samchang Enterprise Co., Ltd., and a radiation safety management service company, respectively.

## G.6.5 Incident report and document control

The AEA stipulates that nuclear-related organizations shall immediately take all necessary safety measures and report such measures to the MEST for the following cases:

- if radiation hazards occur,
- if any failure occurs in nuclear facilities,
- if there is any danger to nuclear facilities or radioactive materials due to

earthquakes, fires or other disasters,
- if radiation generating devices and radioactive materials in possession are stolen, lost, or destroyed by fire or any other incident, or
- if radioactive materials in transportation or packaging leak or are destroyed by fire or any other incident.

The MEST Notice No. 2008-29 (Regulation on the Reporting of Events and Accidents of Nuclear Facilities) stipulates in detail the incident reporting system. It includes the objects, means and procedures of reporting, and the classification of incidents and accidents, which is based on the International Nuclear Event Scale (INES) of the IAEA. The potential events to be reported at the spent fuel management facility are as follows:

- occurrence of surface contamination exceeding the limit at areas other than radiation area due to leakage of radioactive material,
- abnormal increase of radiation level,
- occurrence of unplanned or uncontrolled release of radioactive material into the environment,
- occurrence of release of radioactive material over the release limit, etc.

## G.6.6 Procedures of decommissioning plan formulation, supplementation, and review by regulatory body

In accordance with the AEA, any person who intends to decommission a spent fuel management facility must prepare a decommissioning plan, and submit it to the MEST for approval. The decommissioning plan is to be prepared on grounds of necessary measures against radiation hazards, the data obtained during the operation of the facility and data obtained by facility survey at the point of ending operations.

The operators of all the NPPs and related facilities including spent fuel storage facilities should report the discontinuation of the business to the MEST after the completion of necessary activities for the radiation hazard protection such as transfer, keeping, discharge, treatment, disposal, and decontamination of the radioactive materials. The MEST can order the collection of the used radioactive materials and the decommissioning of the contaminated facilities, if necessary.

## G.6.7 Emergency plan

The operator of spent fuel management facility shall prepare an emergency plan, and secure and operate emergency response organizations and facilities based upon the plan.

## G.7 Disposal of spent fuel (Article 10)

**ARTICLE 10. DISPOSAL OF SPENT FUEL**

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.

The spent fuel management program in Korea maintains a long-term perspective strategy in that it progresses the program in consideration of the national policy and worldwide radioactive waste disposal technology development.

***The R&D program on the disposal technology of the high-level radioactive waste (HLW) was initiated in 1997. After 10 years into the research program, a reference disposal system called the Korea Reference System (KRS) was formulated in 2006 on the basis of the results of the R&D program, which included performance and safety assessment, and studies on the geo-environmental conditions in Korea, an engineered barrier system, and the migration of radionuclides.***

***For the validation of the KRS, a project for constructing a generic underground research tunnel in a crystalline rock called the Korea Underground Research Tunnel (KURT) started in 2003. Following the site characterization study, the tunnel design, and the construction licensing, the construction of the KURT located at the KAERI site started in May 2005. Controlled drill and blasting techniques were applied to excavate a 6m wide, 6m high and 255m long horseshoe-shaped tunnel with a 10% downward slope. After the completion of this construction of the KURT in November 2006, various in-situ tests are being carried out for the validation of HLW disposal techniques. Important in-situ tests, currently underway at the KURT, include tests related to (a) the fluid flow through discontinuities, (b) groundwater chemistry, (c) the thermal behavior of the rock mass, (d) the evaluation of an excavation-damaged zone, and (e) the migration of ions and colloids in an underground environment.***

# H. Safety of Radioactive Waste Management

**ARTICLE 11. GENERAL SAFETY REQUIREMENTS**

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;
(ii) ensure that the generation of radioactive waste is kept to the minimum practicable;
(iii) take into account interdependencies among the different steps in radioactive waste management;
(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;
(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management;
(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation;
(vii) aim to avoid imposing undue burdens on future generations.

## H.1 General safety requirements (Article 11)

### H.1.1 Design criteria and requirements

According to the AEA, radioactive waste disposal facilities shall be designed to provide reasonable assurance that the public health and the environment are protected against radiation hazards due to the construction, operation, closure, and institutional control of the facilities. In order to ensure that the above criteria are satisfied, the permit applicant shall perform a comprehensive and systematic safety analysis. The analysis results shall then be reported to the MEST as a safety analysis report and a radiological environmental report. The principal design criteria and requirements to be considered to ensure the safety of the facility are as follows:

***General considerations***

***Disposal facilities shall be designed to maintain their structural and functional integrity during normal as well as abnormal operating conditions. The design and construction of disposal facilities shall be based on proven engineering practices.***

***When new design and construction methods are applied, they shall be justified with valid rationales.***

***Seismic design***

***Disposal facilities shall be designed to prevent the safety-related functions are not failed due to earthquakes. They shall be established on the basis of the geological conditions, the past earthquake damage records, and the current seismic activities of the area around the disposal site.***

***Natural phenomena other than earthquakes***

***Disposal facilities shall be designed in consideration of the effect of natural phenomena other than earthquakes, such as flooding, extreme winds, landslides, sedimentation, and upheavals that can be anticipated through past records review and on-site investigations of the area surrounding the disposal site so that the safety-related functions are not failed.***

***Drainage***

***Disposal facilities shall be designed to minimize contact of the disposed waste with surface or ground water, during the operation, closure, and post-closure control stages.***

***Accidents induced by human activities***

***Disposal facilities shall be designed to minimize the risk of the leakage of radioactive materials even during man-made accidents such as aircraft crashes, or production, handling and transportation of hazardous materials.***

**Fire and explosion**

***Disposal facilities shall be designed to minimize the risk of the leakage of radioactive materials even during fires or explosions.***

***Ventilation***

***Ventilation systems shall be designed to ensure the safety of radiation workers, frequent users, and visitors and to prevent the dispersion of radioactive materials during normal as well as abnormal operating conditions.***

***Complex facilities***

***Radioactive waste disposal facilities and other nearby nuclear facilities shall not be***

***affected by one another. These facilities shall be designed to minimize their effect on radiation workers, frequent visitors, members of the general public, and the natural environment due to their simultaneous operation.***

***Loss of power***

***Disposal facilities shall be designed to prevent the risk of the leakage of radioactive materials even during a loss of off-site power.***

***Radiation monitoring***

***Disposal facilities shall be designed so that radiation levels in all areas where radioactive materials are handled and controlled is maintained as low as reasonably achievable during normal as well as abnormal operating conditions.***

***Instrumentation and control***

***Disposal facilities shall be designed so that the main systems and parameters affecting radiological safety during the construction, operation, and closure stages are monitored and controlled.***

***Arrangement of disposal facilities***

***Disposal facilities shall be arranged in consideration of a zone arrangement according to the waste types, radioactivity concentration, and packaging methods to facilitate the reception, treatment, and transfer of waste and to minimize the effect of radiation on radiation workers, frequent visitors, and members of the general public during normal operation or in the event of an accident.***

***Construction***

***The construction of disposal facilities shall adhere to quality assurance (QA) requirements. Disposal facilities shall be constructed so as to minimize damage to the functions of natural barriers. Regarding the characteristics of natural barriers assumed at the design stage, their validity shall be confirmed through comparison with on-site measurements obtained during construction.***

***Testing and inspection***

***The equipment and components installed at disposal facilities shall be designed such that they can be periodically tested and inspected so as to confirm that they can continue to be used safely.***

***Closure***

***Disposal facilities shall be designed such that they should be closed when the disposal capacity considered during their design or the total radioactivity of the disposed waste reaches allowable limits, or when their normal functions can no longer be maintained due to unforeseen accidents.***

***Post-closure control***

***Disposal facilities shall be designed such that their safety should be confirmed through the environmental monitoring of surrounding areas for an appropriate period even after their closure.***

## H.1.2 Additional requirements to be considered

**Minimization of the generation of radioactive waste**

***The amount of radioactive waste generated during the operation of nuclear facilities shall be minimized. Accordingly, improvement of radioactive waste treatment systems along with introduction of new treatment technology should be taken into consideration.***

**Criticality safety and thermal safety**

Radioactive waste disposal facilities shall be designed to prevent the formation of critical nuclear conditions during operation and to withstand decay heat and the heat generated by radiation irradiation. To make this possible, in accordance with the ***MEST Notice No. 2008-65 (Acceptance Criteria for Low and Intermediate Level Radioactive Waste)***, the concentration of fissile materials in radioactive waste shall be limited to ***maintain criticality safety***, and cooling functions shall be secured when there is a possibility of overheating the waste due to decay heat.

**Prevention of environmental hazards**

One of the major licensing standards for radioactive waste ***disposal*** facilities is the clause that such facilities shall not impede the prevention of hazards to national health and the environment. The standards for preventing environmental hazards regarding radioactive waste ***disposal*** facilities determined by nuclear energy-related laws include: (1) limits regarding the concentration of liquid and gaseous radioactive materials released from the facilities; ***(2) radiation dose constraints pertaining to liquid and gaseous effluents at normal operation that are applied to the design of the facilities; and (3) public health risks caused by radioactive waste disposal shall be sufficiently***

***below an acceptable level at the post-closure stage.***

***There shall also be no predicted future impact on the environment in the vicinity of the disposal facilities resulting from the permanent disposal of radioactive waste. Future use of natural resources shall not be impeded by either radioactive or nonradioactive contaminants.***

**Biological, chemical and other hazards**

***In accordance with the MEST Notice No. 2008-65 (Acceptance Criteria for Low and Intermediate Level Radioactive Waste),*** waste containing explosive, flammable, and/or pyrophoric materials to be disposed of shall be adequately treated so that hazards due to these features can be removed. In addition, the waste shall be controlled so that it does not lower the integrity of the waste package or the performance of disposal facilities by generating gas, vapor, or liquid as a result of radiolysis, or biological or chemical reaction. It shall also not hinder the safety of workers.

With regard to waste to be disposed of, including corrosive materials, the corrosion rate shall be mitigated and the material shall be packed so as to withstand corrosion; waste that includes toxic, perishable, or contagious materials shall be processed so as to exclude such hazards. Chelating agents included in waste shall be excluded or their contents shall be restricted according to the acceptance criteria of the disposal facility.

**Stability of waste package**

***In accordance with the MEST Notice No. 2008-65 (Acceptance Criteria for Low and Intermediate Level Radioactive Waste),*** waste to be disposed of shall be packed in a nonflammable container, and the packing container should be free from defects as judged by a visual inspection. Furthermore, the package shall be able to maintain its integrity under the circumstances expected in disposal conditions, even when the internal pressure increases due to the generation of gas within the package.

**Restriction of effects on future generations**

The MEST Notice No. 2008-63 (Radiological Protection Criteria for Long-term Safety on Low and Intermediate Level Radioactive Waste Disposal) determines the performance objectives to demonstrate that ***disposal shall be implemented in a manner such that there is no predicted radiological impact from disposal facilities. Additionally, it shall stay within the acceptable range in both the present generation and the future generations.***

## H.2 Existing facilities and past practices (Article 12)

**ARTICLE 12. EXISTING FACILITIES AND PAST PRACTICES**

Each Contracting Party shall in due course take the appropriate steps to review:

(i) the safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;

(ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.

All domestic nuclear facilities including radioactive waste management facilities are constructed and operated after adequate safety evaluations and the authorization of licenses according to the AEA. The maintenance of these facilities according to the licensing conditions is verified through periodical regular inspections and ad-hoc inspections. In addition, when authorized and licensed conditions at specific facilities require revision, authorization and licensing procedures in pursuant of the AEA, such as revision authorizations for major alteration cases and revision reporting for minor alterations, shall be adhered to.

Starting on the effective date of the Joint Convention, the current conditions, past operation history, and major accident and maintenance records of existing radioactive waste management facilities and major radioactive waste-generating facilities in operation in the Republic of Korea were reviewed. As a result, no abnormality was confirmed.

In addition, past practices such as the control of radioactive effluents released into the environment from existing facilities and records on the clearance application of very low level radioactive waste were reviewed. It was verified that past practices had been performed in a manner appropriate to domestic laws in compliance with international safety standards.

**Safety assessment**

The MEST Notice No. 2008-57 (Technical Requirements on the Operation and Control of LILW Repository) stipulates that safety re-assessment is performed on the LILW disposal facility before their closure. Safety re-assessment of disposal facilities shall include: information on the facility, site, and surrounding areas during the operation

period; the total inventory of the waste disposed of; records on events and accidents that occurred during operation and that may affect the safety of disposal; and possible radiological and non-radiological impacts from the disposal on the public and the surrounding environment.

**Safety improvement**

Radioactive waste management facilities undergo a comprehensive evaluation of their safety and performance through periodic regulatory inspections by the MEST, and proper actions shall be taken within a specified time according to established procedures if there is any abnormality in safety or performance as a result of the safety evaluations.

# H.3 Siting of proposed facilities (Article 13)

**ARTICLE 13. SITING OF PROPOSED FACILITIES**

1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:

   (i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;
   (ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure;
   (iii) to make information on the safety of such a facility available to members of the public;
   (iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.

2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of ARTICLE 11.

## H.3.1 Siting-related factors

***General factors***

***The general siting criteria of disposal facilities are outlined in the Regulations on the Technical Standards for Radiation Safety Control. Regarding detailed regulations,***

***the MEST Notice No. 2008-56 (Siting Criteria for Low and Intermediate Level Radioactive Waste Repository)*** stipulates the standards for site locations in terms of the natural environment and according to the human and social environment.

Many factors such as the meteorological conditions, ground surface conditions, and geological conditions, the surface water, ground water, occurrence of earthquakes, ecological characteristics, the use of water resources, other land uses for industrial or military purposes, and the supplementary emplacement of engineering barriers are covered in the criteria.

The MEST Notice No. 2008-53 (Standard Format and Contents of Site Characteristics Reports for LILW Repository) stipulates the following, all of which shall be described in the site characteristics reports:

- data on the current status of the site such as its geography, population, military facilities, major environmental conditions, natural resources, and the ecosystem,
- site safety evaluation data such as the effect of natural disasters and human-induced external events, and design input data, and
- site monitoring and surveillance programs including pre-operational, operational, and post-closure site monitoring and surveillance plans.

**Safety analysis factors**

Safety evaluation for the site of a radioactive waste repository is categorized into an environmental impact assessment applicable to non-radiological aspects under the Environmental Impact Assessment Act enforced by the MOE, a radiological environmental impact assessment and the safety analysis applicable under the AEA as enforced by the MEST.

Such safety analyses shall be performed for the "Approval of Electric Source Development Project Plans" and the "Approval of Radioactive Waste Management Project Plans, as well as for the "Construction/Operation Permit of Radioactive Disposal Facilities".

**Radiological environmental impact assessment**

Under the AEA, a radiological environmental impact assessment shall be conducted to evaluate the impact of radiation or radioactive materials caused by the operation of a radioactive waste disposal facility on the surrounding environment, as one of the fundamental requisites to obtain the construction permit and operating license for the radioactive waste disposal facility.

The radiological environmental report contains facility information, the environmental status of neighboring regions, the predicted radiological impact due to the operation of the facility on the surroundings thereof, the environmental radiation monitoring program to be implemented during the construction and operation of the facility, the radiological impact on the environment resulting from operational accidents and incidents, and the collected opinions of the public.

**Non-radiological environmental impact assessment**

Aside from the radiological environmental impact assessment, the environmental impact assessment checks and evaluates the non-radiological impact induced during the construction and operation of a LILW repository on the surrounding environment in compliance with the provisions of the "Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc.". The licensee shall submit the environmental impact assessment report when applying for approval for an electric source development project plan, and an environmental impact assessment to apply for approval for a radioactive waste management project plan.

The environmental impact assessment shall be performed for 23 items related to the three fields of the natural environment, the living environment, and the social and economic environment. In addition, the opinions of local residents living in the corresponding region shall be collected through a presentation meeting or public hearing before the preparation of an assessment. These shall be included in the assessment. The assessment submitted is to be approved by the MKE upon deliberation with the MOE.

**Safety analysis**

Under the AEA, the licensee shall prepare a SAR and submit it to the MEST in order to ensure safety at every stage of the construction and operation of a radioactive waste disposal facility. This report is one of the core requirements to obtain a construction and operation permit for the radioactive waste disposal facility.

The Enforcement Regulation of the AEA specifies the items to be included in the SAR, which covers safety-related matters, particularly the outline and description of the facility, the site characteristics, the design, construction, operation and maintenance of the facility, site closure and institutional control, safety evaluation and accident analysis, radiation protection, technical guidelines, etc.

In particular, the MEST Notice No. 2008-53 (Standard Format and Contents of Site Characteristics Reports for LILW Repository) requires, as a part of the site safety evaluation, a description of an impact assessment in reference to natural phenomena,

disasters, and external human-made events, as well as construction and design input data.

In particular, the SAR shall describe analysis results and methods regarding the meteorological, hydrological, geological, seismological, geochemical, and geotechnical characteristics needed to conduct a safety assessment of a disposal facility site for an assessment of the impact of natural phenomena and disasters. ***A safety assessment of disposal facilities site due to external man-made accidents*** involving the major industrial, transportation, and military facilities around the disposal facilities shall be described as well.

**Disclosure of Information**

The Government of the Republic of Korea maintains consistently a principle for securing transparency in the entire stage of the site selection process of a LILW disposal facility.

The "Act on Special Cases Concerning Electric Source Development" prescribes to open the details of the project to local residents for a certain period before notice of the designation of the final site and the approval of the Electric Source Development Project Plan. The AEA and the Environment Transportation Disaster Impact Assessment Act of the MOE also specify that the opinions of the public should be collected through public hearings before the preparation of the environmental reports.

The "Special Act on Supporting the Local County around the Low and Intermediate Level Radioactive Waste Disposal Facility" prescribes that the MKE shall open the site selection plan and process as well as the results of site surveys and the LILW disposal facility construction plan to the public, while holding explanatory meetings or forums for the local residents.

In addition, the "Private Environment Monitoring Organization" consisting of local residents and NGO representatives will be organized and operated during the operational period of the LILW disposal facility.

**Consultation with neighboring countries**

The Government of the Republic of Korea has not concluded any specific international agreements with foreign countries on site selection, as the Korean peninsula is surrounded by sea on three sides and is isolated from neighboring countries.

## H.3.2 Permit for radioactive waste management facilities

The permit/approval required for the siting, construction, and operation of radioactive waste management facilities are the "Approval of Electric Source Development Plan" provided in the "Act on Special Cases concerning Electric Source Development," and the "Approval of Radioactive Waste Management Plan" provided in the EBA. Additionally, the "Construction and Operation Permit for Disposal Facilities, etc." prescribed in the AEA is to make the final decision on the selected site as a radioactive waste disposal site.

**Approval of the electric source development plan**

The radioactive waste management project organization shall prepare an electric source development plan that includes information on the outline of the facility, the location and boundary of the facility, the project duration, necessary funds and fundraising, and the installation of public facilities and a cost sharing plan, as well as an environmental impact assessment report. It shall also submit an application for the approval of the plan to the MKE. Then the Minister of the MKE grants official approval to the licensee through consultation with the relevant Ministers of the central government and deliberations at the "Electric Source Development Promotion Commission", after consulting with the head of the relevant local government.

**Approval of the radioactive waste management plan**

The radioactive waste management project organization shall submit an application for approval that includes a facility location map, the layout of the main facilities, an environmental impact assessment report, operation plans after construction, a construction schedule, and estimated funds and fundraising and other related information to the MKE. Then, the MKE reviews the implementation plan and grants official approval to the licensee after consulting with the relevant Ministers of the central government.

**Permit of the construction and operation of radioactive waste disposal facilities**

***In accordance with Article 76 of the AEA, any person who intends to construct and operate the disposal facilities shall file an application for such a permit, with an attached radiological environmental report (RER), safety analysis report (SAR), safety management regulations, statement explaining the design and methods of construction work, and quality assurance plan concerning the construction and operation to the Minister of the MEST. In accordance with Article 79 of the Enforcement Regulations of the AEA, they shall submit additional documents that include the construction and operation plan of the disposal facility; documents on the storage, treatment, and disposal methods of radioactive waste; documents on the type***

***and volume of radioactive waste to be stored, treated or disposed of in the disposal facility; an explanatory statement on the technical capabilities regarding construction and operation of the disposal facility, and documents showing evidence that such equipment and manpower as described in Article 220-4 of the Enforcement Decrees of the AEA have been secured.***

***In accordance with Article 77 of the AEA, standards for permit of disposal facilities are as follows.***

- ***Technical capabilities necessary for the construction and operation of disposal facility and related facilities shall be available.***
- ***Location, structure, equipment, and performance of disposal facilities shall conform to such standards in such a way that they may not be any impediment to the prevention of hazards to human bodies, materials and the general public caused by radioactive materials, etc.***
- ***The construction and operation of disposal facilities etc. do not cause any impediments to the prevention of danger or injury to national health and the environment caused by radioactive materials, etc.***
- ***Equipment and manpower prescribed by the Presidential Decree are secured.***

## H.3.3 Current status of disposal facility site selection

Since the creation of the legal grounds for the implementation of the project by the 1986 revision of the AEA, the Government of the Republic of Korea has actively implemented the selection of the sites for radioactive waste disposal facilities.

The MKE announced new site selection procedures in February 2004, and KHNP, the applicant, 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 10 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 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 Facility" was legislated and announced on March 31, 2005 to stipulate support for areas hosting LILW disposal facility such as special financial support, entry fees, and relocation of the KHNP headquarters. It also stipulates the following to enhance the***

***democracy and transparency of the selection process: 1) 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 in Figure H.3-1, 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 Minister of Knowledge Economy 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.***

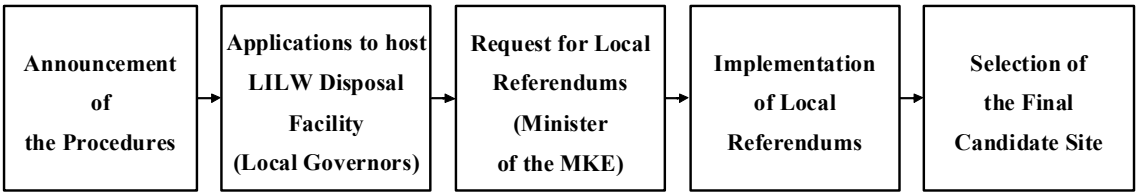


***Figure H.3-1. Site selection procedures of the LILW disposal facility***

***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 H.3-1.***

***On January 2, 2006, the MKE designated and thereupon announced that the prospective rural development area comprising the entire 49 Bonggil-li, Yangbuk-myeon, 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 H.3-1. Results of referendums for site selection*

| *Classification* | *Gyeongju* | *Gunsan* | *Yeongdeok* | *Pohang* |
|---|---|---|---|---|
| *Number of eligible voters* | *208607* | *196980* | *37536* | *374697* |
| *Number of actual voters (absentees)* | *147636 (70521)* | *138192 (65336)* | *30107 (9523)* | *178586 (63851)* |
| *Voter turnout* | *70.8 %* | *70.2 %* | *80.2 %* | *47.7 %* |
| *Percentage of favorable responses* | *89.5 %* | *84.4 %* | *79.3 %* | *67.5 %* |

# H.4 Design and construction of facilities (Article 14)

**ARTICLE 14. DESIGN AND CONSTRUCTION OF FACILITIES**

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;

(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;

(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

## H.4.1 Design-related factors

Design-related factors to be considered for the LILW disposal facilities are provided in the MEST Notices No. 2008-60 (Criteria for the Structure and Equipment of the LILW Repository) and the MEST Notices No. 2008-52 (Standard Format and Contents of Safety Analysis Report for the LILW Repository).

Disposal facilities shall be designed to maintain their structural and functional integrity during normal as well as abnormal operating conditions. The design and construction of disposal facilities, therefore, shall be based on proven engineering practices. In addition, equipments and components installed at disposal facilities shall be designed such that they may be regularly tested and inspected to confirm that they can continue to be used safely.

**General information**

***Wolsong Low and Intermediate Level Radioactive Waste Disposal Center disposal facilities are largely divided into ground and underground facilities (see Figure H.4-1). The ground facilities consist of reception and storage buildings, radioactive waste processing buildings, service buildings, and other supporting buildings. Here, radioactive waste to be disposed of is received from the waste generators such as NPPs, the compliance of the waste with the waste acceptance criteria is verified, and on-site treatment or conditioning is done, if necessary.***

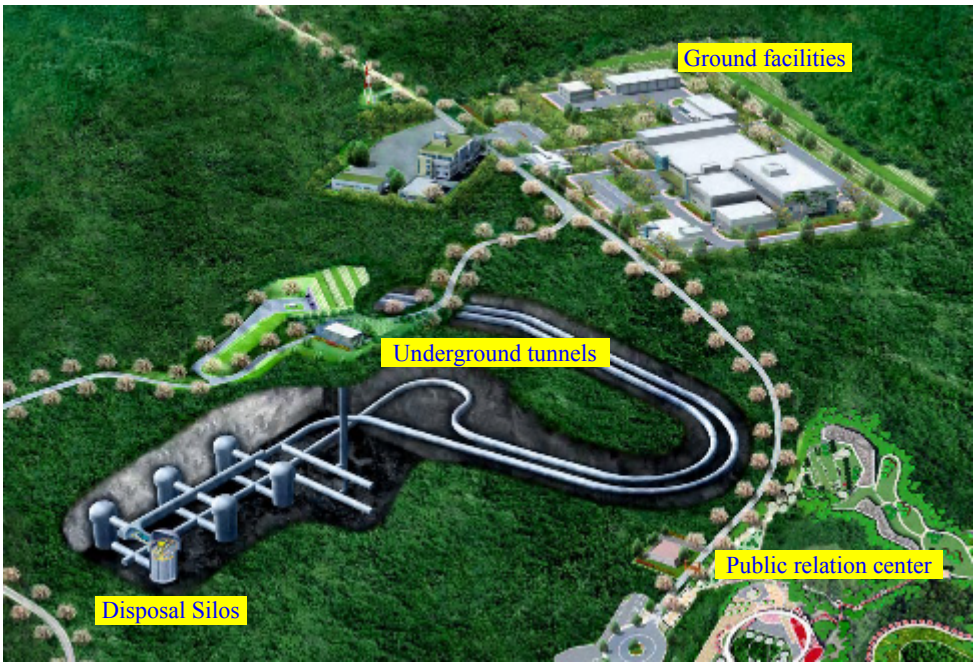


***Figure H.4-1. Bird's eye view of the Wolsong LILW Disposal Center***

***Underground facilities include construction tunnel, operation tunnel, vertical entrances, and unloading tunnel for the construction and operation; and the disposal silos for disposing of waste. At the first, six disposal silos will be constructed approximately 80-130m below sea level in a granite area to dispose of approximately 100,000 waste packing containers (see Figure H.4-2). All disposal silos are reinforced with shotcrete and concrete lining. Most waste storage containers are packed using disposal concrete containers and are then disposed of in the disposal silos.***

***Design goals***

***Radiation exposure to local residents and radiation workers shall meet the limits***

***stipulated by the MEST Notices. These requirements shall be considered at each stage of site selection, design, operation, closure, and post-closure institutional control.***

***The design goals for disposal facilities to protect local residents and radiation workers from radiation effects both during operation and post-closure period are as follows:***

***In-operation design goals***

- ***public: 0.1 mSv/y,***
- ***radiation workers: 20 mSv/y, and***
- ***adherence to "as low as reasonably achievable" (ALARA) guidelines;***

***Post-closure design goals***

- ***normal natural phenomena: 0.1 mSv/y,***
- ***natural or man-made accidents: $10^{-6}$/y, and***
- ***inadvertent intruders: 1.0 mSv/y.***

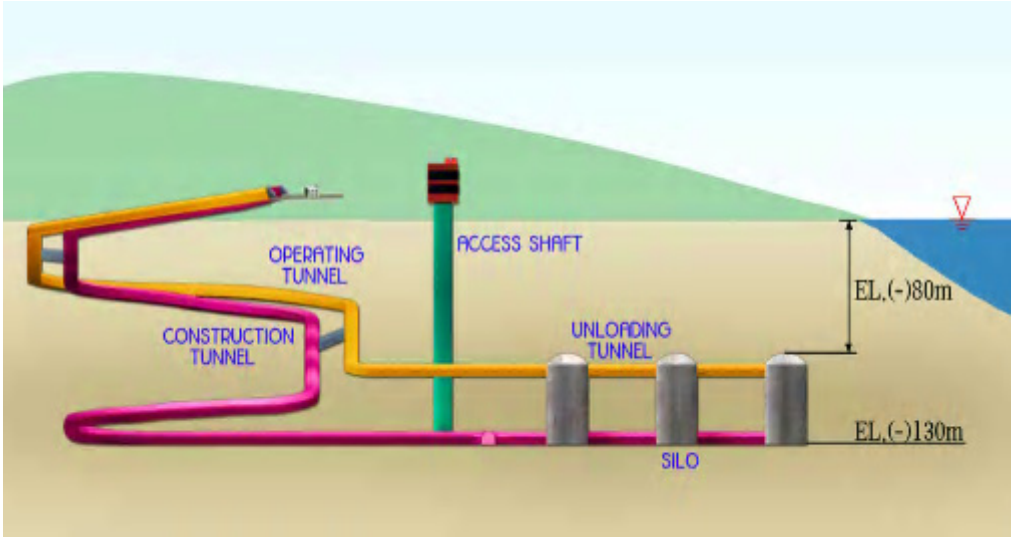


***Figure H.4-2. Cross section view of the underground facilities***

**Design standards**

In accordance with the MEST Notices, ***major design standards should be established*** to minimize the radiological effects on radiation workers and the public during normal operation or in the event of accidents***. In addition,*** disposal facility shall be laid out in consideration of a zone layout in accordance with the waste type, radioactivity concentration, package form, the environmental characteristics of disposal site, and the installation locations of major safety-related systems and/or components.

*Radiological safety*

- ***By applying a multi-barrier concept, waste shall be isolated in the long term, and the facility shall be designed to render active post-closure repair unnecessary.***
- ***The design and operation of the disposal facility shall comply with the site closure and stabilization plans; thus, the performance objectives established for the post-closure period shall be met.***
- ***Disposal facility shall be designed in accordance with the technical standards presented in the MEST Notice No. 2008-31 (Standards on Radiation Protection, etc.).***
- ***Disposal facility shall be designed so that post-closure radiation exposure to the local residents meets the performance objectives presented in the MEST Notice No. 2008-63 (Radiation Hazard Prevention Standards for Low and Intermediate Level Radioactive Waste Disposal Facilities).***
- ***The radiation exposure to radiation workers and local residents shall be ALARA and the radiation absorbed dose of components should not exceed their performance limits.***

*Structural stability*

- ***Disposal facility shall be designed in consideration of the site characteristics to make it possible to supplement and improve site characteristics.***
- ***Through a closure design, infiltration of groundwater or surface water into the radioactive waste that has already been disposed of shall be prevented, and changes in the surface geology and activities of organisms shall not degrade safety-related function of the disposal facility.***
- ***Disposal facility shall be designed in preparation for site characteristic factors such as geology, earthquakes, meteorology, and hydrology as well as other man-made disasters.***
- ***Disposal facility shall be designed to maintain their structural integrity with minimal maintenance and repair activities during the post-closure institutional control period.***
- ***Disposal facility shall be designed to minimize the need for long-term maintenance and repair.***

*Layout of underground disposal facility*

- ***The first stage of the disposal facility involves application of the mined cavity disposal concept.***
- ***Disposal silos should be laid out in solid bedrock.***
- ***Construction and operation tunnels should be laid out to secure a gradient of 10%.***
- ***Vertical shafts should be laid out to facilitate operation and to enhance***

***economic performance of the facility.***

- ***Areas with developed cracks such as faults and fracture zones shall be avoided.***
- ***Disposal facilities shall be located at a depth that can secure a disturbed zone due to blasting and excavation as well as structural stability.***

***Layout of ground building***

- ***The convenience and efficiency of managing the radiation exposure to radiation workers should be enhanced by unifying the access paths to the on-site radiation areas.***
- ***All ground buildings/facilities excluding parking lots should be laid out within a security fence to minimize the entry/security inspection of general vehicles in maintenance zones, and workers and visitors should be able to enter the site only through the security guard office.***
- ***The ground buildings/facilities laid out within the security fence should be categorized into diverse functional zones to enhance the convenience of work (e.g. classification into main building zones and auxiliary building zones).***
- ***Radioactive waste-related buildings should be laid out to minimize the traffic line of vehicles transporting waste at the site.***
- ***Buildings in which radioactive materials are handled should be laid out in locations with the best ground conditions on the site to minimize the effect of natural disasters.***

***<u>Establishment of design system</u>***

***The major technical areas that affect the performance of disposal facilities are the site characteristics investigation, waste characteristics evaluation, facility design, and performance assessment. As these major areas are organically interrelated, in order to satisfy the performance goals regarding disposal facilities, they should be reviewed repeatedly and complementarily in the order of the stages of the entire design process, as shown in Figure H.4-3.***

***Consequently, a design system that can show and integrate the relationships among diverse areas and take into consideration of complex relationships among factors that affect each of these areas was established and implemented, as shown in Figure H.4-4.***

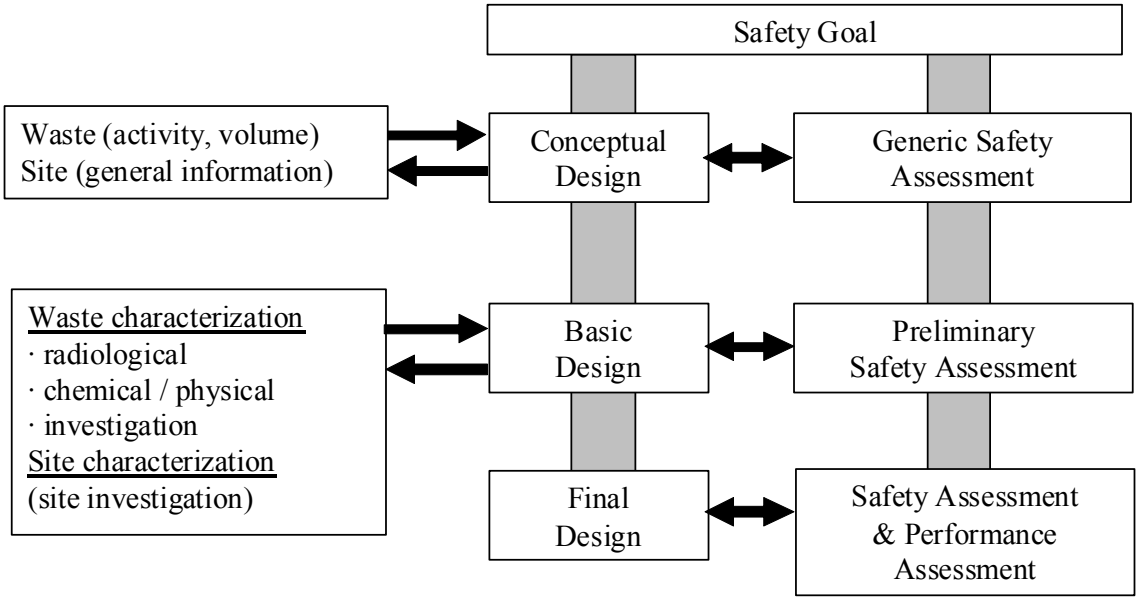


***Figure H.4-3. Design approach for the LILW disposal facility***

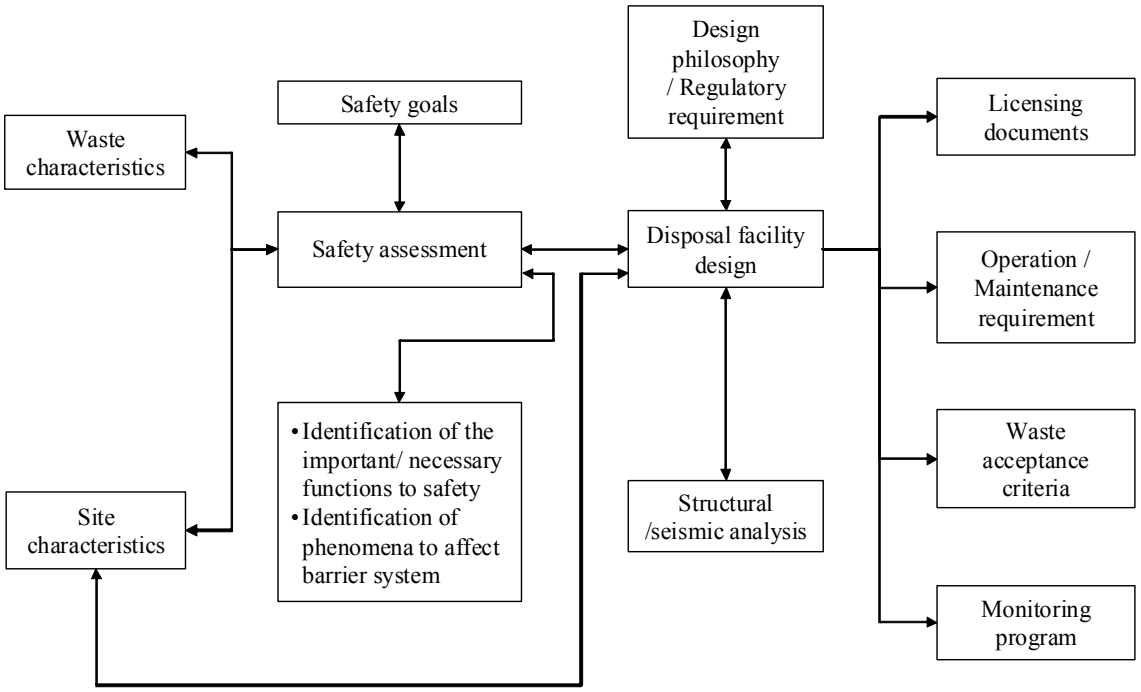


***Figure H.4-4. Mutual interaction among various technical processes***

**Considerations for closure**

The LILW disposal facility shall be designed to make possible their closure when the disposed amount considered during their design or the total radioactivity of the waste disposed of has reached the allowable limits or when it is considered to be no longer possible to maintain their normal functions due to unexpected accidents. Consequently, SAR shall describe the plans for the closure and stabilization of disposal facilities to isolate radioactive waste in the long term as well as the attendant design features.

**Considerations for decommissioning**

***In terms of decommissioning, radioactive waste management facility should be designed by taking into consideration of the following properties.***

- ***Regarding liquid radioactive waste pipes, their length should be minimal within possible limits, and care should be taken to prevent the contamination of surrounding areas due to the leakage of liquid radioactive waste from the joints.***
- ***Care should be taken to prevent the accumulation of radioactive materials in relatively inaccessible areas such as curves and turns in pipes and ducts.***
- ***A mechanism by which piping systems containing actually or potentially liquid radioactive materials can be easily flushed and cleaned should be prepared.***
- ***Adequate space should be secured to accommodate the remote handling components and safety monitoring components necessary for future decontamination and decommissioning.***
- ***Regarding large tanks and components, a hoist should be installed for easy dismantling.***
- ***Regarding piping systems transporting actually or potentially liquid radioactive materials, it should be possible to use gravity for drainage.***

**Radioactive effluent control and considerations for preventing uncontrolled releases**

In accordance with the Notice of the MEST, radiation monitoring systems shall be installed and a distinction shall be made between radiation monitoring systems to monitor the radiation levels of radioactive materials in liquid and gaseous effluents and area radiation monitoring systems to monitor the radiation levels of specific areas in disposal facilities. When radiation levels exceed set points or when abnormalities exist in the facilities, the systems shall have functions to activate an alarm and automatically terminate the release.

With regard to radioactive waste management facilities, it shall be possible to control gaseous or liquid radioactive effluent appropriately during normal and abnormal operations, and such effluents shall not be released into the environment from locations other than the air vents or drainages established in obtaining the license for construction and operation. In addition, so as to monitor the operation conditions of and radioactivity released from waste treatment facilities, appropriate sampling devices and monitoring equipment shall be installed. Furthermore, the possibility of contamination due to the backflow of radioactive materials shall be fundamentally minimized by separation of radioactive waste management facilities from those designed to handle non- radioactive materials.

## H.4.2 Construction-related factors

The Notice of the MEST provides construction-related factors for the LILW disposal facility in detail.

**General considerations**

The construction of disposal facilities shall be based on proven engineering practices. When new construction methods are applied, their safety shall be proved with valid evidence.

**Construction criteria**

Detailed construction-related factors for the LILW disposal facility are provided in the Notice of the MEST No. 2008-60 (Criteria for the Structure and Equipment of the LILW Repository) as:

- Construction of disposal facilities shall adhere to the QA requirements;
- Disposal facilities shall be constructed so as to minimize damage to the functions of natural barriers;
- Regarding the characteristics of natural barriers assumed at the design stage, their validity shall be confirmed through comparisons with the on-site measurements obtained during construction; and
- When construction and operation stages overlap, construction shall be conducted so as not to affect the operation safety of disposal facilities negatively.

# H.5 Assessment of safety of facilities (Article 15)

**ARTICLE 15. ASSESSMENT OF SAFETY OF FACILITIES**

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;

(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;

(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

## H.5.1 Safety analysis and environmental impact assessment

Any licensee who wishes to construct and to operate radioactive waste disposal facilities shall submit a permit application to the MEST beforehand according to the AEA. They shall attach a SAR that includes a separate chapter entitled "Safety Assessment and Accident Analysis" as well as a radiological environmental report. In other words, a safety evaluation of radioactive waste disposal facilities is conducted by permit applicants before the construction of facilities and by the regulatory body independently in order to determine whether to issue a permit after reviewing thoroughly and verifying the appropriateness of the safety assessment performed.

**Analysis through safety analysis report**

The SAR on radioactive waste disposal facilities mainly includes the results of safety assessment and accident analysis of events anticipated during the design, construction, operation, closure and post-closure institutional control of disposal facilities and auxiliary facilities. The main contents of a safety assessment and an accident analysis are as follows:

- identification of the form, types, and amount of waste: Information on waste generated during the operation and closure activities,
- infiltration water: Analysis during the design, safety analysis, operation, post-closure control period, and afterward,
- radionuclide leakage: Under normal and abnormal conditions and in the event

of accidents,
- pathways through which radionuclides eventually reach the human body, and
- impact assessment and its compliance with regulatory standards.

Long-term radiological safety criteria for radioactive waste disposal facilities are presented separately for periods of operation and after post-closure. During the operation of radioactive waste disposal facilities, as with other nuclear facilities in operation, the standards for the prevention of hazards to the environment as described in Subsection F.4.3 (Release Restriction System for Nuclear Facilities) as well as those related to dose limits for the general public are to be applied.

Radiological performance objectives for the post-closure period of disposal facilities are set up in terms of the radiological risks for individuals of critical groups in the future. The annual dose due to normal natural phenomena shall not exceed 0.1 mSv as a dose constraint. In addition, annual risk due to unpredictable phenomena caused by natural or artificial factors shall be restricted to $10^{-6}$ or less as a risk constraint.

The timeframe of post-closure safety assessment is expected to be about 1,000 years. However, when the predicted risk does not reach its maximum value within this period, verification that the leakage of radioactive materials into the surrounding environment will not increase drastically after this period and that acute radiation risk will not occur to individuals shall be duly presented.

For major scenarios that are deemed to affect the dose assessment results considerably as a result of the safety assessment of disposal facilities, an uncertainty analysis shall be conducted. In order to increase the reliability of the safety assessment results, QA principles and related detailed procedures for all stages of the safety assessment including the collection and application of input variables, modeling, detailed calculations, and a comprehensive evaluation shall be prepared and applied.

**Assessment through radiological environmental report**

The radiological environmental report on radioactive waste disposal facilities shall address the effects of the construction, operation, closure, and post-closure of facilities. In particular, the closure impact assessment shall describe the analysis of the predicted migration pathways of radionuclides that can leak from the disposal facilities, an assessment of predicted doses for local residents per exposure pathways due to potential radionuclide leakage in areas within 10 km from the site concerned, and an assessment of the predicted radionuclide concentration in groundwater release points located downstream of the site.

***Safety assessment of the LILW disposal facility***

***In January 2007, the KHNP applied to the MEST for a construction and operation permit of the LILW disposal facility, and submitted a series of licensing documents that included a SAR, a radiological environmental report (RER), and a quality assurance program (QAP), etc. in accordance with the AEA and relevant regulations. The applicant developed scenarios and conducted a safety assessment based on the safety assessment methodology published by the IAEA and recommended by the IAEA-coordinated international research project, Improvement of Safety Assessment Methodologies for Near Surface Disposal Facilities (ISAM).***

***The licensing safety review of the LILW disposal facility was conducted by the KINS, and an in-depth review was performed to confirm the suitability of the facility site and environment, the appropriateness of the disposal system design and construction methods, and the appropriateness of the safety assessment after the closure of the facility. It also determined technically whether legal licensing standards have been met.***

***With a view to improve the public confidence and acceptability for the safety of the first LILW disposal facility to be constructed in the Republic of Korea, an International Review Team (IRT) coordinated by the IAEA conducted an independent peer review of the license application program and activities for the LILW disposal site in October 2007. The IRT conducted an investigation of the Gyeongju site and an in-depth review of the hydrogeological modeling and the safety assessment context. As the results of the review, the IRT recognized the regulatory framework in place to be good and generally compatible with international standards. In addition, the IRT recommended and/or suggested that an uncertainty management program be established, and a few points be developed through the subsequent stages of the repository development, especially in the areas of geology, hydrogeology, groundwater flow modeling, and safety assessment context. The IRT's comments had been prudently considered and reflected in the licensing safety review process.***

## H.5.2 Renewal of safety analysis and reassessment of safety

**Renewal of safety analysis**

The MEST Notice No. 2008-57 (Criteria for the Structure and Equipment of the LILW Repository) stipulates that when there are natural disasters such as earthquakes and floods, or human-induced incidents that can affect the integrity of disposal facilities, the safety of the facilities concerned shall be re-evaluated and related authorization and licensing documents shall be revised based on the latest data. In addition, conditions

related to the safety of the disposal facilities shall be constantly reevaluated and supplemented, if necessary, based on the experience and data obtained from operating disposal facilities and the results of safety evaluations.

**Reassessment of safety**

In addition, the MEST Notice No. 2008-57 (Criteria for the Structure and Equipment of the LILW Repository) also stipulates that the following be re-evaluated to verify the safety of radioactive waste disposal facilities before closure:

- information and data on the facilities, site, and surrounding areas for the period that the performance evaluation concerns, and
- the total inventory of radioactive waste disposed of, records on accidents that have occurred during operation and that can affect disposal safety, and radiological and non-radiological impacts on public and the surrounding environment.

# H.6 Operation of facilities (Article 16)

**ARTICLE 16. OPERATION OF FACILITIES**

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in ARTICLE 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in ARTICLE 15 are defined and revised as necessary;

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in ARTICLE 15 for the period after closure;

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;

(v) procedures for characterization and segregation of radioactive waste are applied;

(vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;

(viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

## H.6.1 Criteria for permit and in-operation management standards

**Criteria for permit**

The criteria for operating license for radioactive waste disposal facilities are specified in the AEA as follows:

- The technical capabilities necessary for the construction and operation of a radioactive waste management facility shall be secured;
- The location, structure, equipment and performance of a radioactive waste management facility shall conform to technical requirements, as prescribed by

the Ordinances of the MEST, in such a way that there may not be any impediment to the protection of human body, materials, and the public against radiological hazards;
- No impediment shall exist to the protection of the public health and the environment against radiological hazards that may accompany the construction and operation of a radioactive waste management facility; and
- The equipment and manpower prescribed by the Presidential Decree shall be secured.

**Preoperational inspection**

The radioactive waste disposal facility shall be through the preoperational inspection to start operation after the completion of the construction of the facility. When the preoperational inspections of the structure, equipment, and performance of the facility meet the criteria for the operating license and the standards of the corresponding the Notices of the MEST, the operation of facility shall be allowed. In other words the constructed disposal facility will be confirmed through the preoperational inspection before the operation as to whether it meets the related criteria and safety standards.

***In-operation management standards***

***The MEST Notice No. 2008-57 (Technical Requirement for the Operation and Control of Low and Intermediate Level Radioactive Waste Repository) stipulates the standards for the in-operation management of disposal facilities, as follows:***

***Performance of structures, systems and components (SSCs):***
- ***The SSCs that are important to the safety of disposal facility and the isolation of waste, they shall maintain the design performance stipulated by the MEST Notice on the structures and equipments of disposal facility and the SAR of these facilities.***

***Periodic surveillance:***
- ***The SSCs of disposal facilities shall be surveyed in appropriate periods to confirm their agreement with the performance stipulated in the SAR.***

***Regular surveillance:***
- ***Regular surveillance plans that include the following information necessary to maintain and manage disposal facilities shall be established and implemented.***
    - ***set-point verification inspection of safety equipment,***
    - ***calibration and functional tests of the monitoring and controlling equipments,***

- ***confirmation of the performance of the radioactive waste management system,***
- ***confirmation of the performance of drainage equipments and ventilation equipment, and***
- ***confirmation of the performance of SSCs that are important to the safety of disposal facility and the isolation of radioactive waste.***

***Radioactive effluent monitoring:***

- ***The concentration of radioactive materials in the air and water emitted from disposal facility sites to the outside shall be monitored so that it will not exceed the radioactive material release concentration.***

***Radiation protection:***

- ***Any person who enters disposal facilities shall be protected from radiation with appropriate measures.***

***Prevention and measures against contamination:***

- ***The waste management process shall be optimized to minimize as much as is reasonably possible the radiation contamination due to waste and the generation of waste due to decontamination at disposal facility site, and, in cases of actual contamination, necessary measures such as decontamination, contamination expansion prevention, and shielding shall be taken to prevent the expansion of such contamination.***

***Repair and modification:***

- ***When the radiation safety of disposal facilities including their ability to isolate radioactive waste is judged to be in an abnormal state, the operators shall perform the necessary repair of the facilities to return them to a normal state and to maintain them at that level.***

***Sites and environmental monitoring:***

- ***To judge the effect of the operation of disposal facilities on the environment, during the operation of disposal facilities, the environment surrounding these facilities shall be monitored in accordance with the regulations in MEST Notices regarding radiological environmental investigations around nuclear reactor facilities and radiological environmental impact assessment.***

***Emergency plans:***

- ***Emergency plans that make it possible to counter emergency situations including hypothetical natural disasters such as radiation emergencies, earthquakes, fires, and extreme winds and flooding shall be established and,***

***if necessary, implemented.***

## H.6.2 Safety management of the operation of disposal facilities

***Safety management standards necessary for the operation of disposal facilities shall be established in advance to prevent hazard to human, material, and the public due to radiation. To make this possible, the same standards shall include the technical and administrative information on radiation safety control necessary to receive, handle, store, transport, treatment, and dispose of radioactive waste during the operation of disposal facilities and to manage and monitor these facilities after their closure. For this, the standards describe the following:***

- ***organization, function and duties,***
- ***operation and surveillance of the facilities,***
- ***radioactive waste management,***
- ***radiation safety management,***
- ***radiation measurement and management,***
- ***exposure control and evaluation methods,***
- ***monitoring of radiation in surrounding areas,***
- ***protection against radiation hazards,***
- ***education and training,***
- ***emergency countermeasures, and***
- ***records and record keeping.***

## H.6.3 Determination of limiting conditions for operation

The limiting conditions for operation necessary for the operation of radioactive waste disposal facilities shall be documented in technical specifications or safety management regulations in accordance with atomic energy-related laws. ***The limiting conditions for operation of the disposal facilities are as follow***:

- ***limiting conditions for the disposal of waste: waste type and amount disposed of, and the total radiation and concentration limit per radionuclide,***
- ***waste acceptance criteria,***
- ***limiting conditions for the operation of disposal facilities: waste handling operation, waste treatment processing operation, waste disposal operation, ventilation system, fire and explosion prevention, power supply system, and effluent monitoring,***
- ***radiation control and monitoring,***

- ***control in management,***
- ***periodic safety assessment, and***
- ***physical protection.***

## H.6.4 Operation procedures

***The MEST Notice No. 2008-57 (Technical Requirement for the Operation and Control of the LILW Repository) stipulates the detailed technical standards below regarding the operation of disposal facilities for the safe operation of such facilities, the prevention of disasters due to these facilities, and environmental conservation. In addition, it stipulates that facility operators present relevant content in permit application documents such as SAR, RER, safety management regulations, and QAP:***

- ***organization and functions,***
- ***zoning and access control,***
- ***in-operation disposal facility management standards,***
- ***waste management standards,***
- ***disposal facility closure standards, and***
- ***institutional control standards, etc.***

***For the operation and management of disposal facilities, operators shall create, as procedures independently documented under their own quality assurance programs, and obtain approval for detailed operation procedures regarding the receiving inspection, handling, storage, disposal, radiation monitoring, and emergency measures of the waste. The appropriateness of these procedures is to be confirmed through diverse regulatory inspections.***

## H.6.5 Engineering and technical support

The AEA stipulates that, as a part of the licensing standards for radioactive waste disposal facilities, the technical ability as well as appropriate equipment and personnel necessary for the construction and operation of these facilities shall be secured. ***Accordingly, the construction and operation licensee of the radioactive waste disposal facility has submitted, as a licensing document, an explanation of the technical capabilities in relation to the construction and operation of disposal facilities. And the licensee plans*** to create, in accordance with the characteristics of each facility, organizations that will provide engineering and technical support to all safety-related areas throughout the ***operation period*** or to do so with ***support*** from external professional organizations through service contracts***.***

## H.6.6 Procedure for the characterization and categorization of radioactive waste

In order to deliver radioactive waste packages to the operator of disposal facilities, the generator shall submit to the operator an "Application Form of Consigning the Receipt of Radioactive Waste", attached with a series of characterization data pertaining to the waste to be delivered. Major characterization data to be requested for the application of consignment are as follows:

- physical, chemical, biological features, and evaluation methods of the features;
- total radioactivity and radionuclide-specific concentrations;
- maximum surface dose; and
- main safety features of waste package and evaluation method, etc.

The MEST Notice No. 2008-65 (Acceptance Criteria for the LILW) limits radioactivity concentrations in each waste disposal package for the following radionuclides: $^{3}H$, $^{14}C$, $^{60}Co$, $^{59}Ni$, $^{63}Ni$, $^{90}Sr$, $^{94}Nb$, $^{99}Tc$, $^{129}I$, $^{137}Cs$, and gross alpha.

## H.6.7 Incident reporting and record control

The AEA prescribes that operators of nuclear facilities should immediately take all necessary safety measures and report such measures to the MEST in the following cases:

- If radiological hazards occur,
- If any failure occurs in nuclear facilities, or
- If there is any danger or possibility of danger to nuclear facilities or radioactive materials due to earthquakes, fires or other disasters, etc.

***The MEST Notice No. 2008-29 (Regulation on the Reporting of Events and Accidents of Nuclear Facilities)*** stipulates in detail the incident reporting system. It includes the objects, means and procedures of reporting, and the classification of events and accidents. Particularly, the major objects for reporting anticipated at radioactive waste management facilities are as follows:

- ***fire or leakage of radioactive materials during their transportation and packing,***
- surface contamination of areas other than the facilities' radiation areas exceeding the limiting values due to the leakage of radioactive materials,
- abnormal increase in the local radiation level,
- unplanned and uncontrolled release of radioactive materials into the environment, or
- release of radioactive materials exceeding effluent control limits.

The classification of incidents and accidents is based on the International Nuclear Event Scale (INES) of the IAEA.

***Information on the storage, treatment, or disposal of radioactive waste shall be documented and kept at disposal facilities in accordance with Article 120 of the Enforcement Regulations of the AEA. The main contents are as follows:***

- ***radioactive waste records,***
- ***radiation safety control records,***
- ***disposal facility inspection records,***
- ***operation, maintenance, and management records,***
- ***disposal facility accident records,***
- ***environmental monitoring, and***
- ***meteorological records.***

## H.6.8 Preparation and revision of decommissioning plans and regulatory review process

Operators of nuclear facilities including radioactive waste disposal facilities, before permanently terminating their license, shall take the necessary measures for protection against radiation hazards including transfer, safe-keeping, discharge, storage, treatment, disposal, decontamination and make a report to the MEST. The MEST may take necessary measures including the collection of radioactive materials, the dismantling of any contaminated facilities, and other such measures.

As established in the MEST Notice No. 2008-57 (Technical Requirement for the Operation and Control of the LILW Repository), when major systems and equipment are removed from radioactive waste management facilities, the safety of disposal facilities currently in operation shall not be affected and there shall be plans for the safe management of the radioactive waste generated during decommissioning.

## H.6.9 Preparation and revision of closure plans and regulatory review process

The MEST Notice No. 2008-57 (Technical Requirement for the Operation and Control of the LILW Repository) stipulates requirements regarding the closure of radioactive waste disposal facilities. The closure of radioactive waste disposal facilities shall be conducted according to pre-approved closure plans and in a manner that facilitates follow-up institutional access control, minimizes the need for continued maintenance, and facilitates follow-up environmental monitoring and surveillance.

Before the actual closure of disposal facilities, various authorization and license documents including a safety analysis of the facilities shall reflect the latest revisions. In addition, the total amount of waste disposed of, records on abnormal events that have occurred during operation and that can affect the safety of the disposal, and the radiological and non-radiological impact of the disposal on the public and the surrounding environment ***shall be reevaluated to prove the safety of the disposal facilities.***

In addition, operators shall finally confirm predicted performance throughout the period stipulated in the SAR at the completion of closure.

## H.6.10 Process for operational experience analysis and feedback

On the basis of the experience gained through the process of managing and controlling disposal facilities and the results of safety evaluations, the operator of disposal facilities shall frequently re-evaluate the conditions regarding the safety of facilities and supplement them, if necessary.

# H.7 Institutional measures after closure (Article 17)

**ARTICLE 17. INSTITUTIONAL MEASURES AFTER CLOSURE**

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

(i) records of the location, design and inventory of that facility required by the regulatory body are preserved;
(ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required; and
(iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

## H.7.1 Record keeping

Pursuant to the AEA, radiological data related to radioactive waste disposal shall be permanently preserved. Accordingly, the development of a national radioactive waste inventory management program is under way. The related records, particularly, the location and design documents of the disposal facility are to be preserved in accordance with the QA program.

With respect to requirements regarding the keeping and preservation of records on radioactive waste disposal facilities, the items to be recorded, time at which the records shall be drawn up, and preservation period are stipulated in detail in the Enforcement Regulations of the AEA and the MEST Notice No. 2008-57 (Technical Requirement for the Operation and Control of the LILW Repository). The major information to be recorded is as follows:

- radioactive waste-related records: manifest information, amount and type of the waste concerned, and disposal locations
- radiation safety control-related records: radiation level of facilities and radiation workers' exposure dose
- facility inspection records: pre-operational inspection, regular inspection, and disposal inspection records
- operation and maintenance records: results of the inspection, surveillance, and maintenance of the major equipments
- facility incident records
- ***environmental monitoring: sampling location and time/date, analytical method and results***

- ***meteorological records: direction and velocity of the wind, atmospheric stability, precipitation, and atmospheric temperature***

With regard to radioactive waste disposal facilities, the following records shall be maintained on annual basis: 1) site characteristics investigation documents; 2) facility design and construction-related data; 3) waste reception requirements and procedures; 4) safety analysis report; 5) radiological environment impact assessment; 6) data on the characteristics of the waste disposed of; 7) disposal facility and waste locations; 8) other data on the characteristics of the repository; 9) environmental monitoring records; 10) records on unintentional accidents during operation and after closure; 11) closure-related documents; 12) the QA documents; and 13) institutional control plan and its results.

To preserve the records above, facility licensees shall establish organizations, responsibility, and locations for the maintenance of records and shall maintain and store records to provide a complete and objective description of the activities included in all stages of disposal. In addition, to ensure the use and maintenance of appropriate information after the closure stage, records shall be updated and maintained such that they are easily accessible and usable.

## H.7.2 Institutional control

***In accordance with the MEST Notice No. 2008-57 (Technical Requirement for the Operation and Control of the LILW Repository),*** operators of radioactive waste disposal facility shall establish institutional control plans and submit them to the MEST by one year before the commencement of institutional control. In case they wish to revise control plans, operators shall submit a statement of the reasons for revision and revised control plans to the MEST by June of the corresponding year before that in which the revision is to take place. Institutional control plans shall include the following:

- control period,
- control organization and responsibility,
- characteristics of the waste disposed of, disposal facilities, and site concerned,
- control methods (control items, control method per item), and
- QA Program regarding institutional control.

The institutional control period shall be established in consideration of the characteristics of the waste, engineering design, site characteristics of the disposal facilities, predicted social activities related to the disposal facilities concerned, records,

and historical experience regarding maintenance. After the control period, further control activities shall be unnecessary and the risk or dose calculated according to appropriate methods shall satisfy performance objectives for the disposal facilities concerned.

Institutional control methods shall be able to prove that radiation protection requirements are met by reasonably verifying the closure performance of the disposal facilities. Institutional control consists of radiological environment investigation, non-radiological environment investigation, maintenance, site monitoring, access restriction, safety evaluation, and record-keeping. However, detailed control methods may be adjusted according to the results of the systematic safety evaluation of the disposal facilities or the characteristics of the disposal facilities and site. Site monitoring shall meet post-closure site monitoring plans regarding the disposal facilities in site characteristics reports or the SAR.

## H.7.3 Intervention in the case of unplanned release

With regard to radioactive waste disposal facilities, the concentration of radioactive materials during ventilation and drainage shall be monitored so that the concentration of radioactive materials released from the restricted areas on the site does not exceed the effluent control limits. As for ventilation and drainage monitoring equipment, alarms and the automatic blockage of relief valves shall trigger when set points have been exceeded. In addition, when radioactive materials in a liquid or gas state are released into the environment from areas other than drainages and air vents or under unplanned and uncontrolled conditions, operators shall make oral reports within 4 hours and submit a detailed report within 30 days to the MEST.

During the institutional control of radioactive waste disposal facilities, the unplanned release of radioactive materials into the environment shall be prevented or monitored through radiation environment investigation, maintenance, and site monitoring activities.

# I. Trans-boundary Movement (Article 27)

**ARTICLE 27. TRANSBOUNDARY MOVEMENT**

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments.

In so doing:

(i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

(ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

(iii) a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;

(iv) a Contracting Party which is a State of origin shall authorize a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement;

(v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this ARTICLE, unless an alternative safe arrangement can be made.

2. A Contracting Party shall not licence the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.

3. Nothing in this Convention prejudices or affects:

(i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;

(ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;

(iii) the right of a Contracting Party to export its spent fuel for reprocessing;

(iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

# I.1 Domestic transport regulations

Regulations for the transport of radioactive materials are described in the AEA, the Enforcement Decree of the AEA, the Enforcement Regulations of the AEA, the Regulation concerning the Technical Standards of Radiation Safety Management, etc., and the Notice of the MEST entitled 'Regulation on the Packaging and Transport of Radioactive Materials, etc.'

The domestic regulations for the transport of radioactive materials are based on the 'Regulations for the safe transport of radioactive materials' of the IAEA, and the reflection of the 1996 IAEA Regulations for the Safe Transport of Radioactive Materials (ST-1) on the AEA were enacted between 1999 and 2001. At present, the 1996 IAEA Regulations for the transport of radioactive materials are being reflected to domestic regulations for the transport of radioactive materials on the AEA.

Especially, Article 90 of the AEA, Articles 235 through 239 of the Enforcement Decree of the AEA, Articles 90 through 99 of the Enforcement Regulations of the AEA, Articles 83 through 122 of the Technical Standards of Radiation Safety Management provide the notification of transporting radioactive materials, the report of transportation by foreign ship, the inspection of packing and transportation, and the design approval, and inspection for shipping cask.

The detailed technical regulations for safe transportation on radioactive materials are described in the Notices of the MEST No. 2008-60 (Regulation on the Packaging and Transport of Radioactive Materials) and No. 2008-68 (Regulation on Inspection of Manufacture and Use of Radioactive Material Transport Containers), respectively.

# I.2 Safety requirements

## I.2.1 General requirements

The general safety requirements for the transport of radioactive materials specify radiation exposure and contamination controls for persons engaged in radioactive material transportation work, education and training, quality assurance, and measures, etc. in case of accidents.

## I.2.2 Transport containers

The safety requirements for transport containers provide the safety requirements by type

of transport container corresponding to each A-type package, B-type package, and packages containing fissile materials, while separating such requirements into general requirements and test requirements. General requirements and test requirements for transport containers conform to the requirements specified in the IAEA Regulations (ST-1).

### I.2.3 Transport

The safety requirements for transport include requirements such as the packaging limits by type of load, for example, A-type package, B-type package and package containing fissile materials as well as the surface dose rate, surface contamination limit of loads, and requirements such as the load limit by transport means such as vehicles, airplanes, ships, isolation, and the radiation dose rate at the surface of transport means. These safety requirements for transport conform to the requirements specified in the said IAEA Regulations (ST-1).

The Enforcement Regulations of the AEA specify that the radioactive materials, which undergo trans-boundary movement, should meet the regulation of packing and transportation of the countries of transit and/or destination.

## I.3 Approval and administrative action

### I.3.1 Design approval

The approval prescribed in the AEA includes design approval for special radioactive material and low-dispersive radioactive material, and design approval for shipping casks specified in par. 801 IAEA ST-1, design approval for shipping casks, and the special arrangements specified in par.312 IAEA ST-1. The MEST issues a design approval for radioactive material or shipping cask that an application for design approval is made by model. It is a rule to check the integrity of shipping casks through source surveillance in making a cask for which design approval is given. Meanwhile, the manufactured cask in use requires integrity-related inspections at the interval of every 5 years from the manufactured date in order to secure safety in continued utilization.

## I.3.2 Approval for transport containers

As for B-type packages, C-type packages, and packages containing fissile materials, it is provided that the details of transport including radioactive contents, the type of load, a written transport procedures and an accident response procedure should be notified to the MEST in advance of the transport day, and the MEST should review said details, and give order to rectify factors apt to impair safety, if any, before transportation. As for loads declared, transport surveillance or periodic inspections are conducted to check the possibility of violating transport regulations.

## I.3.3 Special arrangements

A person who intends to have a ship or airplane loaded with radioactive materials arriving in any port or airport in Korea, or passing through Korean territorial waters or aerial routes shall notify the MEST of such fact not later than 7 days before the day planned to start operations after the loading of radioactive materials.

## I.3.4 Trans-boundary movement cases

There has been no trans-boundary movement of the LILW to or from Korea until now. In June 1998, all of the 299 spent fuel rods stored in the research reactor were sent back to the originating countries as soon as initiating the decommissioning of the KRR-1 and 2 ***(refer to J.2.3 for the sealed source).***

# J. Disused Sealed Sources (Article 28)

**ARTICLE 28. DISUSED SEALED SOURCES**

1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.

2. A Contracting Party shall allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

## J.1 Legal system

The radioisotope (RI) waste management business for the safe treatment and storage of the RI wastes was established in October 1989. After the construction of RI waste management facility at KAERI, the RI waste was collected from August 1990 and had operated the RI waste management facility until the end of 1996. The responsibility of the RI waste management was transferred from the MEST to the MKE in 1996. Since January 1997, the KHNP has the responsibility for the management and operation of the RI waste management facility according to the AEA and the EBA.

In accordance with Article 52 of Enforcement Decree of the EBA, the RI waste management includes ***storage and treatment*** of the RI waste which are not included in the radioactive waste generated from the NPP. The MKE is responsible for the ***administrative supervision*** of the ***management of*** RI wastes. The KINS entrusted by the MEST, implements licensing, safety review, and regulatory inspections for the RI waste management facility.

Disused sealed RI sources have to be collected and delivered to the NETEC of the KHNP by respective RI users directly, or through the Korea Radioisotopes Association (KRIA) or consignment agencies.

## J.2 Management of disused sealed sources

### J.2.1 Requirements for facilities and handling

Disused sealed sources generated from RI users are temporarily managed by the owner ***in its licensed*** storage facility which passed facility inspections by the KINS. It is

compulsory to specify matters on safety such as shielding, ***waste management,*** etc. in the radiation safety report ***and their safety management regulations with regard to*** the storage capacity of ***the facility,*** and to keep them safely.

Currently, the KHNP safely stores and manages RI wastes in accordance with the AEA in the RI waste management facility of the NETEC located in Daejeon. The facility is annually inspected by the regulatory body.

## J.2.2 Management

**Procedures of waste management by RI users**

In accordance with Article 65 (License for the Use, etc. of Radioisotopes and Radiation Generating Devices) of the AEA, all RI users or organizations shall have RI utilization license issued by Minister of the MEST to import or purchase the radioisotopes or the radiation generating devices. The organizations of the RI utilization to import or purchase the RI or the radiation generating devices from abroad are required to meet the importation provisions of the KRIA. All the RI users or organizations to purchase the domestic radioisotopes or the radiation generating devices shall only have the RI utilization license issued by the MEST.

***Generally***, disused sources are ***stored temporarily in a source container*** at the licensed storage facility, ***and then delivered to the NETEC of the KHNP by RI users. Also,*** the domestic RI users generating RI wastes as provided in ***the MEST Notice No. 2008-47*** (Regulation on the Packaging and Transport of Radioactive Materials and Regulation that has to be observed by Radioisotope Seller) ***may*** entrust the collection of the RI waste to the RI sellers. The collected RI wastes shall be transferred to ***the RI waste management facility at the NETEC, after paying the management cost*** as provided in Article 83 (Control of ***Radioactive*** Wastes Bearing of Expenses, etc.) of the EBA .

**Procedures of the operation & management for the RI waste management facility by the NETEC**

The KHNP/NETEC takes over ***disused*** sources of decayed radioactivity from RI users under Article 53 (Radioactive Waste Delivery) of the Enforcement Decree of the EBA. In accordance with the MKE Notice No. 2002-67 (Regulation for the Consigning of Radioactive Waste and Its Cost), the ***KHNP/NETEC*** operates the RI waste management facility and safely stores and manages RI wastes ***which have been received from RI users***. The ***national*** RI waste management system is shown in Figure J.2-1.

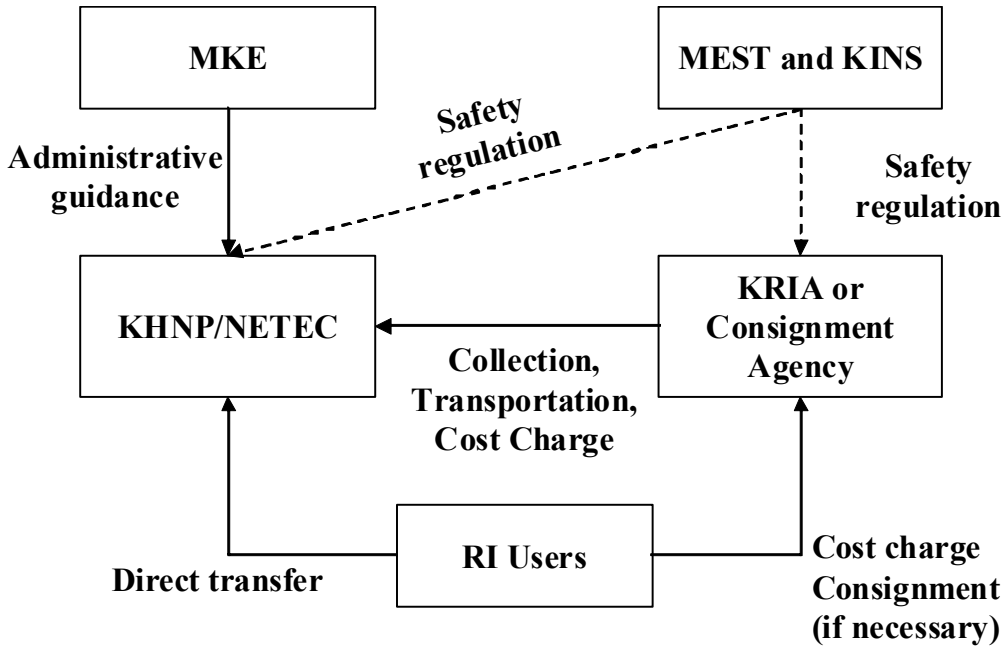


**Figure J.2-1. Radioisotope waste management system**

## J.2.3 Return

***Currently, the sealed sources used in the Republic of Korea are mostly imported from foreign countries. Based on the sales contract between the domestic licensed RI sellers and the foreign manufacturers, some of the disused sealed sources are returned to the foreign manufacturers. On the other hand, in case of the sealed sources manufactured in the Republic of Korea such as $^{192}$Ir and $^{60}$Co, when they are exported to foreign countries and if foreign RI users wish to return the disused sealed sources, they are allowed to be returned to the seller in the Republic of Korea. The return of disused sealed sources requires appropriate procedures that include the conformity of import requirements set forth in the AEA. The disused sealed sources from abroad are then delivered to the KHNP/NETEC RI waste management facility. Thus far, 470 disused sealed sources have been returned to the Republic of Korea.***

# K. Planned Activities to Improve Safety

## K.1 Stepwise approach for improving the long-term safety of the LILW disposal facility

***With a view to the improvement of long-term safety of the radioactive waste disposal facility, a step-by-step approach throughout the life cycle of the facility (i.e. site selection, construction, operation, closure, and institutional control after closure) is needed and now considered to be an international best practice. The AEA also stipulates a stepwise regulatory framework for the disposal facility; through a sequential regulatory review system of early site approval (if necessary), permit for construction/operation, review of closure plans, and review of termination of institutional control, and a regulatory inspection system of preoperational inspection, regular inspection, disposal inspection, and QA inspection (see Figure K.1-1).***

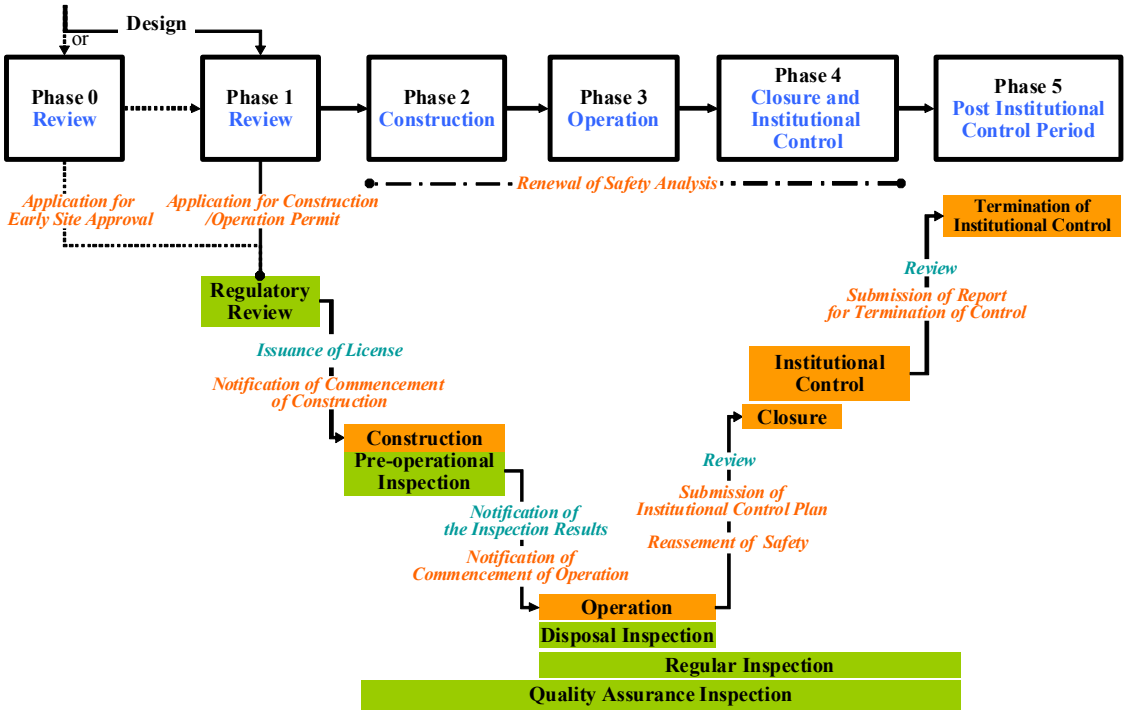


***Figure K.1-1. Stepwise regulatory framework for the radioactive waste disposal facility under the AEA***

*In the process of conducting licensing safety review on the LILW disposal facility (i.e. the Wolsong Low and Intermediate Level Radioactive Waste Disposal Center), the KINS derived a series of items to be developed continuously throughout the life cycle of the facility, based upon its own review findings in which the IRT's comments were also prudently reflected, and requested the KHNP to show additional information on detailed action plan to promote the long-term safety of the facility. In response to the request, the KHNP established a draft action plan for improving safety cases at each stage (i.e. construction, operation, closure, and post-closure) of the facility development, in the areas of systems and equipment, site and structures, geology, hydrogeology and geochemistry, safety assessment for operation and post-closure phases, etc.*

*The draft action plan was submitted to the KINS, reviewed and revised in the process of licensing safety review, deliberated by the NSC as a part of the regulatory review results, and then was finalized as the "Construction and Operation Permit Follow-up Action Plan". On July 31, 2008, the MEST issued the construction and operation permit for the LILW disposal facility and officially requested the KHNP to implement the action plan as a license condition. Afterwards, the KINS was designated to follow up and verify the KHNP's implementation status of the action plan, in which a series of areas, sub-items, scope and contents, timeline, procedure, and methods to be implemented for improving the long-term disposal safety were specified.*

*The KHNP, a permitted constructor and operator of the LILW disposal facility, is currently implementing scheduled action items in accordance with the action plan, and the KINS is verifying its implementation status along with conducting preoperational inspection. The action plan will be continuously implemented and verified along the sequential stages of commissioning, operation, and prior to closure of the disposal facility. Through this, the confidence on the safety case at each step of the facility development will be build-up, and the action plan could ultimately contribute to promote the long-term safety of the Wolsong Low and Intermediate Level Radioactive Waste Disposal Center.*

## K.2 Establishment of the R&D action plan for improvement of safety of spent fuel management

*In 2007, an experts committee convened by the Ministry of Education, Science and Technology (MEST) drafted a comprehensive R&D action plan for the technical verification of the spent fuel management scheme for the future nuclear energy system in Korea. This may become a basis in the process of establishing the national*

*long-term nuclear R&D program after public consultation through forums, public hearings, etc.*

*The draft R&D action plan, a measure to promote the long-term safety of spent fuel management, was prepared in a way to contribute to sustainable use of nuclear energy, protect public health, and minimize environmental burden to the next generation by maximizing the environment friendliness of the disposal system of high-level radioactive waste through reuse of spent fuel in an appropriate manner.*

*The draft R&D action plan mainly consists of development and verification of a pyroprocess and a sodium-cooled fast reactor, which are highly proliferation-resistant, through designing and construction of an engineering-scale mock-up equipment and system by 2011, the construction of an engineering-scale verification facility (Engineering Scale Pyroprocess Facility, ESPF) by 2016, designing of a pilot pyroprocess plant by 2020, and the completion and operation of the pilot facility (Korea Advanced Pyroprocess Facility, KAPF) by 2025 (see Figure K.2-1).*

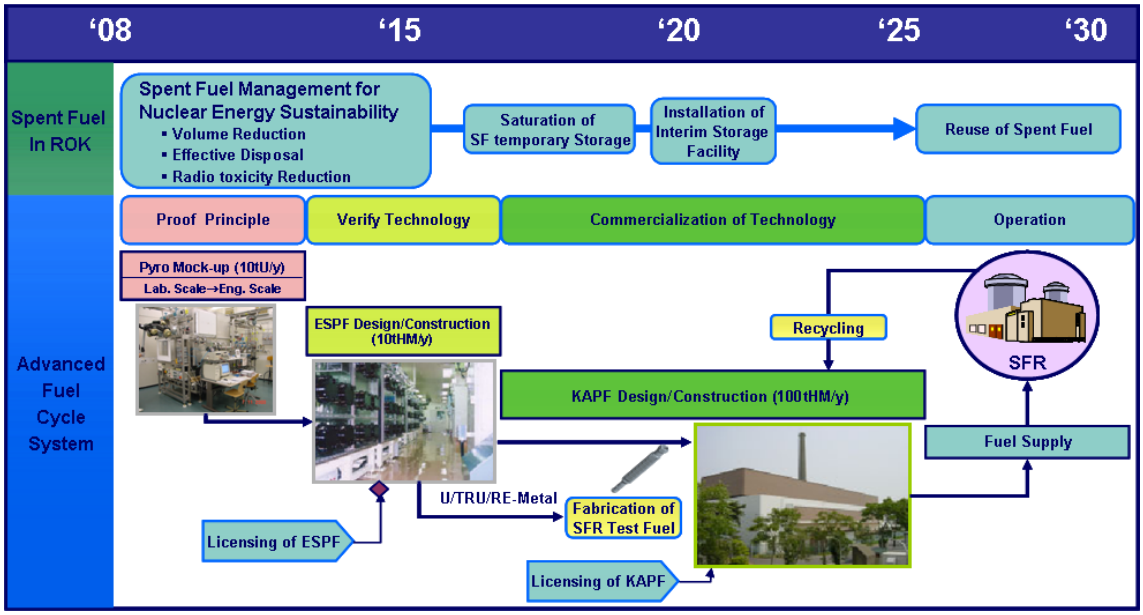


**Figure K.2-1. Draft R&D action plan for improvement of safety of spent fuel management**

*According to the proposed draft action plan, it is expected to reduce the volume of spent fuel by recovering U and TRU, and increase the efficiency of the final repository by separating out and storing heat generating isotopes. It is also expected that the time needed for the radiological toxicity of spent fuel to be reduced down to*

*that of natural uranium can be shortened to hundreds of years, through the burning of the recovered TRU elements in the fast reactors.*

## K.3 Legislation of the Radioactive Waste Management Act

*To distinguish those who are responsible for generating and disposing of radioactive waste and to secure the safety, transparency, and professionalism of the management of radioactive waste, the Radioactive Waste Management Act was legislated and announced on March 28, 2008. This in turn created the grounds for establishing the Korea Radioactive Waste Management Corporation (KRMC), an independent and professional management organization. The Corporation will be officially launched on January 1, 2009 and will conduct the storage, treatment (excluding spent fuel), and disposal of radioactive waste, selection of sites for radioactive waste management facilities, and construction and post-closure control, all of which have been currently performed by the KHNP.*

*Due to the legislation of the Radioactive Waste Management Act, financial resources such as radioactive waste managers' payments and spent fuel management charges will be used to establish the Radioactive Waste Management Fund.*
*This Fund will be used to support radioactive waste management and related subsidiaries. It will be managed and operated by the Minister of Knowledge Economy. By changing the current reserve accumulation method to a fund accumulation method, it has become possible to secure the financial resources necessary for the stable management of radioactive waste and operate the resources objectively and transparently.*

## K.4 Legislation plan of the Natural Radiation Management Act

*For the optimal control of the radiation exposure to the public using consumer products that use naturally occurring radioactive material (NORM) as one of their ingredients, the Government is currently legislating for managing natural radiation, NORM, and consumer products.*

*The draft Act titled "Natural Radiation Management Act" includes clauses on the recycling and management of dispersions generated by the handling of ingredients*

***through the investigation, analysis, and evaluation of radiological effects such as the accumulation of natural radioactive material and radiation doses within raw ingredient handling facilities.***

***Once the Act is legislated, the MEST will be able to establish a management system not only for artificial radiation, which the AEA already addresses, but also for natural radiation. The Act will make it possible to manage all aspects of safety related to radiation.***

## K.5 Application of polymer solidification technology

***Spent resin generated from NPPs is packed into the high density polyethylene containers and the borated liquid waste concentrate is dried and stabilized with paraffin in 200-liter drums. A new solidification technology was studied to enhance the ease of operation of the current solidification technology and to reduce the disposal cost.***

***Consequently, research was conducted to select the optimal solidification technology of spent resin and the borated liquid waste concentrate. The research was intended to satisfy disposal requirements, achieve high volume reduction ratio, and lower the occupational radiation exposure. To do this, diverse technologies were reviewed in terms of their technicality, economic feasibility, and licensability. As a result, a polymer solidification technology that utilizes polymers as a solidifying agent was found to be the most appropriate.***

- ***The waste loading or embedding ratio can be increased compared to other solidification technologies.***
- ***There is no generation of secondary radioactive waste, as off-gas treatment is unnecessary.***
- ***The solidified waste is easy to handle because its specific gravity is small, thus making it light. In addition, it exhibits a self-healing effect against defects due to external shock and it shows high microbial degradation resistance even after disposal.***
- ***The solidified waste is not sensitive to the chemical properties of the radioactive waste and shows high corrosion resistance, chemical resistance, and leaching resistance.***

***To confirm the appropriateness and optimal solidification state of the polymer***

***solidification technology, performance tests were conducted on polymer-solidified waste. The borated liquid waste concentrate, which was dried and granulated, was solidified with polymer and the dehydrated spent resin was also solidified with polymer.***

***The polymers used in this solidification technology were epoxy-based special polymers. A hardener and a diluent were used as additives to enhance the ease of operation and to create optimal solidified waste. The optimal solidified waste conditions were derived through performance tests conducted on solidified waste test specimens that were created by adjusting the ratio of the polymers, the hardener, and the diluent in experiments. According to solidified waste performance tests, the most appropriate combination was judged to be that of the polymers and only the hardener as an additive to solidify the waste. Performance tests were done on the polymer-solidifying agent, which included compressive strength tests, leaching tests, immersion tests, irradiation tests, and thermal cycling tests. When the radioactive waste was solidified using the polymer solidification technology, the resulting solidified waste was demonstrated to meet disposal requirements sufficiently.***

**Table K.5-1. Result of performance tests on the polymer-solidifying agent**

| Test item | Characteristics unit | Limit | Experimental result | Test method |
|---|---|---|---|---|
| Compressive strength test | psi | over 500 | 2106~4064 | KS F-2405 |
| Leaching test | Leaching index | over 6 | Co: 12.0~25.7<br>Cs: 10.4~25.2 | ANSI 16.1 |
| Immersion test | psi | over 500 | 554~3953 | ANSI 16.1<br>KS F-2405 |
| Irradiation test | psi | over 500 | 1819~2741 | NRC BTP<br>KS F-2405 |
| Thermal cycling test | psi | over 500 | 2931~6440 | ASTM B553<br>KS F-2405 |

# Annexes

Annex A. List of Spent Fuel Management Facilities

Annex B. List of Radioactive Waste Management Facilities

Annex C. List of Nuclear Facilities under Decommissioning

Annex D. Nuclear Safety Charter

Annex E. Nuclear Safety Policy Statement

Annex F. Notices of the MEST applicable to Radioactive Waste Management

Annex G. References

# Annex A. List of Spent Fuel Management Facilities

## Annex A-1. Spent fuel storage facilities at NPP Sites

**(As of December 2007)**

| Facility | Location | Storage Type | *Storage Capacity* | |
|---|---|---|---|---|
| | | | ***Inventory [MTU]*** | ***Total Capacity (*) [MTU]*** |
| Kori Unit 1 | GiJang-gun, Busan | Wet | ***127.19*** | ***164*** |
| Kori Unit 2 | " | Wet | ***285.48*** | ***313*** |
| Kori Unit 3 | " | Wet | ***703.96*** | ***888*** |
| Kori Unit 4 | " | Wet | ***506.39*** | ***888*** |
| Yonggwang Unit 1 | Yonggwang-gun, Jeonnam Province | Wet | ***431.28*** | ***888*** |
| Yonggwang Unit 2 | " | Wet | ***387.71*** | ***420*** |
| Yonggwang Unit 3 | " | Wet | ***245.29*** | ***470*** |
| Yonggwang Unit 4 | " | Wet | ***225.83*** | ***470*** |
| Yonggwang Unit 5 | " | Wet | ***101.20*** | ***219*** |
| Yonggwang Unit 6 | " | Wet | ***99.77*** | ***219*** |
| Ulchin Unit 1 | Ulchin-gun, Kyungbuk Province | Wet | ***374.51*** | ***404*** |
| Ulchin Unit 2 | " | Wet | ***352.99*** | ***382*** |
| Ulchin Unit 3 | " | Wet | ***180.56*** | ***209*** |
| Ulchin Unit 4 | " | Wet | ***177.07*** | ***209*** |
| Ulchin Unit 5 | " | Wet | ***76.46*** | ***219*** |
| Ulchin Unit 6 | " | Wet | ***51.84*** | ***219*** |
| Wolsong Unit 1 | GyeongJu, Kyungbuk Province | Wet | ***666.87*** | ***801*** |
| Wolsong Unit 2 | " | Wet | ***658.76*** | ***706*** |
| Wolsong Unit 3 | " | Wet | ***693.03*** | ***706*** |
| Wolsong Unit 4 | " | Wet | ***647.99*** | ***706*** |
| Wolsong Dry Storage | " | Dry | ***2425.68*** | ***3061*** |

* : except for emergency cores

## Annex A-2. Characteristics of spent fuel storage pools at the KAERI research facilities

**(As of December 2007)**

| Facility | Location | Storage Type | Storage Capacity | |
|---|---|---|---|---|
| | | | Fuel Type | *Total Capacity (MTU)* |
| HANARO Spent Fuel Storage Pool | Yuseong-gu, Daejeon | Wet | HANARO 36 Element Fuel Assembly | ***1.320*** |
| | | | HANARO 18 Element Fuel Assembly | ***0.561*** |
| PIEF Spent Fuel Storage Pool | Yusong-gu, Daejeon | Wet | PWR Spent Fuel Assembly | ***10.5*** |

# Annex B. List of Radioactive Waste Management Facilities

## Annex B-1. Storage facilities for the LILW at NPP sites

**(As of December 2007)**

| Facility | Location | Purpose | Operation Year | Capacity [drum] |
|---|---|---|---|---|
| Kori No. 1 | GiJang-gun, Busan | Storage from Kori Units 1~4 | 1978 | 10000 |
| Kori No. 2 | 〃 | 〃 | 1979 | 6000 |
| Kori No. 3 | 〃 | 〃 | 1987 | 11200 |
| Kori No. 4 | 〃 | 〃 | 1993 | 23000 |
| Wolsong No. 1 | GyeongJu, Kyungbuk Province | Storage from Wolsong Units 1 ~ 4 | 1983 | 9000 |
| Yonggwang No. 1 | Yonggwang-gun, Jeonnam Province | Storage from Yonggwang Units 1, 2 | 1986 | 13300 |
| Yonggwang No. 2 | 〃 | Storage from Yonggwang Units 1~6 | 2002 | 10000 |
| Ulchin No. 1 | Ulchin-gun, Kyungbuk Province | Storage from Ulchin Units 1, 2 | 1989 | 7400 |
| Ulchin No. 2 | 〃 | Storage from Ulchin Units 1~ 6 | 1997 | 10000 |

## Annex B-2. Radioactive waste treatment facilities at NPP sites

| Reactor Type | Facility Feature | | |
|---|---|---|---|
| | Gaseous* | Liquid | Solid |
| PWR | Treatment by gas decay tank or charcoal delay bed for effluent processing | Treatment by filtering, evaporation or ion exchange method | Treatment by sorting, compacting, drying or solidification method |
| PHWR | Treatment by charcoal delay bed for effluent processing | Treatment by filtering, or ion exchange method | Treatment by sorting, compacting, or drying method |

* Radioactive effluent is treated through HEPA and/or charcoal filter of HVAC system

## Annex B-3. Storage facilities for radioactive waste at the KAERI

| Facility | Location | Purpose | Organization | Capacity [drums] |
|---|---|---|---|---|
| Storage | Yusong-gu, Daejeon, | LILW | KAERI | ***16018*** |

## Annex B-4. Radioactive waste treatment facilities at the KAERI

| Facility | Location | Purpose | Operation year | Facility Feature | |
|---|---|---|---|---|---|
| | | | | Process | Throughput |
| Radioactive Waste Treatment Facility (RWTF) | Yusong-gu, Daejeon | Treatment of radioactive waste generated from research facilities | 1991 | Bituminization | 0.03 $m^3$/h |
| | | | | Evaporation | 1 $m^3$/h |
| | | | | Compaction | 60 ton |
| | | | | Solar evaporation | 0.6 $m^3$/h |

## Annex B-5. Storage facilities for radioactive waste at the KNF

| Facility | Location | Purpose | Operation Year | Capacity [drum] |
|---|---|---|---|---|
| Storage No. 1 | Yuseong-gu, Daejeon | Storage of solid waste | 1993 | 4900 |
| Storage No. 2 | 〃 | 〃 | 1998 | 4000 |

## Annex B-6. Radioactive waste treatment systems in nuclear fuel fabrication facility at the KNF

| Facility | Location | Purpose | Operation Year | Characteristics | |
|---|---|---|---|---|---|
| | | | | Throughput | Main Process |
| PWR liquid waste treatment system in Plant 1 | Yuseong-gu, Daejeon | Liquid waste treatment | 1988 | 18 $m^3$/d | Lime precipitation and centrifuge |
| PWR liquid waste treatment system in Plant 2 | 〃 | 〃 | 1998 | 〃 | 〃 |
| PHWR liquid waste treatment system in Plant 2 | 〃 | 〃 | 1998 | 〃 | Flocculation |
| Solid waste treatment system in Plant 1 | 〃 | Solid waste treatment | 1988 | - | Shredding & compaction |
| Solid waste treatment system in Plant 2 | 〃 | 〃 | 1998 | - | Cutting & compaction |

## Annex B-7. RI waste storage facility at the NETEC

| Facility | Location | Purpose | Operation Year | *Capacity [drum]* |
|---|---|---|---|---|
| RI waste storage facility | Yuseong-gu, Daejeon | RI waste interim storage | 1993 | ***9750*** |

## Annex B-8. RI waste incinerator at the NETEC

| Facility | Location | Purpose | Operation Year | Treatment Capacity | |
|---|---|---|---|---|---|
| Radioactive waste incinerator | Yuseong-gu, Daejeon | Incineration:<br>- RI waste<br>- Radioactive waste generated from KAERI | 2000 | Solid waste | 15~25 kg/h |
| | | | | Liquid waste | 8 L/h |

# Annex C. List of Nuclear Facilities under Decommissioning

**(As of December 2007)**

| Facility | Location | Licensee | Specification | Year | | Status | Estimated Radioactive waste | |
|---|---|---|---|---|---|---|---|---|
| | | | | Operation | Shutdown | | Volume [$m^3$] | Total radio-activity [TBq] |
| KRR-1 | Nowon-gu,, Seoul | KAERI | TRIGA Mark-II (250 kWth) | 1962 | 1995 | Under Decommiss-ioning | ***90*** | ***2.0E-2*** |
| KRR-2 | 〃 | 〃 | TRIGA Mark-III (2 MWth) | 1972 | 1995 | 〃 | 453 | 1.2E+0 |
| Uranium Conversion Facility | Yusong-gu, Daejeon | 〃 | ADU [1] AUC [2] (100Ton/y) | 1982 | 1992 | 〃 | ***200*** | ***1.4E-2*** |

1) ADU: Ammonium Diuranate
2) AUC: Ammonium Uranyl Carbonate

# Annex D. Nuclear Safety Charter

Recognizing that the peaceful use of nuclear energy contributes to national development and improvement of the quality of the people's life, and confirming that protection of the people and preservation of the environment through safe control of nuclear energy have the first and foremost priority over others, we pledge ourselves:

1. To maintain the highest standards of safety in the use of nuclear energy;
2. To release information regarding nuclear safety promptly and transparently;
3. To reflect the public opinion in formulating nuclear safety policies;
4. To assure the independence and fairness in nuclear safety regulation;
5. To strengthen research and development of technologies on nuclear safety;
6. To abide sincerely by national laws and international agreements on nuclear safety;
7. To complement and improve the nuclear safety-related legal system continuously;
8. To promote nuclear safety culture and incorporate it in our workplace.

September 6, 2001

# Annex E. Nuclear Safety Policy Statement

## 1. Introduction

The following declares the Ministry of Science and Technology's major policies for the assurance of nuclear safety through the settlement of nuclear regulatory goals and principles to meet growing public concern for nuclear safety and the environment. The purpose of this Statement is to improve the consistency, adequacy and rationality of nuclear regulatory activities by notifying the public and concerned people in and out of the nuclear field of the Government's basic policies regarding nuclear safety.

As declared in the report titled, "Directions of Long-term Nuclear Energy Policy through the Year 2030", which was approved at the 234th Atomic Energy Commission in July 1994, Korean nuclear policy is aimed at establishing the safe use of nuclear energy for peaceful purposes and improving public welfare. Therefore, the assurance of nuclear safety should be given first priority in the development of nuclear power, and organizations and individuals engaged in nuclear power activities should adhere to safety principles as top priority.

The Korea public's distrust of nuclear safety has grown significantly due to the Chernobyl nuclear accident. Sometimes we are confronted with a vocal and often powerful anti-nuclear movement, particularly in regions where nuclear facilities will be built. Therefore, people in the nuclear field should have a more pro-active attitude in assuring nuclear safety so that much-needed public's trust and confidence can be obtained, and they should devote more effort to communicating with the public to resolve outstanding issues.

As a matter of course, nuclear safety is not a matter for one country but a worldwide concern. The "Nuclear Safety Convention" signed by IAEA member states during the 38th IAEA General Conference is one example of world-wide efforts to enhance nuclear safety. Its objectives are to establish national measures on nuclear safety and to ensure that each contracting party fulfills its obligations under the said Convention. As a result, each contracting country has an international responsibility for nuclear safety.

The Government of the Republic of Korea will continue to pursue its goal of achieving a high level of nuclear safety through the enhancement of safety technologies and the internationalization and rationalization of the regulatory system, recognizing that the overriding priority should be given to the assurance of nuclear safety before the development of the nuclear industry.

## 2. Safety Culture

The Government reaffirms that nuclear safety takes top priority in the development of nuclear energy and that it should be of foremost concern to organizations and individuals engaged in nuclear activities. The Government also develops safety culture, which was presented by the IAEA, recognizing that nuclear safety issues are more closely related to human factors rather than to technical ones, as demonstrated by two nuclear accidents of TMI and Chernobyl.

The safety of nuclear facilities can be secured through dedication to common goals for nuclear safety by organizations and individuals at all levels by giving a high priority to safety through sound thought, full knowledge and a proper sense of safety responsibility. The Government recognizes that nuclear safety is achieved not only by safety systems and strict regulations throughout the stages of design, construction, operation and maintenance of nuclear power plants, but also by the spread of safety culture.

In meeting this commitment, the Government strives for strict regulations through the development of clear safety goals and regulatory policies. It will actively encourage safety-related research and technical developments to achieve technical expertise in regulatory activities and will ensure regulatory independence and fairness by minimizing any undue pressure and interference.

Nuclear utilities establish management policies, giving high priority to nuclear safety, and foster a working climate in which attention to safety is a matter of everyday concern. Managers encourage, praise and provide tangible rewards to employees for commendable attitudes and good practices concerning safety matters. On the contrary, when errors are committed, individuals are encouraged to report them without concealment and to correct them to avert future problems. For repeated deficiencies in or negligent attitudes toward nuclear safety, managers take firm measures in such a way to prevent the same errors from occurring again. In this way, safety culture can be achieved through sound safety policies and full understanding of safety culture by senior management and through proper practices and implementation by individuals engaged in the nuclear industry.

## 3. Regulatory Principles

The ultimate responsibility for safety of nuclear facilities rests with the licensee. This is in no way diluted by the separate activities and responsibilities of designers, suppliers, constructors and regulators.

The Government has an overall responsibility for ensuring the protection of the public health and the environment from radiation hazards that may occur in the development of nuclear energy. It inspects and ensures the appropriateness of the licensee's safety practices through nuclear regulations and establishes a high level of safety assurance in

order to achieve safety goals on a government level. To effectively regulate, the Government sets forth the following five principles to encourage high-safety performance.

## A. Independence

The Government establishes the legal framework for the independent regulatory organization responsible for nuclear regulatory activities. It takes proper measures to ensure the independence of the regulatory organization, which is functionally separated from other organizations and systems involved in the development of nuclear energy. It also ensures that the regulatory organization acts on its own objectives and technical judgment without any political interference and influence from external sources.

The regulatory organization should maintain an extensive program of research and sufficient staff resources to review and audit licensee's submittals so that it can independently verify the validity of a licensee's assertions, which are critical to regulatory decisions. The regulators do their work seeking to achieve the highest standards of ethical performance and professionalism. Regulators' decisions and judgments must be based on objective, unbiased assessments, considering possible conflicting interests of those involved, and their work must be documented. Based on safety culture, the regulatory organization should support and guide the licensee in solving its problems, but only to the extent that the regulatory organization's independence is not impeded.

## B. Openness

The purpose of nuclear regulations is to protect public safety and to ensure that all activities are legal and public. The Government maintains an open channel with the public for regulatory information so that the public can understand and rely on the regulatory process. The Government is also devoted to establishing a sound social stand on nuclear safety by making an effort to inform the public properly and openly of nuclear activities, including safety matters.

The Government also develops nuclear policies based on public consensus, paying attention to the public's right to know about the regulatory process. To accomplish this, the Government extends an opportunity to the public to participate in regulatory processes and publicizes related information under the principle titled, "Openness and Democratization of Nuclear Administration".

However, restricted information from industries or concerned individuals is protected and kept in confidence, and treated according to the provisions concerned. The Government objectively informs the public of its activities so that it may collect public opinions more soundly and properly, and it strives to get public consensus through constant communication and interaction with regulators, licensees and the public.

## C. Clarity

Nuclear regulations should be enforced through clear regulatory policies, which are based on safety goals on a national level. There should be a coherent nexus between regulations and agency goals and objectives. Agency position should be documented to be readily understood and easily applied.

The Government endeavors to ensure that the licensee is fully informed about regulators' policies so that the licensee can prepare for new policies in advance in order to achieve nuclear safety effectively upon implementation. In a case where new or revised regulations are expected, the Government informs the licensee of the regulatory policies and provides guidance in advance and establishes regulatory practices to minimize the licensee's process of trial and error caused by the revision of regulatory requirements.

The licensee should thoroughly observe the AEA, technical standards and regulatory guidance, and if there is a need to revise them or there are any unreasonable acts or technical standards, the licensee should communicate its view with the regulatory organization in order to initiate revisions.

## D. Efficiency

The regulatory organization has the responsibility to provide the licensee and the public with the best possible management and administration of regulatory activities. To accomplish this, it must make constant efforts to evaluate and upgrade its regulatory capabilities.

The regulatory organization should possess a sufficient number of staff that is capable in performing regulatory activities, which are closely connected with many technical areas, and regulatory activities must be performed efficiently to contribute to the achievement of the goal of "Nuclear risk reduction".

Regulatory decisions must be made with the best use of all resources invested in the regulatory process to minimize undue impediments.

Before regulatory decisions related to the improvement in nuclear safety are made, the nuclear risk reduction scale and economic benefits that can be gained from the improvement should be reviewed first.

To efficiently perform regulatory activities with limited capabilities and time, appropriate prioritization of regulatory activities must be made based on risks, costs, and other factors. Regulatory alternatives, which minimize cost, are adopted unless they increase the degree of risk, and in all cases resources should be used effectively for the improvement of nuclear safety.

## E. Reliability

The regulatory organization endeavors to eliminate public distrust and fear of nuclear activities and to obtain the public's trust and support through fair regulations based on technical and professional judgments. Regulatory decisions must be made promptly and fairly, and reliably based on the best available knowledge from

research and operational experiences.

The Government obtains up-to-date technical information on nuclear safety and applies this information to regulatory activities. When regulatory requirements need to be either newly established or changed, the most suitable option is adopted after the effectiveness of its implementation and technological difficulties resulting from any changes are sufficiently reviewed.

The Government does its best to run its regulatory system efficiently and systematically, and to thoroughly enforce the regulations in order to secure the public's trust on nuclear safety systems.

## 4. Directions of Nuclear Safety Policy

To quickly realize the establishment of safety culture and a safety assurance system, each organization prepares its “Implementation Program of Safety Culture” and the regulatory body provides a systematic basis to evaluate the results of its implementation.

Nuclear power plants in operation or under construction are supplemented with regulatory requirements consistently and systematically to achieve an international level of nuclear safety, taking into account the possibility of severe accidents.

For newly constructed nuclear power plants, factors which may increase the total risk caused by the construction of an additional nuclear power plant at the same site of existing plants are to be mitigated by improving the safety level at each grade as compared with that of existing nuclear power plants. For nuclear power plants in operation, maintenance, repair, inspection, and monitoring of components are to be strengthened. “Periodic Safety Reevaluation” is established and implemented to reassess and supplement safety deficiencies which may be caused by the aging of facilities and application of old technical standards.

In accordance with regulatory requirement changes in and out of the country, the existing atomic energy law system is to be revised and supplemented, and related technical standards and regulatory guidance are to be maintained in order to efficiently perform regulatory activities.

In consideration of the technical expertise required for nuclear regulatory activities, safety research should be continuously strengthened to meet the growing demand of regulatory requirements due to technical advancements in the nuclear field.

Solutions for unresolved safety issues, including generic safety issues of nuclear power plants, are promptly found and reflected in policy. Operating records and accident and failure data are analyzed to determine factors that affect the safety of nuclear power plants, and efficient safety supplementary measures are also established.

The regulatory organization reviews the introduction of “Optimum Assessment & Probabilistic Assessment” for safety analyses, and encourages the licensee to introduce

new technologies when and if they are considered to be reasonable safety assurance measures, as proven by their application.

An "Overall Safety Assessment" is performed using probabilistic safety assessment and "Nuclear Regulation based on Risk" is done through sound safety regulations in consideration of cost-benefit factors.

Quantitative safety goals and regulatory guidelines for the examination, prevention and mitigation of severe accidents are established and improved to be gradually applied to advanced nuclear power plants as well as to existing facilities. In addition, design and operational safety of nuclear power plants are achieved through these measures in order to minimize human error.

Radiation protection is achieved by the concept, "Radiation exposure should be kept as low as reasonably achievable (ALARA)", taking into account economic and social circumstances, and for individual exposure dose, the introduction of radiation protection standards based on the new ICRP 60 recommendations are being favorably reviewed.

In response to growing public concern about nuclear safety, nuclear safety-related information and regulatory activities are open to the public through the publication of the "white paper on nuclear safety" and through the periodic release of information about accidents and failures at nuclear power plants.

## 5. Conclusion

The nuclear community strives for the public's proper understanding of nuclear energy and the establishment of safety culture by hearing and addressing the public's concerns with understanding and by using the collected wisdom of those involved to solve any problem together.

Nuclear safety cannot be achieved in a day, but rather it is secured through the licensee's constant efforts to improve nuclear safety and through the regulator's thorough enforcement activities. The basic concept of nuclear regulations is to protect the public from radiation hazards and to pursue a "better safety performance" as allowed by circumstances.

To this end, the Government is devoted to developing a higher level of nuclear safety technology and regulatory system, and to achieving an international level of nuclear safety through participation in the "Nuclear Safety Convention".

In conclusion, the Government reaffirms that the assurance of nuclear safety is the highest duty of the regulatory organization and ensures that such an important role is performed faithfully to secure nuclear safety on behalf of the public.

September 10, 1994

# Annex F. Notices of the MEST applicable to Radioactive Waste Management

## Radioactive Waste

### Standard Format and Contents of Safety Analysis Report for Low and Intermediate Level Radioactive Waste Repository (No. 2008-52)

This guide purposes to define the matters related to the composition of the safety analysis report for low and intermediate level radioactive waste repository. This guide will be applied to the safety evaluation and accident analysis for the design, construction, and management of the disposal facilities for low and intermediate level radioactive waste and of their accompanying facilities, and for problems anticipated during the institutional control period.

### Standard Format and Contents of Site Characteristics Report for Low and Intermediate Level Radioactive Waste Repository (No. 2008-53)

The regulation defines the matters regarding site characteristics report for low and intermediate level radioactive waste repository. This regulation will be applied to near-surface disposal and rock-cavity disposal for low and intermediate level radioactive waste in the regions of land, seashore, or islands. As these regulations include only minimal technological matters pertaining to each disposal form or method, technological details might be added or excluded in part.

### Standard Format and Contents of Site Characteristics Report for Spent Fuel Interim Storage (No. 2008-54)

The regulation aims to define the matters regarding site characteristics report for spent fuel interim storage. This regulation will be applied to wet-type of spent fuel interim storage on surface of ground.

### Quality Assurance Criteria for Radioactive Waste Management Facilities (No. 2008-55)

This criteria purpose to define the necessary details on QA programs for low and intermediate level radioactive waste repository and spent fuel interim storage facility. The criteria applies to the site characteristics investigation, design, operation, closure and institutional control of the LILW repository and site characteristics investigation, design, construction and operation for spent fuel interim storage facility, respectively.

### Siting criteria for Low and Intermediate Level Radioactive Waste Repositories (No. 2008-56)

The criteria specify the minimum technical criteria on site conditions of near-surface repository for low and intermediate level radioactive wastes with the provision of the Enforcement Decree of the AEA.

**Technical Requirement for the Operation and Control of Low and Intermediate Level Radioactive Waste Repository (No. 2008-57)**

The regulation purposes to manage disposal facilities safely, prevent disasters due to disposal facilities, and protect the environment by defining detailed technological standards regarding the management of disposal facilities for low and intermediate level radioactive waste. This regulation will be applied to the management, closure, and institutional control of disposal facilities of low and intermediate level radioactive waste and their safety assessment on normal and abnormal events which are likely occurred during the operation, closure, and institutional control of repository.

**Siting Criteria for Spent Fuel Interim Storage Facilities (No. 2008-58)**

The regulation aims to specify the minimum technical criteria on site conditions of the interim storage facility for spent nuclear fuel with the provision of the Enforcement Decree of the AEA.

**Criteria for Structure and Equipment of Low and Intermediate Level Radioactive Waste Treatment System (No. 2008-59)**

The criteria stipulate the detailed technical requirements on structure and equipment that must be considered in relation to the design and operation of various treatment facilities of low and intermediate level radioactive waste.

**Criteria for Structure and Equipment of Low and Intermediate Level Radioactive Waste Repository (No. 2008-60)**

The criteria stipulate the minimal requirements on structure and equipment that must be considered in relation to the construction and installation of low and intermediate level radioactive waste repository.

**Regulation on Inspection of Radioactive Waste Disposal (No. 2008-61)**

The Regulation aims to establish requirements needed to inspect the disposal of low and intermediate level radioactive waste at waste disposal facilities. Operators who wish to undergo disposal inspection must submit inspection application form for each batch of waste to the MEST up to one month before in which disposal is to be implemented.

**Incineration Criteria of Low and Intermediate Level Radioactive Waste (No. 2008-62)**

This criteria purpose to provide technical details for incinerator facilities of low and intermediate level radioactive waste in order to secure the operational safety at the time of incineration treatment of radioactive waste.

**Radiological Protection Criteria for Long-term Safety on Low and Intermediate Level Radioactive Waste Disposal (No. 2008-63)**

The criteria purpose to define the necessary details for preventing radiological risks to human health or the environment in relation to the disposal facilities of low and intermediate level radioactive waste and to establish performance objectives to secure

the long-term safety in the case of the permanent disposal of radioactive waste. The performance objectives will indicate that after the closure of a disposal facility, risks caused by radioactive waste disposal which shall be within the acceptable level both in the present generation and in future generations, and it will also be applied to review and evaluation of radiological safety.

**Regulation on the Clearance Level of Radioactive Waste (No. 2008-64)**

The regulation purposes to define clearance level for deregulation of very low level radioactive waste and procedures, methods, and other necessary details for deregulation application of very low level radioactive waste below the clearance level in the Enforcement Decree of the AEA.

**Acceptance Criteria for Low and Intermediate Level Radioactive Waste (No. 2008-64)**

The criteria purpose to define delivery methods, plan and procedures and other necessary details needed upon consignment of the delivery of disposal of low and intermediate level radioactive waste to operator as well as specific guideline of waste acceptance which should satisfy at the time of disposal of waste.

**Acceptance Criteria for Spent Fuel (No. 2008-66)**

The criteria aim to provide the general requirements for delivering spent fuel as generated from the nuclear power plant to operator of the AFR spent fuel interim storage facility. This criteria purpose to define delivery methods, plan and procedures and other necessary details needed upon consignment of the delivery of spent fuel to operator of the AFR spent fuel interim storage facility.

***Technical Requirement for the Radiation Safety Management of Low and Intermediate Level Radioactive Waste Transport Ships (No. 2008-67)***

***The regulation purposes to provide technical details for radiation safety management of the LILW transport ships.***

**Regulation on Inspection of Manufacture and Use of Radioactive Material Transport Containers (No. 2008-68)**

The regulation purposes to provide technical details for inspection of manufacture/use of radioactive material transport containers, especially standards in respect of the items, methods for inspection by type of transport containers.

**Regulation on the Packaging and Transport of Radioactive Materials, etc. (No. 2008-69)**

The regulation purposes to establish requirements and technical details needed for ensuring packaging and transport safety of radioactive materials as stipulated in the Enforcement Decree of the AEA.

## Radiation

### Standards on Radiation Protection, etc. (No. 2008-31)

The purpose of the standards lies in establishing standards related to radiation pr otection according to the regulations for radiation protection in the AEA. Especial ly included are classification of radioactive waste, definition of effluent control li mits, and radiological design limits to prevent human and environments from radiat ion hazards, which applies to the design of the radioactive waste management facili ties.

## Reactor Facilities

### Regulation on Preparation, etc. of Radiological Environmental Report of Nuclear Power Utilization Facilities (No. 2008-27)

The regulation purposes to describe the necessary matters regarding items of report, its preparation method and others related to the composition of the radiological environmental report for assessment of the radiological impacts that may occur in the environment due to construction and operation of the nuclear facilities as well as of the draft radiological environmental report for public consultation/hearing of residents nearby. This regulation will be applied to the draft radiological environmental report for the nuclear power plant, the LILW disposal facility and spent fuel interim storage facility, and to the radiological environmental report for research reactor with 100kW thermal, and other waste management facilities and etc.

### Regulation on the Environmental Radiation Survey and Impact Analysis in the Vicinity of Nuclear Facilities (No. 2008-28)

The regulation purposes to describe the necessary details regarding the implementation of a survey of radiation environment and assessment of the radiological impacts on the surrounding environment of nuclear facilities which should be carried out by their installers and/or operators.

### Regulation on the Reporting of Events and Accidents of Nuclear Facilities (No. 2008-29)

The regulation purposes to describe the necessary details regarding reporting items, their procedures and impacts assessment on events and accidents of reactor facilities. Especially this regulation will be applied for items of events and/or accidents which should be reported to the MEST and release the related information to the general public during operation of nuclear facilities.

# Annex G. References

## Domestic


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2) Ministry of Education, Science and Technology (MEST), Nuclear Safety Policy Statement, September 1994

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4) Ministry of Knowledge Economy (MKE) / Korea Hydro and Nuclear Power Co., White Paper on Nuclear Development, August 2008

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## Foreign


1) International Atomic Energy Agency, Regulations for the Safe Transport of Radioactive Material, ST-1, IAEA, 1996

2) International Atomic Energy Agency, The Principles of Radioactive Waste Management, Safety Series No. 111-F, 1995

3) International Commission on Radiological Protection (ICRP), 1990, Recommendations of ICRP, ICRP Pub. 60, 1991

4) International Atomic Energy Agency, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources No. 115, IAEA, 1996

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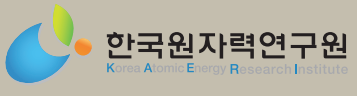


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