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

Oct. 2011

Ministry of Education,
Science and Technology

**The Republic of Korea**

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# FOREWORD

This National Report describes the implementation status 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 deposited the ratification of on September 16, 2002.

This National Report was prepared in accordance with the "Guidelines Regarding the Form and Structure of National Reports on Joint Convention (INFCIRC/604/Rev.1)" under the Joint Convention and described the implementation status by reflecting the observations given in the Summary Report of the 3rd Review Meetings. This Report maintains the structure of article-by-article approach based on every implementation of the obligations contained within the topical arrangement of the Joint Convention. The cutoff date of this national report preparation was December 31, 2010, otherwise specified in the report.

This National Report covers the civilian facilities and their associated lands, buildings and equipment 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 Korea as defined in Articles 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 (MEST), Korea Institute of Nuclear Safety (KINS), Korea Hydro & Nuclear Power Co., Ltd (KHNP), Korea Radioactive Waste Management Corporation (KRMC), Korea Electric Power Corporation Engineering & Construction Company, INC (KEPCO E&C), Korea Electric Power Corporation Nuclear Fuel Company (KEPCO NF), and Korea Atomic Energy Research Institute (KAERI).

Fourth National Report of the Joint Convention

# SUMMARY


The government of the Republic of Korea has maintained a consistent national policy for a stable energy supply through nuclear power generation. Korea's first commercial operation of a nuclear power plant commenced with Kori Unit 1 in 1978, and there are currently 21 nuclear power plants in operation and 5 others are under construction.

At the 249th Atomic Energy Commission (AEC) meeting held on September 30, 1998, Korea resolved the "National Radioactive Waste Management Policy" and established the fundamental policy for the management of radioactive waste. Accordingly, radioactive waste has been managed based on principles such as management under government responsibility, safety as the highest priority, minimization of radioactive waste generation, the "Polluter Pays" principle and transparency of the site selection process.

The application scope of this Joint Convention is spent fuel and radioactive waste specified in the domestic Atomic Energy Act (AEA) and technical standards. It includes spent fuel and radioactive waste generated from nuclear reactors for power generation and research, and radioactive waste generated from nuclear fuel cycle facilities and organizations using radioisotopes (RIs), etc.

The challenges that Korea is facing were presented at the 3rd Review Meeting held in Vienna, Austria, May 2009, and the government is pushing through with subsequent actions regarding the following challenges:

- ☐ Seeking intermediate storage measure and long-term management policy decisions for spent fuel,
- ☐ Actual implementation of the developed radioactive waste disposal technologies,
- ☐ Appropriate utilization of the newly established radioactive waste management fund.

The fourth national report was written based on the provisions of the Joint Convention and matters changed or progress made since 2009 are as follows:

□ Establishment of the 『1st Comprehensive Plan for Nuclear Safety (2010~2014)』 (March 2010)

- Completion of a safety regulation system consisting of the Nuclear Safety Charter, Nuclear Safety Policy Statement, and Comprehensive Plan for Nuclear Safety by suggesting the Nuclear Safety Vision, 5 policy goals, and 18 priority projects required for securing nuclear safety.

□ Establishment (March 2008) and revision (December 2009) of the Radioactive Waste Management Act (RWMA)

- The RWMA which integrates and systematically organizes matters concerned with the management of radioactive waste specifies the management of Low and Intermediate Level Radioactive Waste (LILW), foundation of the Korea Radioactive Waste Management Corporation (KRMC), and the establishment of the Radioactive Waste Management Fund. The RWMA revised in December 2009 provided the basis for carrying out procedures to gather a broad range of opinions concerning matters that anticipate social conflict such as the management of spent fuel for the process of establishing a master plan for radioactive waste management.

□ Establishment of the KRMC as the exclusive radioactive waste management agency (January 2009)

- The KRMC was established as the exclusive radioactive waste management agency to ensure safety and effective management of radioactive waste in accordance with the RWMA.

□ Construction of the LILW disposal facility (August 2008 ~)

- The disposal facility for the LILW is under construction, and phase 1 construction for disposal capacity of 100,000 drums will be completed by the end of 2012.

□ Operation of receipt/storage building of the LILW disposal facility (December 2010)

- Before completion of the LILW disposal facility, the receipt and storage of 2,000 drums of the LILW were started in the operating receipt/storage building in December 2010.

□ Monitoring of environmental radioactivity

- The nuclear power utilization facility operator should evaluate and report on the environmental impact of radiation regarding the operation of the facility, and the Ministry of Education, Science and Technology (MEST) and the Korea Institute of Nuclear Safety (KINS) confirm and monitor the environmental radioactivity around the facility.

# List of Abbreviations

| | |
|---|---|
| **ADU** | Ammonium Di-Uranate |
| **AEA** | Atomic Energy Act |
| **AEC** | Atomic Energy Commission |
| **AFR** | Away From Reactor |
| **AINS** | Automatic Information Notification System |
| **ALARA** | As Low As Reasonably Achievable |
| **APR1400** | Advanced Power Reactor 1400 |
| **AtomCare** | Atomic Computerized Technical Advisory System for the Radiological Emergency |
| **AUC** | Ammonium Uranyl Carbonate |
| **CP** | Construction Permit |
| **DAW** | Dry Active Waste |
| **EBA** | Electricity Business Act |
| **ECL** | Effluent Control Limit |
| **FADAS** | Following Accident Dose Assessment System |
| **GIS** | Geographical Information System |
| **HANARO** | High-flux Advanced Neutron Application Reactor |
| **HLW** | High-Level Radioactive Waste |
| **IAEA** | International Atomic Energy Agency |
| **ICRP** | International Commission on Radiological Protection |
| **IERNet** | Integrated Environmental Radiation Network |
| **IMEF** | Irradiated Material Examination Facility |
| **INES** | International Nuclear Event Scale |
| **IRRS** | Integrated Regulatory Review Service |

# List of Abbreviations

| | |
|---|---|
| **KAERI** | Korea Atomic Energy Research Institute |
| **KEPCO** | Korea Electric Power Corporation |
| **KEPCO E&C** | KEPCO Engineering & Construction Company, INC |
| **KEPCO NF** | KEPCO Nuclear Fuel Co., Ltd. |
| **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 |
| **KPS** | Korea Plant Service & Engineering Co., Ltd. |
| **KRIA** | Korea Radioisotope Association |
| **KRMC** | Korea Radioactive Waste Management Corporation |
| **KRR** | Korea Research Reactor |
| **KRS** | Korean Reference Disposal System |
| **LEMC** | Local Emergency Management Center |
| **LILW** | Low and Intermediate Level Radioactive Waste |
| **MEST** | Ministry of Education, Science and Technology |
| **MIFFAF** | Ministry for Food, Agriculture, Forestry and Fisheries |
| **MKE** | Ministry of Knowledge Economy |
| **MLTM** | Ministry of Land, Transport and Maritime Affairs |
| **MOE** | Ministry of Environment |
| **MOEL** | Ministry of Employment and Labor |
| **MOFAT** | Ministry of Foreign Affairs and Trade |
| **MOPAS** | Ministry of Public Administration and Security |
| **NEMC** | National Emergency Management Committee |

# List of Abbreviations

| | |
|---|---|
| **NPP** | Nuclear Power Plant |
| **NRB** | Nuclear Regulatory Bureau |
| **NSC** | Nuclear Safety Commission |
| **NSSC** | Nuclear Safety and Security Commission |
| **OEMC** | Off-site Emergency Management Center |
| **OL** | Operation License |
| **OPR1000** | Optimized Power Reactor 1000 |
| **PHWR** | Pressurized Heavy Water Reactor |
| **PIEF** | Post-Irradiation Examination Facility |
| **PNSC** | Plant Nuclear Safety Committee |
| **PSR** | Periodic Safety Review |
| **PWR** | Pressurized Water Reactor |
| **QA** | Quality Assurance |
| **QAP** | Quality Assurance Program |
| **REMDAS** | Radiological Emergency Meteorological Data Acquisition System |
| **RI** | Radioisotope |
| **RWMA** | Radioactive Waste Management Act |
| **SIDS** | Safety Information Display System |
| **SIREN** | System for Identifying Radiation in Environments Nationwide |
| **SSC** | structures, systems and components |
| **STES** | Radiation Source Term Assessment System |
| **UCF** | Uranium Conversion Facility |
| **WACID** | Waste Comprehensive Information Database |

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# A. Introduction

# A. Introduction

The government of the Republic of Korea has maintained a consistent national policy of fostering nuclear power industries for stable energy supply to overcome the insufficient energy resources in the country. Nuclear power accounts for approximately 32 % of the total electricity generation in Korea.

Since the commencement of the first commercial operation of Kori Unit 1 in April 1978 to the latest commercial operation of Shin-Kori Unit 1 in February 2011, 21 units of NPPs are currently operating commercially. Seventeen units out of the 21 operating nuclear power plants (NPPs) are pressurized light water reactors (PWRs) and located at Kori, Yonggwang and Ulchin sites. The remaining four units are pressurized heavy water reactors (PHWRs) at Wolsong site.

The government set up a plan to increase the portion of nuclear energy facilities to the total energy facilities from 24.5% to 32% and the portion of nuclear power generation capacity to the total power generation capacity from 31.4% up to 48.5% by constructing a total of 13 NPPs by 2024 including the 5 units (OPR1000 3 units, APR1400 2 units) that are currently under construction and 6 units (APR1400) planned according to the 5th Power Supply Scheme announced in December 2010.

The government separated the tasks for the nuclear power promotion and regulation, and established in February 2011 the Nuclear Regulatory Bureau under the Ministry of Education, Science and Technology (MEST) to enhance the regulatory independence. It also established the Korea Radioactive Waste Management Corporation (KRMC), an exclusive radioactive waste management agency, in January 2009 pursuant to the provisions of the Radioactive Waste Management Act (RWMA) for the safe and efficient management of radioactive waste. The KRMC has been constructing a low and intermediate level radioactive waste (LILW) disposal facility since the government issued the construction and operation license on July 31, 2008 and phase 1 of the disposal facility will be completed at the end of 2012.

The Korean government has strove to secure a disposal site for the safe management of radioactive waste since the early 1980s. The 249th meeting of the Atomic Energy Commission (AEC) held in September 1998 established the “National Radioactive Waste Management Policy”, which aims at completing the construction of the LILW disposal facility by 2008 and a centralized spent fuel interim-storage facility by 2016;

site selection had not been successful even after 18, however. Therefore, a revision of the policy was made at the 253rd AEC meeting held on December 17, 2004, stipulating the completion of construction of the LILW disposal facility by 2008. Nonetheless, the national policy for spent fuel management including the construction of the centralized spent fuel interim-storage facility was to be decided later on in view of domestic and international technology development.

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 LILW generated from the NPPs has been stored at on-site radioactive waste storage facilities.

Currently only one research reactor is under operation: HANARO(Hi-flux Advanced Neutron Application Reactor) at the Korea Atomic Energy Research Institute (KAERI) located in Daejeon. The spent fuel and radioactive waste generated from this facility are stored in the storage facilities inside the site. Operation of the HANARO has commenced since 1995 and the HANARO has thermal power of 30MW. Two research reactors, Korea Research Reactor 1 and 2 (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.

All fuels for the domestic NPPs are fabricated by the Korea Electric Power Corporation Nuclear Fuel (KEPCO NF) 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 December 2010, the number of user licensees utilizing radioactive materials in medicine, research work and industry has increased steadily to nearly 4,700. These facilities are located throughout the country and generate various types of radioactive waste. Radioisotope (RI) contaminated waste from these facilities is stored at a RI waste management facility at the RI management facilities of KRMC in Daejeon.

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

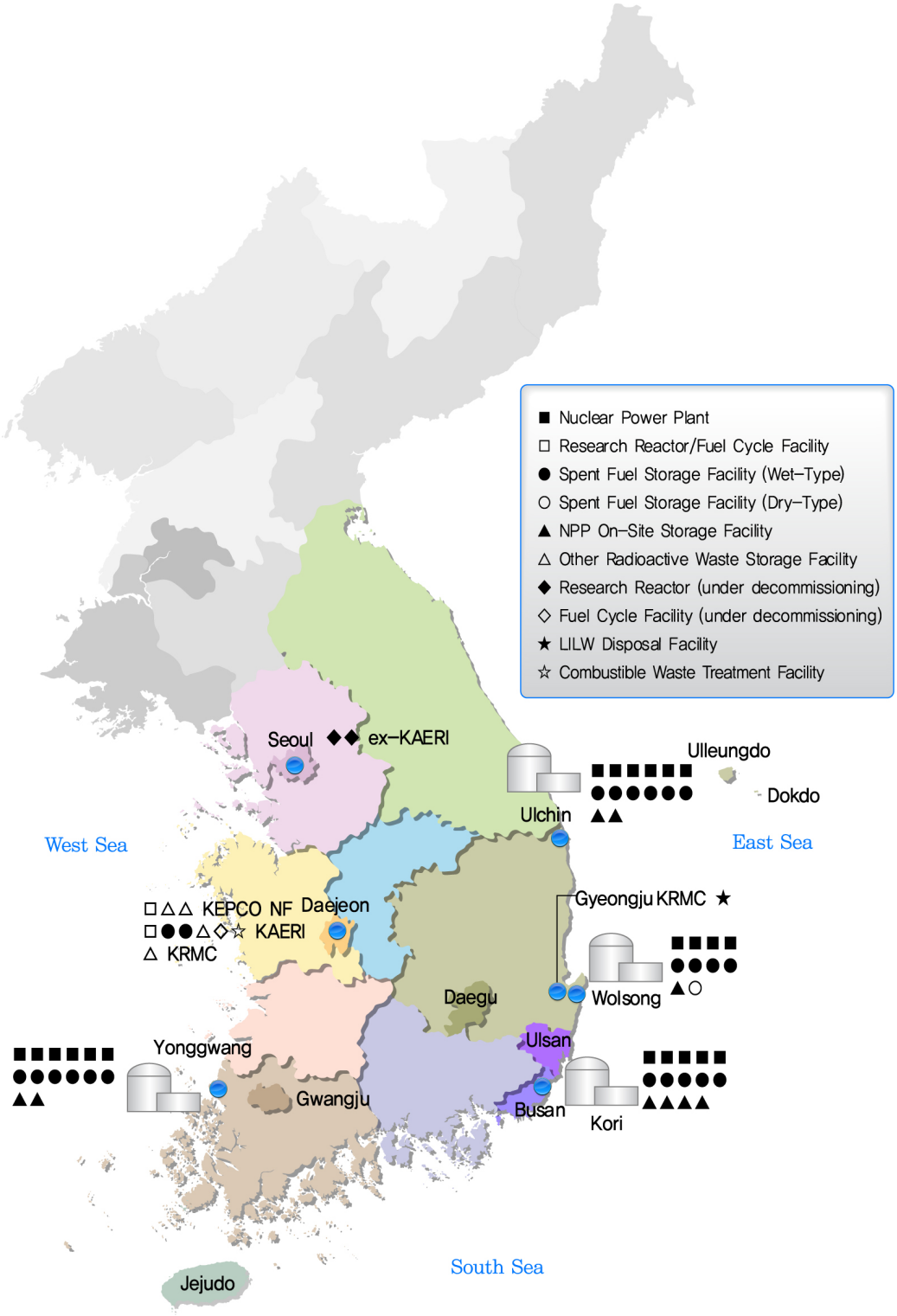


Figure A.1-1. Locations and operational status of major radioactive waste generation sources and management facilities (as of February 28, 2011)

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

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

**ARTICLE 32. REPORTING**

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:

- spent fuel management policy;
- spent fuel management practices;
- radioactive waste management policy;
- radioactive waste management practices;
- criteria used to define and categorize radioactive waste.

## B.1 National policies and principles

### B.1.1 National policies

The 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 disposal facilities shall be managed transparently, and the government shall explain to the public about its will for securing safety during the site selection process. The summary of the national policy statements includes the following;

1) **Direct control by the government**

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

**2) Top priority under safety**

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

**3) Minimization of radioactive waste generation**

- Radioactive waste generation shall be minimized.

**4) "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.

**5) Transparency of the 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 (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.

1) 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 disposal facilities or rock cavern disposal facilities. The construction and operation of one or two radioactive waste disposal facilities shall be accomplished by 2008.
2) 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 the relevant 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 the 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 storage, treatment, and disposal activities for radioactive wastes that are above the clearance level from the generators of radioactive waste. The KRMC was established on January 1, 2009 in accordance with the RWMA (established on March 28, 2008) for the safe and efficient management of radioactive waste.

### Regulations, codes of practice, and standards

The MEST together with the Korea Institute of Nuclear Safety (KINS) develops the regulations and codes of practice needed for the safe management of spent fuel and radioactive waste. Domestic regulations and codes shall be consistent with international norms including the relevant Safety Fundamentals, Safety Principles, and Safety Guides provided by the International Atomic Energy Agency (IAEA).

### Interim storage for spent fuel

Spent fuel generated from NPPs has been stored within each plant by expanding the storage capacity. Considering 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 through public consultation among stakeholders. The government is conducting a study titled “Expert Service for Preparing Alternatives for the Management of Spent Fuel” (see chapter G.7).

### LILW disposal facility

In order to implement the fundamental principles approved at the 253rd meeting of the

AEC(December, 2004), the Korean government decided on the construction of a disposal facility that could dispose of 100,000 drums (hereafter, “drums” means “200 liter-drum equivalents” unless specified otherwise) for the first stage and would ultimately reach a total of 800,000 drums after gradual expansion. As for the first stage disposal method, the adoption of a rock cavern disposal facilities scheduled to be completed by the end of 2012 was decided.

### Radioactive waste management expenses

Radioactive waste generators shall pay for radioactive waste management expenses when delivering radioactive waste to the radioactive waste disposal facility operator in compliance with the “Polluter Pays” principle.

## 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 interim storage in accordance with the conclusions of the 249th and 253rd meetings of the AEC. For PWRs, high-density storage racks are under construction in each plant in order to expand storage capacity. Since the storage capacity of the spent fuel pools at Kori Units 1 and 2 has been reached, the spent fuel generated from both units has been transferred to the storage pools at neighboring Kori Units 3 and 4. For PHWRs at the Wolsong site, an on-site dry storage facility has been operating. One hundred of those canisters were additionally constructed in November 2006 for a total capacity of 162,000 bundles within 300 concrete canisters to resolve the problem of capacity shortage of the pre-existing spent fuel pools of Wolsong Units 1, 2, 3 and 4. Additionally, 7 modules of MACSTOR-400 (Modular Air-Cooled STORage 400) with total capacity of 168,000 bundles were constructed in February 2010 and are currently operated.

### B.2.2 Research facilities

#### 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

The 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 the HANARO operation and test fuels which have been irradiated at HANARO and have taken post-irradiation examinations.

#### Post-irradiation examination facility

The post-irradiation examination facility (PIEF) is equipped with a water pool 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 PIEF. 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. 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 discharged into the environment as well through high-efficiency particulate filter and charcoal filter under continuous monitoring into the environment. The gaseous effluent being released into the atmosphere at the restricted area boundary shall satisfy the maximum radioactivity concentration, Effluent Control Limit (ECL) specified addressed by the Notice of the MEST addresses. 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 the reactor coolant and related systems containing radioactivity. In general, liquid radioactive waste is treated with evaporators, demineralizers, filters, and/or reverse osmosis equipment. The effluent is released to the sea after monitoring. The Notice of the MEST prescribes the ECL for the liquid effluent being discharged into the environment at the restricted area boundary. 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.

### Solid radioactive waste management

Most solid radioactive wastes consist of dry active waste (DAW) and secondary process waste. DAW is generated during the 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. DAW is compressed by a conventional compactor (capacity: 30 ton) into drums. For Ulchin Units 5 and 6, vitrifiable miscellaneous solid wastes are vitrified using a "LILW vitrification facility." The use of a vitrification facility reduces the waste volume by approximately 90%. Waste condensate and spent resin had been solidified mainly with cement during a fixed period of time in the past (~ 1995); afterward, however, the waste condensates generated from the reactors for power generation were completely dried in a drying facility and stabilized with paraffin. Nonetheless, paraffin stabilization will be discontinued in the future considering permanent disposal stability. In the future, waste condensates will be disposed of in a manner that can enhance permanent disposal stability. Spent resin is kept in a highly 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

### Gaseous radioactive waste management

In each facility, a ventilation system is equipped with filters to treat off-gas prior to its release into the atmosphere. The stacks of each facility, as 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 wastes are evaporated using the evaporator in the facility. The resulting condensate is processed in a solar evaporation, and the residue is bituminized. No liquid waste is discharged into the environment.

### Solid radioactive waste management

The solid radioactive waste, generated from each facility of the 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 whose radiation dose rate is below the internal guidelines is packed in 200-liter steel drums through waste compaction, and kept in the

storage facility. Combustible waste generated in the decommissioning process of research reactors 1, 2 and the uranium conversion facility (UCF) will be incinerated.

### 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 to the outside environment through the stack. As usual, gaseous radioactive waste is properly controlled so that the resulting off-site exposure dose does not exceed the regulatory limits through the blockage of release if the preset limits are exceeded, under the continuous monitoring of radioactivity within the gaseous effluent.

#### Liquid radioactive waste management

Liquid waste is separated into two kinds of waste, PWR type waste from the PWR fuel fabrication facility and 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. Treated liquid waste falling below the release limits may be subjected to batch-wise discharge. Data such as discharge volume, and release amounts of radioactivity are recorded and maintained.

#### Solid radioactive waste management

Most solid wastes from the fuel fabrication facility consist 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, which are then stored in the waste storage facility after measuring the radioactivity, weight, surface contamination level, and radiation dose rate for each package.

### B.3.4 RI waste management facility

RI is 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 the wastes generated by RI, Etc. users, open source waste is collected and delivered to the KRMC by the Korea Radioisotope Association (KRIA), whereas the disused sealed source waste is delivered to KRMC directly by RI users or through a consignment agency. The KRMC 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 compressible wastes are compacted. Combustible waste that conforms to the requirement of the regulatory limit is handled within the site. For safe and efficient storage, some disused sealed sources are stored in a special container after separating the source part from the source canister.

## B.3.5 LILW disposal facility

### Radioactive waste for disposal

The LILW disposal facility that is currently under construction will dispose of the LILW generated from power generation facilities and research facilities, nuclear fuel processing facilities and facilities using RI.

### Disposal capacity

The total capacity of the LILW disposal facility is 800,000 drums; 100,000 drums will be disposed of through the rock cavern disposal facilities in the first phase.

### Disposal method

LILW will be disposed of separately in 6 silos depending on the size and characteristics of the waste in order to maintain disposal container integrity and minimize the empty gap between packaging containers.

For loading efficiency, 16-Pack (4×4) disposal containers for 200-liter drums and 9-Pack (3×3) disposal containers for 320-liter drums are used. The waste drums are placed inside the disposal containers, which are handled with remote equipment such as a crane.

## 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 as the object of disposal, including spent fuel. The Enforcement Decree of the AEA defines high-level radioactive waste (HLW) as radioactive waste whose radioactivity concentration and heat generation exceed the limit value specified by the MEST. Strictly speaking, materials other 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. 2009-37 (Radiation.001, Standards for Radiation Protection, Etc.) as follows and HLW is radioactive waste to accord simultaneously with below conditions:

- radioactivity : $\geq$ 4,000 Bq/g for α-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, with 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 the annual individual dose shall be below 0.01 mSv/y and the total collective dose shall be 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)

# 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, research reactor facilities, nuclear fuel cycle facility, and RI users are covered in the National Report.

The definition and classification of radioactive waste are 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 purposes of the Joint Convention. But the RI wastes transferred to the RI management facility from military use are incorporated in the inventory of the National Report.

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

# 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, characteristics, and inventory of spent fuel storage facilities at each plant.

As of the end of December 2010, spent fuel inventories for PWRs and PHWRs are 5,174.5 MTU and 6,195.9 MTU (3,285.4 MTU under dry storage and 2,910.5 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 31, 2010)

| NPP Site | Type of Storage | Inventory (MTU) | Initial Enrichment (w/o of $^{235}U$) | Fuel Type |
|---|---|---|---|---|
| Kori | wet | 1,825.0 | 4.1 ~ 4.5 | PWR |
| Yonggwang | wet | 1,812.5 | 4.5 | PWR |
| Ulchin | wet | 1,537.0 | 4.5 | PWR |
| Wolsong | wet | 2,910.5 | natural uranium | PHWR |
| | dry | 3,285.4 | | |

## D.1.2 Research facilities

### HANARO research reactor

HANARO is a multi-purpose research reactor designed for fuel performance testing, material irradiation testing, RI production, and basic science and applications study. It is currently in use for various research and development activities.

HANARO's spent fuel storage pool is a heavy concrete structure with interior lining of stainless steel plate. The vault contains three storage lattices and has the capacity to store new fuel temporarily including spent fuel generated during normal operation for 20 years. Annex A-2 provides the details of HANARO's spent fuel storage pool. Table D.1-2 shows the inventory of spent fuel generated from HANARO.

## Post-irradiation examination facility

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

PIEF consists of three pools, four concrete hot cells, two lead hot cells, and supporting installations. Annex A-2 shows the spent fuel storage pool at PIEF.

As of the end of December 2010, spent fuels from NPPs are stored in the PIEF in the form of assemblies, spent fuel rods, and specimens to carry out post-irradiation examinations. Table D.1-2 shows the amounts of fissile materials remaining within fuel elements.

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

(as of December 31, 2010)

| Facility | Stock (MTU) |
|---|---|
| HANARO | 0.7 |
| PIEF | 3.3 |

# D.2 Radioactive waste management

## D.2.1 Nuclear power plants

Nuclear power plants that are currently in operation are equipped 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 consists of gas decay tanks and/or charcoal delay beds. The liquid waste treatment system is equipped with a liquid waste evaporator, ion exchanger or reverse osmosis equipment. 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 on-site facilities are listed in Annexes B-1 and B-2.

The 87,176 drums of radioactive waste generated from NPPs are stored at the on-site storage facilities. Table D.2-1 shows the inventory status of radioactive waste stored at the on-site storage facilities as of the end of December 2010.

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

(as of December 31, 2010)

| NPP site | Inventory [200L drum] | Major Radionuclide | Total activity Estimated [TBq] |
|---|---|---|---|
| Kori | 40,670 | $^{60}$Co, $^{137}$Cs, Etc. | 5.2E+2 |
| Wolsong | 9,802 | $^{60}$Co, $^{137}$Cs, Etc. | 1.0E+2 |
| Yonggwang | 21,125 | $^{60}$Co, $^{137}$Cs, Etc. | 8.5E+4 |
| Ulchin | 15,579 | $^{60}$Co, $^{137}$Cs, Etc. | 4.2E+2 |
| Total | 87,176 | - | 8.6E+4 |

## D.2.2 Research facilities

The KAERI operates a radioactive waste treatment facility as well as storage facilities for the safe management of liquid and solid radioactive waste generated from research facilities. Annexes B-3 and B-4 show KAERI's radioactive waste storage facilities and treatment facility, respectively.

All the liquid radioactive wastes generated from the KAERI are treated with an evaporation process. The resulting concentrate is solidified by a bituminization process, whereas the condensate is treated by a solar evaporation process. Solid waste is treated for volume reduction with a compactor and stored on-site.

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

Table D.2-2 shows the inventory of radioactive waste in storage with the major radionuclides as of the end of December 2010.

Beginning 2011, the KAERI will operate a combustible waste treatment facility to reduce the volume of combustible wastes generated the UCF decommissioning process. Annex B-5 lists the location and capacity of this facility.

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

(as of December 31, 2010)

| Facility | Inventory [200L drum] | Major Radionuclides | Total Activity Estimated [TBq] |
|---|---|---|---|
| Radioactive waste storage facilities | 12,182 | $^{54}$Mn, $^{60}$Co, $^{238}$U, $^{137}$Cs, $^{131}$I, Etc. | 1.3E+0 |

## D.2.3 Nuclear fuel fabrication facility

Two nuclear fuel fabrication plants are operated by the KEPCO NF. 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 plants are almost the same and details of the storage facility are listed in Annex B-6. 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-7.

As of the end of December 2010, the amount of waste generated from the nuclear fuel fabrication facility is up to 6,046 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 KEPCO NF facilities

(as of December 31, 2010)

| Facility | Inventory [200L drum] | Major Radionuclide | Total Activity Estimated [TBq] |
|---|---|---|---|
| Radwaste storage facilities | 6,046 | $^{234}U$, $^{235}U$, $^{238}U$ | 3.2E-1 |

## D.2.4 RI waste management facility

The RI waste generated from domestic RI users is collected and stored at the RI waste management facility operated by the KRMC. There are 3,488 drums of RI wastes in the facility with safety as of the end of December 2010. Annex B-8 lists the location and main characteristics of the RI waste management facility.

Table D.2-4 shows the inventory of RI waste stored in the RI waste management facility, as of December 31, 2010.

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

(as of December 31, 2010)

| Facility | Inventory [200L drum] | Major Radionuclide | Total Activity Estimated [TBq] |
|---|---|---|---|
| RI waste storage facility | 3,234 (unsealed source sources) | $^{125}I$, $^{99m}Tc$, Etc. | 2.9E+2 |
| | 254 (disused sealed sources) | $^{60}Co$, $^{137}Cs$, $^{241}Am$, Etc. | |

## D.2.5 LILW disposal facility

For the safe management of LILW, the first stage of the LILW disposal facility in

Gyeongju is scheduled to be constructed by the end of December 2012. First of all, the radwaste receipt/storage building in the site of the disposal facilities is in operation to receive the radioactive waste from NPP's which are required to secure additional storage capacity. Annex Table B-9 lists the location and major characteristics of the radwaste receipt/ storage building.

As of the end of December 2010, the radwaste receipt/storage building is storing and managing 2,000 drums of LILW from NPPs. Table D.2-5 shows the inventory, major radionuclide and total activity.

Table D.2-5. Inventory of the LILW disposal facility

(as of December 31, 2010)

| Facility Name | Inventory [200L drum] | Major Radionuclide | Total Activity Estimated [TBq] |
|---|---|---|---|
| LILW disposal facility (Radwaste receipt / storage building) | 2,000 | $^{60}$Co, $^{137}$Cs, Etc. | 1.7E+1 |

## D.2.6 Others

Taekwang Industrial Co., Ltd. in Ulsan generated radiologically contaminated byproducts 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, 2010.

Taegutec Co. in Daegu generated radiologically contaminated byproducts in the process of producing wire. Since the closure of their production facilities in 2004, contaminated byproducts 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, 2010.

# 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 and 4 $m^3$ containers, and stored in the reactor hall of KRR-2. As of December 2010, the inventory of radioactive waste generated from the KRR-1 and 2 decommissioning site is given in Table D.3-1. The major radionuclides in radioactive waste are $^{60}Co$, $^{137}Cs$, and $^{152}Eu$.

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

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

(as of December 31, 2010)

| Facility | Inventory [200L drum] | Major Radionuclide | Total Activity Estimated [TBq] |
|---|---|---|---|
| Temporary storage building | 1,460 | $^{60}Co$, $^{137}Cs$, $^{152}Eu$, Etc. | 6.9E-1 |

## D.3.2 Uranium conversion facility

Radioactive waste from the UCF decommissioned is stored in a temporary storage building in the conversion facility. The inventory of radioactive waste generated from the UCF decommissioning site as of the end of 2010 is presented in Table D.3-2. All wastes are contaminated only with natural uranium.

Annex C, also includes the estimated waste from the decommissioned UCF.

Table D.3-2. Inventory of radioactive waste stored at the UCF decommissioning site

(as of December 31, 2010)

| Facility | Inventory [200L drum] | Major Radionuclide | Total Activity Estimated [TBq] |
|---|---|---|---|
| Temporary storage building | 4,813 | Natural uranium | 4.9E-5 |

## D.4 Record keeping and reporting

The nuclear licensee has been maintaining the relevant records on radioactive waste using their own record-keeping system. In accordance with the reporting provisions of the AEA, the licensee has reported to KINS 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. 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. Legislative and Regulatory Framework

## E.1 Implementing measures (Article 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 (Article 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 of nuclear regulation

### E.2.1.1 Nuclear regulation related laws

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

Laws concerning nuclear regulation (Figure E.2-1) consist of 4 levels: the AEA and its Enforcement Decree and Enforcement Regulations (including regulations concerning the technical standards of nuclear power utilization facilitiy[1)], Etc., and regulations concerning the technical standards of radiation safety management), and Notices of the MEST. The AEA provides for basic and fundamental matters concerning safety regulation as shown in Table E.2-2.

1) "Nuclear Power Utilization Facility" means the facility falling under any of the following subparagraphs:
   1. Nuclear reactor and related facility
   2. Nuclear fuel cycle facility
   3. Nuclear material use facility
   4. Production facility, use facility, distribution facility, storage facility, conservation facility, treatment facility and discharge facility of radioisotope
   5. Radiation generating device and subsidiary facility thereof
   6. Interim storage facility of spent nuclear fuel
   7. Permanent disposal facility of radioactive waste
   8. Treatment and storage facility of radioactive waste.

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 | - |
| Radioactive Waste Management Act | Provides procedures related to radioactive waste management | MKE | Refers to the AEA for the safety regulations of radioactive waste management facilities |
| Electricity Business Act | Provides the basic system of electricity business | MKE | Specifies the basic system of the Electricity Business Act including nuclear power plants |
| Electric Source Development Promotion Act | Provides special cases relevant to the development of electric sources | MKE | Prior designation notice of nuclear site |
| Basic Act 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 Act 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 | MOEL | 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 | MOEL | 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 |

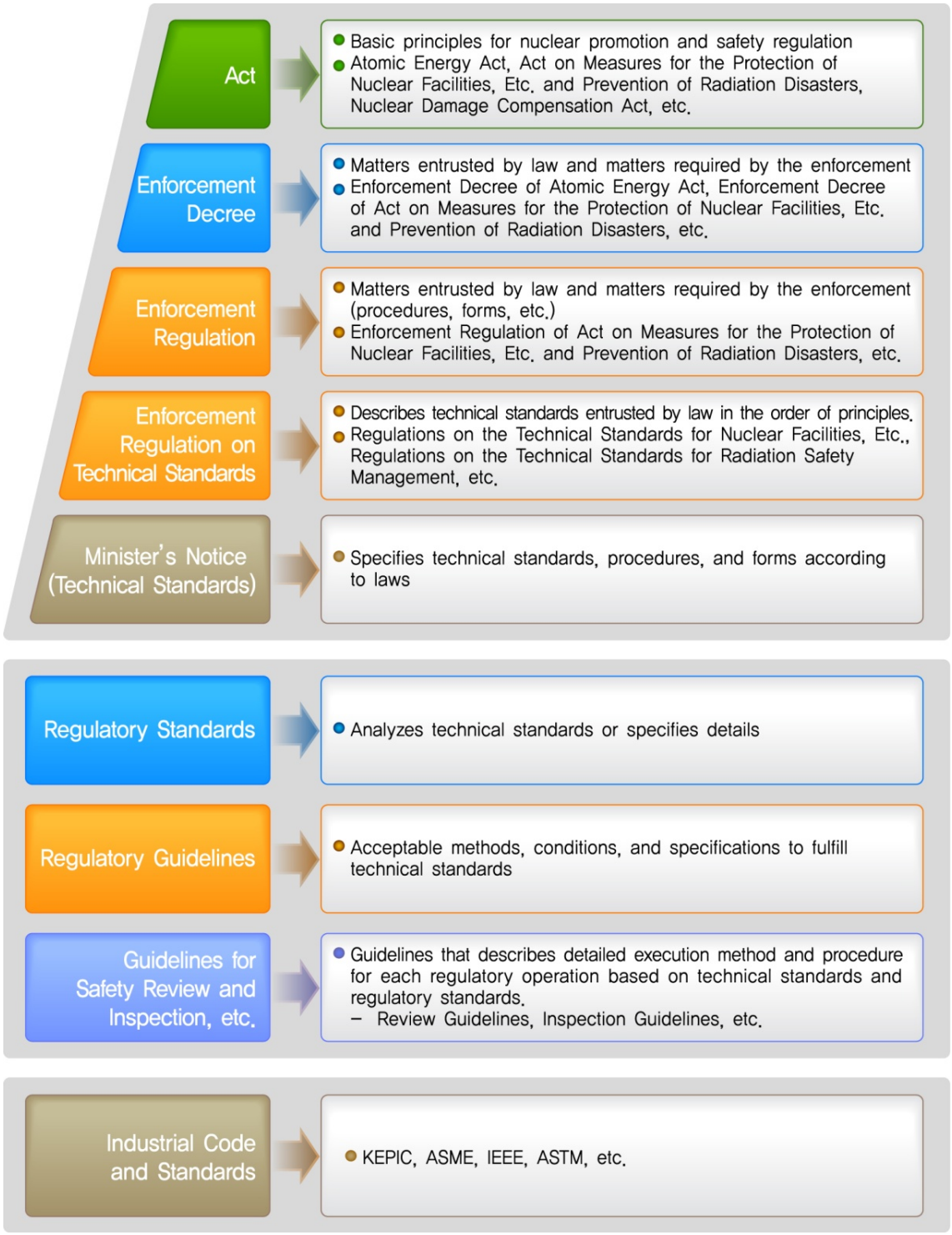


Figure E.2-1. Legal hierarchy of the Atomic Energy Act

Table E.2-2. Contents of Atomic Energy Act

| Division | | Major Contents |
|---|---|---|
| Chapter 1 | General provisions | The purpose of the AEA and definition of terminology used in AEA |
| | Article 2 (definitions) | Definition of radioactive waste |
| Chapter 2 | Atomic energy commission and nuclear safety commission | Atomic Energy Commission and Nuclear Safety Commission related matters |
| | Article 4 (functions of commission) | Specifies 'matters concerned with the basic radioactive waste management plan' in the review and resolution of the Atomic Energy Commission |
| | Article 5.2 (functions of safety commission) | Specifies 'matters concerned with the safe management of radioactive waste' in the review and resolution of the Nuclear Safety Commission |
| Chapter 3 | Establishment and enforcement of the overall nuclear energy promotion program, research and development, Etc. of nuclear energy | Establishment and enforcement of the comprehensive promotion plan for nuclear energy, nuclear energy research and development institution, burden of cost for nuclear energy research and development work |
| Chapter 3.2 | Nuclear energy research and development fund | Establishment, management, and operation of fund, Etc. |
| Chapter 4 | Construction and operation of nuclear power reactors and related facilities | Criteria of permit for the construction and operation of nuclear reactor facilities and research reactor facilities, permission procedure, documents to submit, inspection, Etc. |
| Section 1 | Construction of nuclear power reactors and related facilities | |
| Section 2 | Operation of nuclear power reactors and related facilities | |
| Section.3 | Construction and operation of nuclear research reactors, Etc | |
| | Article 31 (decommissioning of nuclear power reactors and related facilities) | Specifies the inclusion of 'radioactive waste treatment and disposal method' in the nuclear power reactor and related facilities decommissioning plan |
| Chapter 5 | Deleted | |
| Chapter 6 | Nuclear fuel cycle enterprise and use, Etc. of nuclear materials | Permission procedure, permission criteria, inspection procedure and method concerning nuclear fuel cycle enterprise and use of nuclear material |
| Section 1 | Nuclear fuel cycle enterprise | |
| Section 2 | Use of nuclear materials | |
| | Article 55 (decommissioning of nuclear fuel cycle facilities) | Specifies that the 'radioactive waste treatment and disposal method' must be included in the nuclear fuel cycle facility decommissioning plan |
| Chapter 7 | Radioactive isotopes and radiation generating devices | Permission procedure and standard, inspection procedure and method |
| Chapter 7.2 | Deleted | |
| Chapter 8 | Disposal and transport | Permit for construction and operation and inspection of disposal facilities, Etc. |
| | Article 76 (permit for construction and operation of disposal facilities, Etc.) | Specifies the matters related to the construction and operation permit of those who wish to construct and operate radioactive waste storage, treatment, and disposal facility and annexed facilities and the permit application |
| | Article 84 (restrictions on disposal of radioactive waste) | Specifies the prohibition of sea dumping of radioactive waste and legitimate disposal |
| Chapter 9 | Personnel dosimetry service | Registration and inspection of reader |
| Chapter 10 | License and examination | License examination, issue of license, Etc. |
| Chapter 11 | Regulation and supervision | Set up of a restricted area and radiation hazard protection measures, Etc. |
| Chapter 12 | Supplementary provisions | Permission and designation requirements, approval of report on specific technologies, protection of workers, Etc. |
| | Article 104.5 (gathering residents' opinion) | Specifies that those who wish to obtain a construction and operation permit for a radioactive waste disposal facility or spent fuel storage facility must collect residents' opinions |
| | Article 104.6(preservation of environment) | Specifies that the constructor and operator of radioactive waste disposal facilities must conduct an environmental radiation survey and a radiological environmental impact assessment |
| Chapter 13 | Penal provisions | Penal provisions, fine for negligence, and joint penal provisions |
| Addendum | | Enforcement date, transitional measures, and relationship with other laws |

It includes provisions on the AEC, the Nuclear Safety Commission (NSC), permit for the construction and operation of radioactive waste storage, processing and disposal facilities, and accessory facilities (disposal facilities). The Enforcement Decree of the AEA (the Presidential Decree) stipulates the particulars designated 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 Enforcement Regulation of the MEST) stipulates the particulars including detailed procedures, 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. Finally, the Notices of the MEST prescribe the regulatory requirements, technical standards and guidelines, as designated by the same Act, same Decree and same Regulation.

However, the government specified the details of safety management in relation to the research, development, production and utilization of nuclear energy and established the Nuclear Safety Act on July 25, 2011 in order to prevent radiation hazards and enhance public safety This Act will be put into effect on October 26, 2011. Following the establishment and enforcement of the Nuclear Safety Act, nuclear laws will be divided into the Nuclear Energy Act which describes basic laws concerning nuclear energy promotion and the Nuclear Safety Act which describes the basic laws concerning nuclear regulations.

The Nuclear Safety Act is composed of 11 chapters including the general rules, the establishment and enforcement of the comprehensive plan for nuclear safety and the construction and operation of reactors and related facilities as in Table: E.2-3 and describes basic matters concerning nuclear safety regulations. In particular, the comprehensive plan for nuclear safety specified in the nuclear safety act presents the nuclear safety vision, 5 policy goals and 18 priority projects. As the first comprehensive nuclear safety plan was established in March 2010 that covers 2010 ~ 2014, the government now has a complete safety regulation system in place that includes the nuclear safety charter, nuclear safety policy statement and the comprehensive plan for nuclear safety.

Table E.2-3. Contents of Nuclear Safety Act (to be enforced October 26, 2011)

| Division | | Major Contents |
|---|---|---|
| Chapter 1 | General | Purpose of Nuclear Safety Act and Definitions of Terms |
| | Article 2 (definition) | Definition of radioactive waste |
| Chapter 2 | Establishment and implementation of comprehensive plan for nuclear safety | Establishment and enforcement of Comprehensive Plan for Nuclear Safety and the promotion of Nuclear Safety Research and Development Project, Etc. |
| Chapter 3 | Construction and operation of nuclear power reactor and related facilities | Describes overall matters related with the construction and operation of nuclear power reactors and related facilities |
| Section 1 | Construction of nuclear power reactor and related facilities | |
| Section 2 | Operation of nuclear power reactor and related facilities | |
| | Article 28 (decommissioning of nuclear power reactor and related facilities) | Specifies that the radioactive waste treatment and disposal method must be included in the decommissioning plan |
| Section 3 | Construction and operation of research reactors | Describes overall matters related to the construction and operation of research reactors |
| Chapter 4 | Nuclear fuel cycle enterprise and use of nuclear material, Etc. | Permission procedure and criteria for nuclear fuel cycle enterprise |
| Section 1 | Nuclear fuel cycle enterprise | |
| | Article 42 (decommissioning of nuclear fuel cycle facility) | Specifies that the radioactive waste treatment and disposal method must be included in the decommissioning plan |
| Section 2 | Use of nuclear material | Permission procedure and criteria for the use of nuclear material |
| Chapter 5 | Radioactive isotope and radiation generating devices | Permission procedure and standard, inspection procedure and method |
| | Article 54 (registration of agency) | Specifies that those who wish to collect, treat, and transport radioactive isotopes, Etc. and radioactive waste must register with the Commission |
| Chapter 6 | Disposal and transport | Construction and operation permit and inspection of disposal facilities, Etc. |
| | Article 63 (permit for construction and operation of disposal facilities, Etc.) | Specifies that those who wish to construct and operate a radioactive waste disposal facility, Etc. must obtain the permission from the Commission |
| | Article 70 (restrictions on disposal of radioactive wastes) | Prohibition of sea dumping of radioactive waste |
| Chapter 7 | Personnel dosimetry service | Registration and inspection of reader |
| Chapter 8 | License and examination | License examination, issue of license, Etc. |
| Chapter 9 | Regulation and supervision | Set up of a restricted area and radiation hazard protection measures, Etc. |
| Chapter 10 | Supplementary provisions | Permission and designation requirements, approval of report on specific technologies, protection of workers, Etc. |
| | Article 103 (gathering residents' opinion) | Specifies that those who wish to obtain a construction and operation permit for a radioactive waste disposal facility or spent fuel storage facility must collect residents' opinions |
| | Article 104 (preservation of environment) | Specifies that the constructor and operator of a radioactive waste disposal facility must conduct an environmental radiation survey and a radiological environmental impact assessment |
| Chapter 11 | Penal provisions | Penal provisions, fine for negligence, and joint penal provisions |
| Addendum | | Enforcement date, interim measures, relationship with other laws |

## Atomic Energy Act (AEA)

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

- provisions on the permit for the construction/operation of disposal facilities,
- provisions on safety inspections related to installation and operation of

radioactive waste management facilities,

- provisions on restrictions regarding the disposal practices of radioactive wastes including prohibition of dumping into the sea,
- provisions on the safe transport and package of radioactive materials, Etc.

## Enforcement Decree of the AEA

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:

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

## Enforcement Regulations

The Enforcement Regulations 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 the detailed procedures and methods necessary for implementing the AEA and its Enforcement Decree, and the detailed technical standards thereof.

- detailed provisions on the detailed procedures and methods necessary for implementing the AEA and its Enforcement Decree, and on the particulars regarding the control and management of radioactive wastes, packaging and transport 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 the particulars regarding facilities, equipment and performance of near surface disposal, geological disposal, spent fuel management facilities Etc. (technical standards for radiation),
- provisions on performance standards for disposal facilities, for example, radiation monitoring, drainage, fire protection, and emergency power systems (technical standards for radiation)

### Notices of the MEST

The Notices of the MEST present the detailed technical standards for radioactive waste management specified in the AEA and its Enforcement Decree, and the Enforcement Regulations. Table E.2-2 lists the Notices of the MEST applicable to the safety management of radioactive waste.
Among them, the principal notices related to radioactive waste management are listed as follows:

- Siting Criteria for the LILW Disposal Facility,
- Acceptance Criteria for LILW,
- Radiological Protection Criteria for Long-term Safety of LILW Disposal,
- Regulation on the Clearance Level of Radioactive Waste, Etc.

### E.2.1.2 Radioactive Waste Management Act (RWMA)

The government established the RWMA which integrates and systematically organizes matters concerned with the management of radioactive waste and announced the Act on March 28, 2008. The foundation of the RWMA provided the basis for the management of LILW, the establishment of the KRMC and the establishment of the radioactive waste management fund. This Act was came into effect on January 1, 2009 and it consists of four stages the RWMA and its Enforcement Decree and Enforcement Regulations and Notices of the MKE as in Figure; E.2-2. The RWMA amended in December 2009 provided the basis for the procedures to gather a wide range of opinions concerning matters to anticipate social conflict such as the management of spent fuel to aid in the process of establishing the master plan for radioactive waste management.

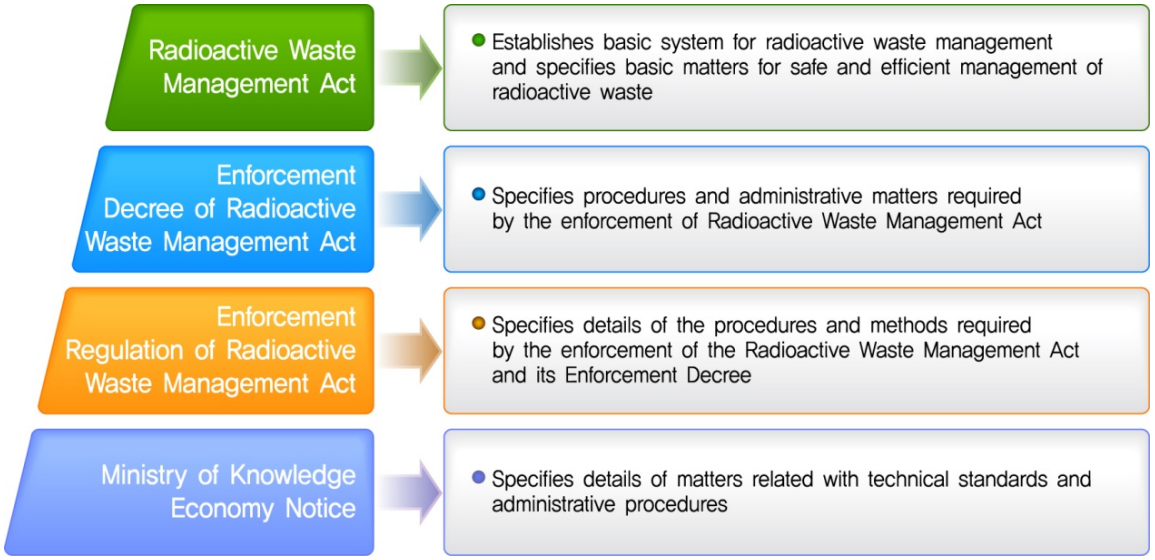


Figure E.2-2. Legal hierarchy of the Radioactive Waste Management Act (RWMA)

Public Notices issued by the Notices of the MKE stipulate matters authorized by the higher law and the standards and procedures required by the implementation and major radioactive waste related notices are listed in Annex G.

- Regulation on the calculation criteria for radioactive waste management expenses and spent fuel management provisions,
- Regulation on the management of the Radioactive Waste Management Fund,
- Regulation on the radioactive waste reception method.

#### E.2.1.3 Laws related to the protection of nuclear facilities, Etc. and prevention of radiation disasters

The Physical Protection and Radiological Emergency Act was enacted in May 2003 to strengthen the physical protection systems for nuclear material and nuclear facilities and the radiological disaster management system. This Act inherits the articles related to physical protection and radiological disaster prevention as previously specified in AEA as well as specifies various requirements for strengthening physical protection and radiological disaster prevention measures.

#### E.2.1.4 Laws related to nuclear damage compensation

For the civil liabilities of the business operator due to a nuclear accident, the Nuclear Damage Compensation Act (1969) and the Nuclear Damage Compensation Contract Act (1975) were enacted to prescribe the general principles for civil liabilities concerning internationally accepted nuclear damage in order to provide accurate information concerning the damage and promote the wholesome development of the nuclear business. The Nuclear Damage Compensation Act was revised in January 2001 to reflect on domestic laws the contents of the Vienna Convention revised in 1997. The revision of the Act concretized the concept of nuclear damage, set the limit of liability of the business operator to 300 million SDR[2] (Special Drawing Rights) and set the upper limit of the compensation amount also to 300 million SDR. Actual amounts of compensation are specified in the Enforcement Decree, and the amount of compensation of NPP is KRW 50 billion as of the end of 2010.

### E.2.2 Nuclear regulatory framework

In the government's nuclear safety regulation system, the MEST has absolute authority with regard to overall nuclear safety regulations. The government gave the MEST the authority in relation to nuclear safety regulations such as the establishment of a nuclear safety policy and licensing under the provision of nuclear safety related laws such as the AEA. Likewise, various sectors of the government are dealing with nuclear safety management related operations in fulfilling their own duties by forming an organic system with the MEST. For example, the Ministry of Environment has absolute authority with regard to the environment protection policy; it is also in charge of environmental protection and management concerning natural background radiation. The Ministry of Public Administration and Security (National Emergency Management), which implements national disaster prevention and management measures is in charge

[2] It is the Special Drawing Rights of the International Monetary Fund (IMF) and a type of international reserve currency exercised since 1970. It is considered as the 3rd currency following gold and the dollar. For it to satisfy the requirements of a standard international currency with recognized value, there were moves to use the SDR for international trade, yet the dollar is still used as the standard currency in the actual foreign exchange market.

of the safety of combustible materials in nuclear facilities. Figure E.2-3 shows the government sectors that are related with the safety management concerning nuclear facilities and activities.

The government separately operates the Office of Legislation which has absolute authority over government legislation in order to check whether safety regulations are overlapping or missing when laws related to the operations of these government sectors are established or amended. The regulation on legislative operation management (Presidential Decree) also stipulates that related sectors must consult with each other through overall legislative activities. Article 89 of the Constitutional Law of Korea prescribes that bills for the establishment or amendment of laws, confirmation of authorities between administrative branches and major policy adjustments must be reviewed by the Cabinet Meeting presided by the President to prevent the overlapping or omission from the source of safety regulation requirements.

For nuclear safety regulation requiring professional technologies, the government established and is operating the KINS which is a professional regulatory agency, under the provision of the AEA and Act on the establishment of the Korea Institute of Nuclear Safety in order to strengthen expertise in matters concerned with nuclear safety regulation. The KINS is engaged in regulatory services concerning nuclear safety entrusted by the Minister of the MEST which include areas such as safety reviews, inspections, training and R&D based on expert knowledge concerning nuclear safety regulations and accumulated experiences.

The government also established the NSC under the MEST to seek professional consultation for the decisions of the Minister in charge of nuclear safety regulation in areas such as reviewing and resolving pending issues and important matters concerning nuclear safety as well as reassessing the results of safety reviews and inspections that were entrusted to professional institutes. In other words, NSC is playing a very important role in securing the importance of nuclear safety as well as the transparency, independence, reliability and fairness of safety regulations.

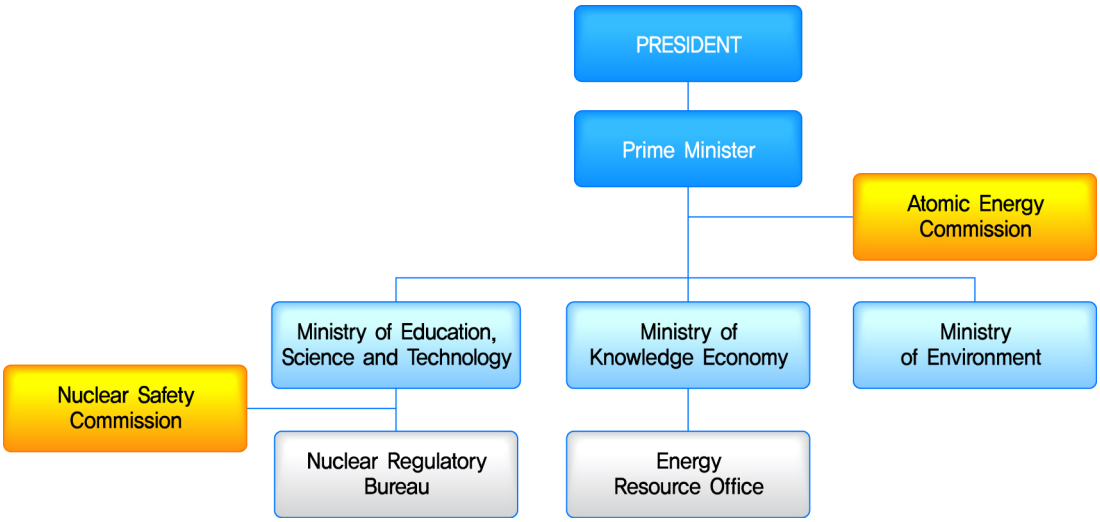


Figure E.2-3. Government organizations related to radioactive waste management

## E.2.3 Licensing system and safety evaluation

The licensing procedure of spent fuel management facilities and radioactive waste management facilities is done as a one-step process that combines the construction and operation permit, pursuant to the AEA as shown in Figure E.2-4.

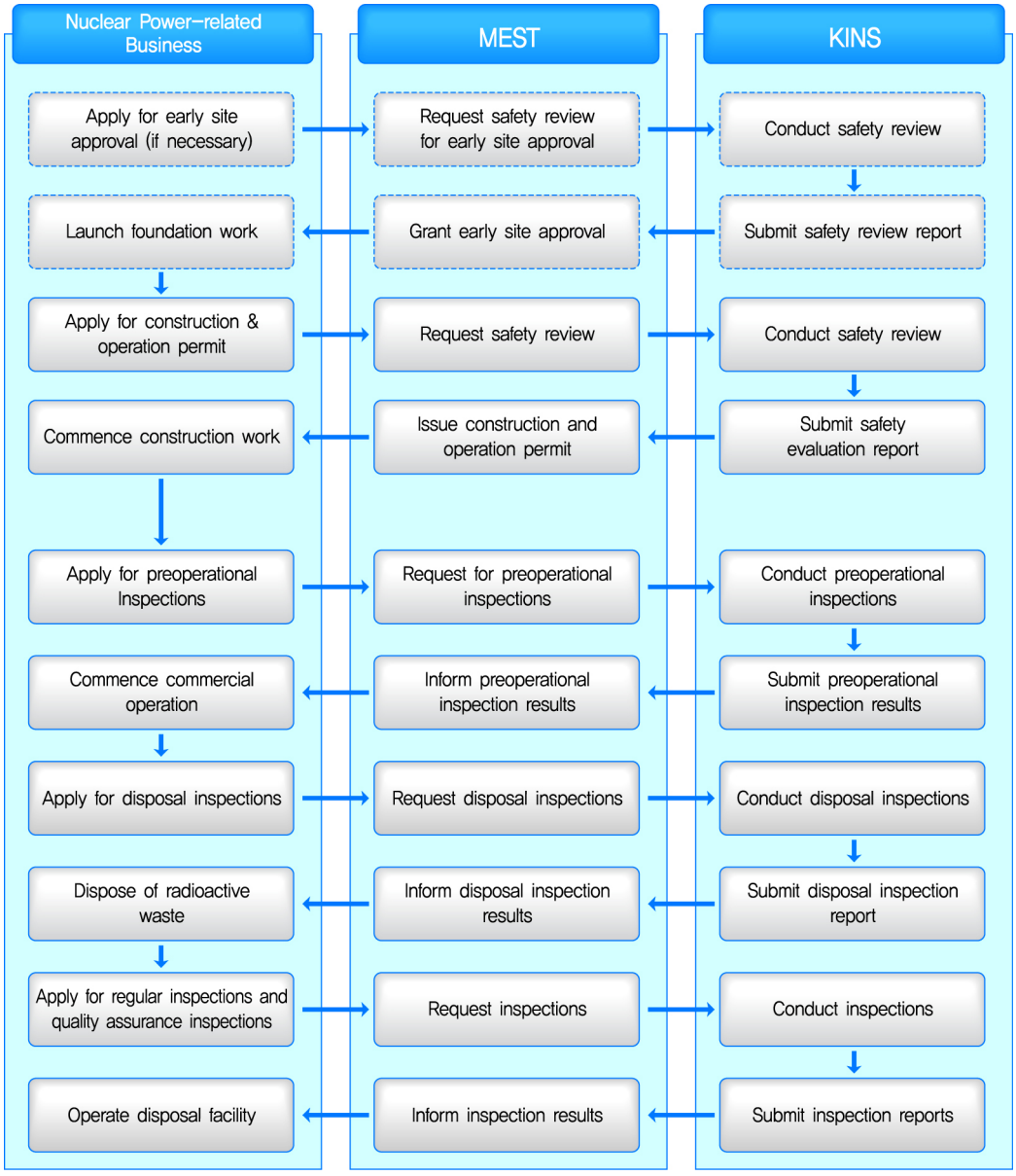


Figure E.2-4. Licensing procedures for radioactive waste management facilities

### 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 to the MEST an application for approval accompanied by a site survey report and a radiological environmental report. Based on the results of the safety review by the KINS regarding the application for early site approval, the Minister will grant official approval. The KINS conducts a review to evaluate the adequacy of a site for radioactive management facilities and radiological impacts on the environment adjacent to the site.

### Permit for the construction/operation of a radioactive waste management facility

In order to obtain a permit for the construction/operation of a radioactive waste management facility, the applicant shall submit an application for permit 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 regarding 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 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, implementation of regulatory criteria in due course, assessment of environmental effects resulting from the construction and operation of the facility, and proposal on 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 opinion of the residents of the area surrounding the site.

### Approval for amendment of construction operation permit

Any amendment of approved matters such as the amendment of design that can or is anticipated to affect the safety of radioactive waste management facilities during the operation or amendment of technical specifications for operations requires permit in advance from the MEST.

## 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.

### 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 to 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 to all related technical standards stipulated 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 to the conditions of the operation license and whether the facility can still withstand under normal and abnormal condition 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 each stage of the construction and operation of a radioactive waste management facility are being performed in conformity to 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 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 permit application meet the relevant requirements, the MEST will issue a permit. The Minister of the MEST may impose minimum conditions therein, if deemed necessary to secure safety. If any violation is found as a result of the 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 the necessary documents on its business and to supplement any and all submitted documents. The Minister may also conduct regulatory inspections to verify that the documents are in conformity to 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 the revocation of a license or suspension of business within one year, if the operator of a radioactive waste management facility falls under any 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 public interest, surcharges may be imposed in lieu of the suspension of 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 a result of regulatory inspections for the construction or operation of a radioactive waste management facility.
- 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 RWMA prescribe definitely where the responsibility lies for each stage of radioactive waste management.

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

With regard to LILW management, the MKE has the responsibility of formulating basic policies regarding radioactive waste management including the projection of radioactive waste generation and disposal facilities construction plan, including the responsibility to designate a radioactive waste management facility operator in accordance with the RWMA.

## E.2.7 Clearance

The clearance of 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 the necessary enforcement actions, where a violation of the regulatory requirements has taken place,
- to conclude agreements with other domestic government or non- government 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 documents and opinions from public or private organizations or persons as may be necessary and appropriate,
- to maintain contact with foreign regulatory bodies and relevant international organizations,
- to enter, at any time, the premises of any nuclear facility that is 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 each stage of 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 MEST/NRB

The government grants the MEST to take full responsibility for safety regulation administration for the utilization of nuclear facilities, Etc. according to Article 24 of the Government Organization Act (The Ministry of Education, Science and Technology) of Statute No. 10339.

The NRB is also established under the MEST in accordance with Article 4 (Substructure) and Article 19 (Nuclear Regulatory Bureau) of the Presidential Decree (The Ministry of Education, Science and Technology and the Organization of Substructure) to take exclusive charge of the regulatory operations during the entire life process of nuclear utilization facilities from site selection to design, construction, trial run, operation and decommissioning in order to effectively implement the responsibilities and functions of the MEST concerning nuclear safety regulation and licensing of nuclear utilization facilities.

The MEST entrusts professional technology fields of nuclear safety regulation such as safety reviews in relation to the licensing of nuclear utilization facilities, safety regulation inspections in relation to the production, construction and operation of nuclear utilization facilities and the R&D of nuclear utilization facility safety regulation related technical standards to the KINS in accordance with Article 111 (Delegation of Authority) of the AEA and Article 303 (Classification of Entrusted Institutions) of its Enforcement Decree. On the other hand, the MEST entrusts safety measures for nuclear related facilities and nuclear materials and physical protection to the Korea Institute of Nuclear Non-proliferation And Control (KINAC) in accordance with Article 9.6 (Affairs of Nonproliferation and Control Institute) of the AEA.

As presented in Figure E.3-1, the NRB is operating 5 departments such as the Nuclear Safety Division, the Nuclear Radiation Division, the Nuclear Control Division, the Integrated Regulatory Review Service (IRRS) Mission Team and the Nuclear Emergency Team to implement efficiently the responsibilities and functions of safety regulation under the provision of the MEST Enforcement Regulation (Enforcement Regulation on the MEST and its Subordinate Organizations). These teams constituting the NRB implement nuclear safety regulation such as nuclear facility licensing, review and evaluation, inspection and implementation, regulatory policy development, safety

regulation due to radiation utilization, radiation protection, radioactive waste safety management, and the establishment and management of radiological emergency measures.

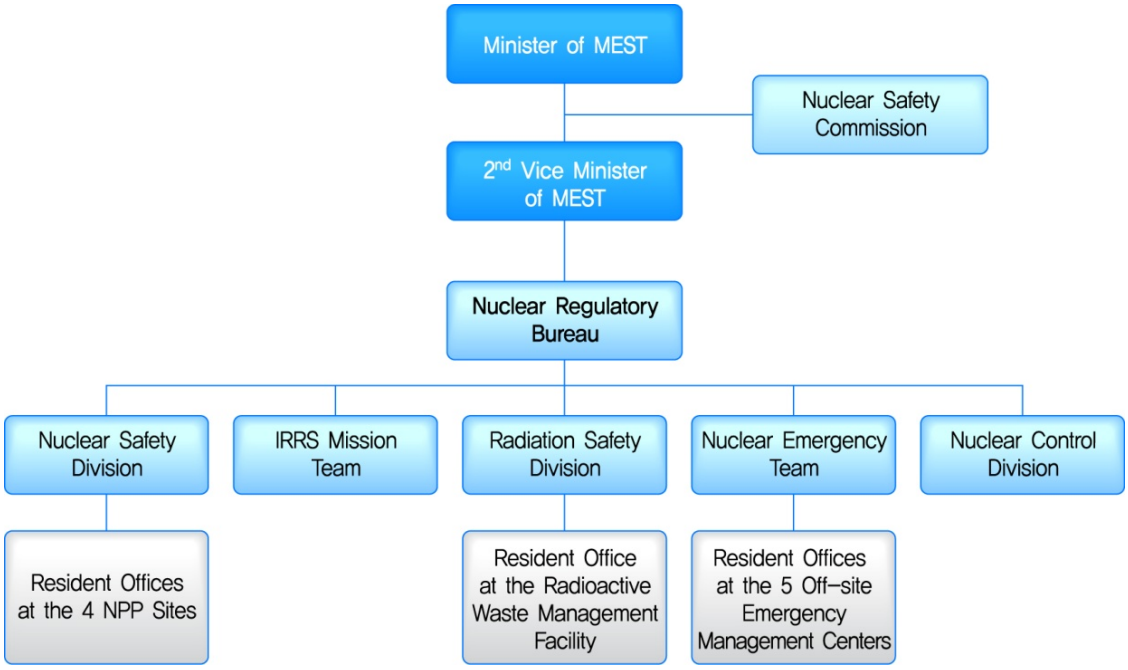


Figure E.3-1. Organization chart of the MEST (as of May 31, 2011)

Emergency Team manages the "Nuclear Power Plant Site Resident Office" which was established to conduct daily inspections in NPP sites under construction or in operation and support of regulatory operations such as the examination and report for abnormal NPP status and the "Radioactive Waste Management Facility Resident Office" which was established to provide on-site support for regulatory operations related to the construction and operation of radioactive waste management facilities, and the "Off-site Emergency Management Center Resident Office" asked with supporting the implementation of emergency measures of a site during a nuclear accident.

For close cooperation between the NRB and the KINS, one of the KINS employee is dispatched as the liaison officer to the Nuclear Safety Division and also to the Radiation Safety Division, and regulatory operations such as the on-site inspection and supervision of the resident offices established in the nuclear facility sites are jointly conducted by the NRB and the resident inspectors dispatched by the KINS.

The details of the duties of the divisions and teams under the NRB are as follows:

## Nuclear safety division

- establishment and control of the basic policies relevant to nuclear safety,
- integration, control and management of nuclear safety regulatory tasks,
- licensing and safety regulation of nuclear facilities,
- establishment and operation of monitoring systems for the safety operation of NPPs,
- approval of standard design of NPPs,
- review and approval of topical reports on specific technologies,
- tasks related to the Periodic Safety Review (PSR) of NPPs,
- establishment and operation of technical standards relevant to nuclear safety,
- research and development of various regulatory processes including inspections for the operation and safety control of nuclear power generation facilities,
- fostering and supporting the International Nuclear Safety School,
- supervision of NPP site resident officers, Etc.

## IRRS mission team

- preparations required before undergoing IAEA IRRS,
- preparing and conducting a review of inspection materials, undergoing inspections,
- following action of IRRS, Etc.

## Radiation safety team

- establishment and control of radioactive source safety management measures,
- establishment and control of preventive measures for radiation risks resulting from the utilization of nuclear power,
- licensing and safety regulations related to the production and utilization of nuclear materials, RIs and radiation generators,
- licensing and safety regulations related to the construction and operation of radioactive waste disposal facilities,
- safety regulations on the decommissioning of nuclear facilities,
- design approval and inspection of radiation devices and transportation vessels,
- establishment and application of technical standards for radiation safety,
- establishment and operation of monitoring systems for the safety operation of

and supervision of radioactive waste management facility resident officers, Etc.

### Nuclear emergency team

- supervision and control of off-site emergency management center resident officers,
- general management of radioactive disaster situations,
- including rapid instructions and situation control of radiation disasters, devising of proper countermeasures for the disasters, Etc.

### Nuclear control division

- establishment and implementation of the international nuclear non-proliferation program,
- legislation and enforcement of the national nuclear control system,
- establishment and implementation of policies on the safety measures of the IAEA, and cooperation on safety measures among countries,
- establishment and operation of the national nuclear control plan,
- tasks related to the Comprehensive Test Ban Treaty (CTBT),
- research and development to secure technical competency for addressing the safety measures of nuclear materials,
- training of experts and development of technology for operating the nuclear test detection and analysis equipment,
- collection and analysis of technical information relevant to nuclear materials, Etc.

### Resident inspector's office at NPP sites

- inspection and reporting on the status of construction and operation of NPPs,
- confirmation of safety management at sites and enforcement of corrective actions,
- witnessing of licensees' inspections for reactors and major facilities relevant to nuclear materials,
- supporting the on-site inspection tasks of inspection-entrusted institutions, Etc.

### Radioactive waste management facility resident office

- identification and reporting on the status of construction and operation of radioactive waste management facilities,
- witnessing of licensees' inspections during the construction and operation of the facilities, and confirmation of safety management and enforcement of corrective actions,
- investigation and reporting on abnormal situations such as incidents and disaster,
- supporting the on-site safety regulatory activities of the inspection-entrusted institutions, Etc.

**Off-site emergency management center resident office**

- collection of on-site disaster information and notification thereof to the NRB Headquarters,
- prompt command and situation control at the sites,
- conducting appropriate actions to cope with disasters,
- discharging the function of central information center,
- communication with the licensee's radiation emergency preparedness headquarters, Etc.

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

The NSC, which is directly responsible to the Minister of the MEST was established and is in operation under the provision of Article 5 (Nuclear Safety Commission) of the AEA to review and resolve objectively and transparently important matters concerning nuclear safety based on the independence of safety regulation and fairness in accordance with the AEA. The NSC also established and is operating a Special Committee on Nuclear Safety (SCNS) to examine and review its operations in depth.

The NSC was 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 the 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 investigate and deliberate technically matters under its jurisdiction. This Committee consists of up to 25 experts, 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. The NSC may also organize and operate the Special Investigation Committee if nuclear and/or radiation accidents occur.

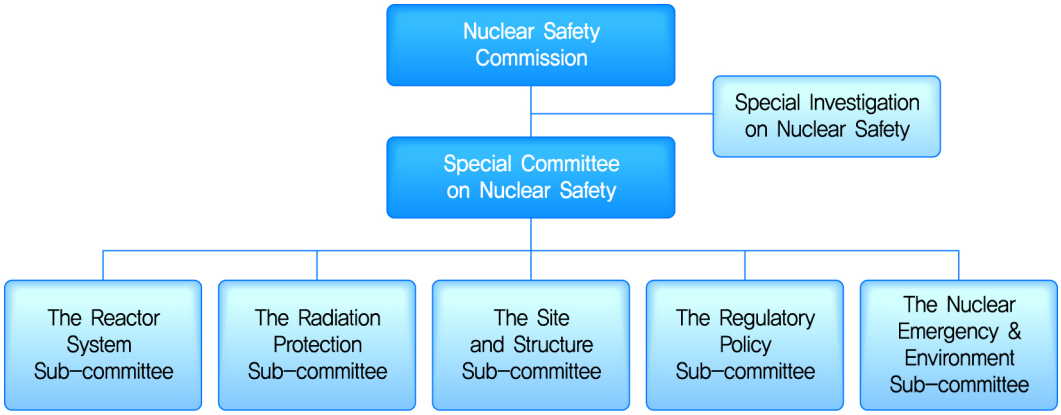


Figure E.3-2. Organization chart of the NSC

### 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 Act on the Establishment of the Korea Institute of Nuclear Safety, handling 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:

- Nuclear facility safety regulation
  - Review and inspection of nuclear power plants
  - Review and inspection of nuclear cycle facilities and research reactors
- Radiation safety regulation
  - Confirmation of safety in the use of RIs
  - Review and inspection of radioactive waste disposal facilities
- Radiation emergency response
  - Radiological accident and terror response and disaster prevention
  - Monitoring of environmental radioactivity throughout the territory and area near nuclear power plants
  - Detection of nuclear tests and nuclear accidents in neighboring countries
- Nuclear safety regulation research and development and professionalization
  - Development of safety regulation criteria and techniques
  - Development of safety regulation policy and system, cultivation of professional human resources

- National technical qualification examination
  - License examinations related to nuclear utilization facility operation and nuclear material handling
  - National technical qualification examinations related to nuclear energy
- Enhancement of global leadership and national trust
  - Enhance contribution to the international society and support the export of nuclear power plants
  - Spread a safety culture as well as national trust enhancement activities

The KINS consists of 2 headquarters, 6 divisions, 1 school, 1 agency, and 40 sections, as shown in Figure E.3-3. It operates the Advisory Committee on Nuclear Safety, a consultative body for technical matters on safety regulations consisting of experts from the KINS and other external organizations. As of the end of July 2011, the KINS has a total of 429 staff members.

To share its safety regulation technology and experience with the international community, the KINS opened in January 2008 the International Nuclear Safety School, which has also functioned as the IAEA's Asian training center since its conclusion of a Nuclear Safety Cooperation Agreement with the IAEA.

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

The KINS signed cooperation agreements with 18 institutes of 14 countries and 3 international organizations.

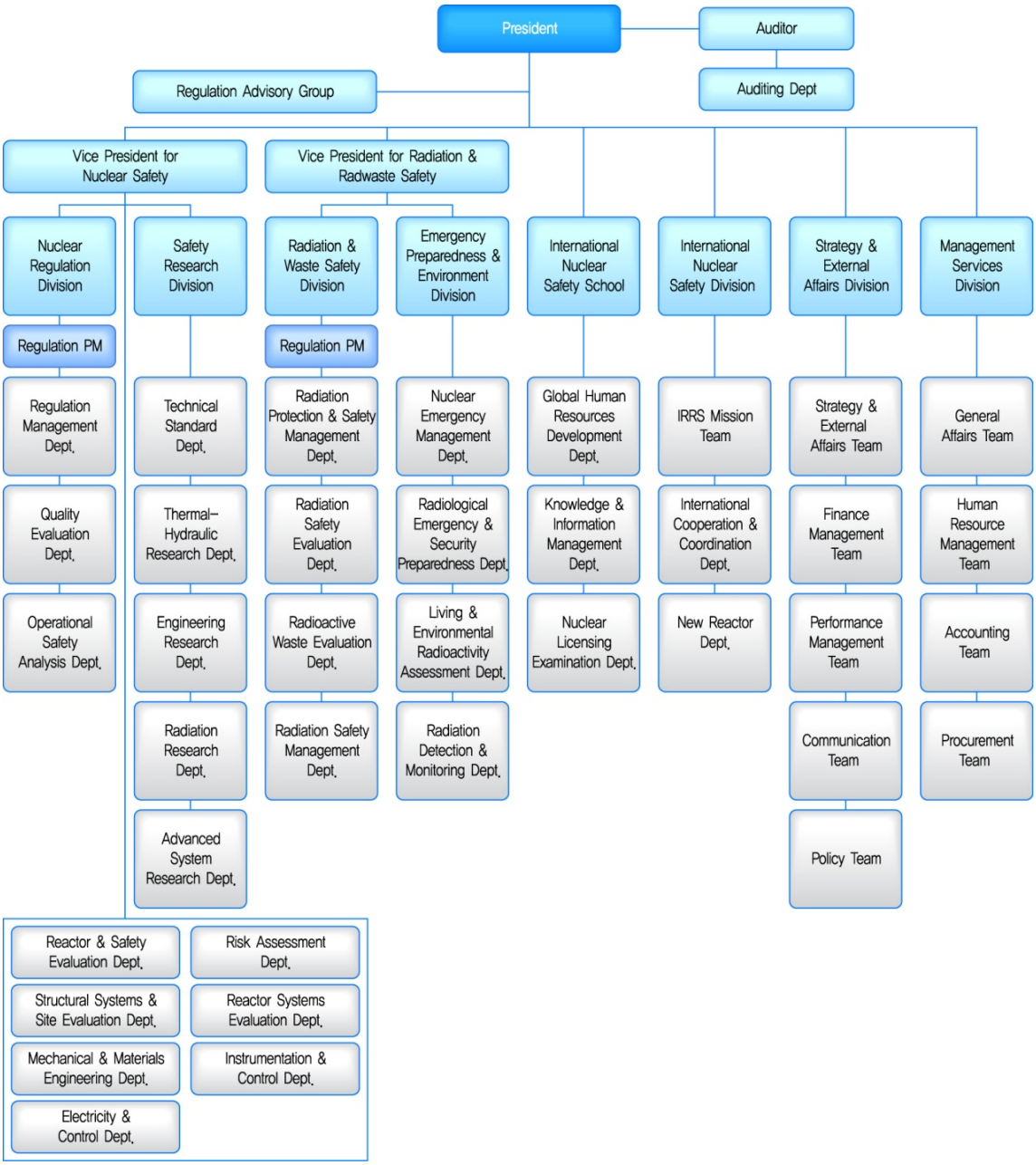


Figure E.3-3. Organization chart of the KINS (as of May 31, 2011)

## E.3.3 Regulatory independence

The AEA, APPRE, and the Nuclear Damage Compensation Act clearly specify that the Minister of the MEST shoulders legal responsibility for regulation. On the other hand, the MKE shoulders responsibility for the nuclear power industry and for radioactive

waste management in accordance with the Electric Business Act and the RWMA, respectively. In other words, the functions of the MEST which is responsible for regulation and the MKE which is responsible for the nuclear power generation industry and promotion are legally and clearly divided under the provisions of the Government Organization Act and its subordinate provisions.

In the AEA and related laws, the authority for nuclear safety regulation is given to the MEST which is in charge of making decisions for safety regulations that cannot be influenced by other sectors of the government or external agencies. Likewise, the status and political neutrality of officials of the MEST are protected by the State Public Officials Act stating that regulatory decisions are not influenced by political changes such as change of government.

The Minister of the MEST can attend the cabinet meeting presided by the President every week as the cabinet member for making independent reports on affairs taking place under his or her jurisdiction such as nuclear safety. If there is a conflict of interest with other sectors of the government during the operation or when conflict is anticipated, the Minister can consult with the related sectors concerning the operation and also provide independent advice to the Ministers of related sectors if independent advice for nuclear safety is required.

The NSC under the MEST and was established to review and resolve important matters related to nuclear safety. The Headed by the MEST, the Commission consists of experts from academic circles as well as the private sector, excluding any expert engaged in the management of nuclear power reactors and related facilities in accordance with the AEA. In other words, the review and decision making process of the NSC is protected against external or political influences.

The KINS conducts regulatory operations concerning nuclear safety and control as entrusted by the Minster of Education, Science and Technology based on the AEA and related laws, it was established and is operating as an independent agency to conduct professional and technical operations within specific fields to eliminate the influence of interested organizations in the decision making process.

# F. Other General Safety Provisions

# 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 the generated spent fuel and radioactive wastes in compliance with related activities before these materials are transferred to the licensee of the treatment, 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 Korean government adopted the State's ultimate responsibility of radioactive waste management in light of the fact that these wastes are needed and that they required long-term safe management. Based on this principle, the MKE carries out management policies regarding 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 overall responsibility for ensuring the protection of public health and environment from radiation hazards that may occur in the course of 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

As the sole nuclear power generating company in Korea, the KHNP has 4 divisions in the headquarters and 4 nuclear power sites, 1 hydro power site, and 4 special offices including the Nuclear Power Education Institute and the Radiation Health Research Institute as shown in Figure: F.2-1.

#### Organization and human resources

At the head office, the KHNP operates the Radiation Safety Team consisting of approximately 15 staff members exclusively in charge of the safe treatment of radioactive waste generated in the course of operating NPP under the Safety & Environment Department and the Radiological Emergency Response Team consisting of approximately 5 staff members under the Emergency Management Office to take exclusive charge of radiation emergency measures for nuclear power reactor facilities.

At NPP, the Radiation Safety Team has approximately 20 staff members and engages in health physics, radiation protection, and radioactive waste management, and 5 members are in charge of waste management operations such as radioactive waste treatment and temporary storage. The KHNP is also planning to establish a team in each NPP to take exclusive charge of delivering waste to disposal facilities. For the maintenance of

radioactive waste related facilities, the KHNP consults radiation management agencies handling radioactive waste in connection with partners such as KEPCO Plant Service & Engineering Co., LTD (KPS) to provide technical support.

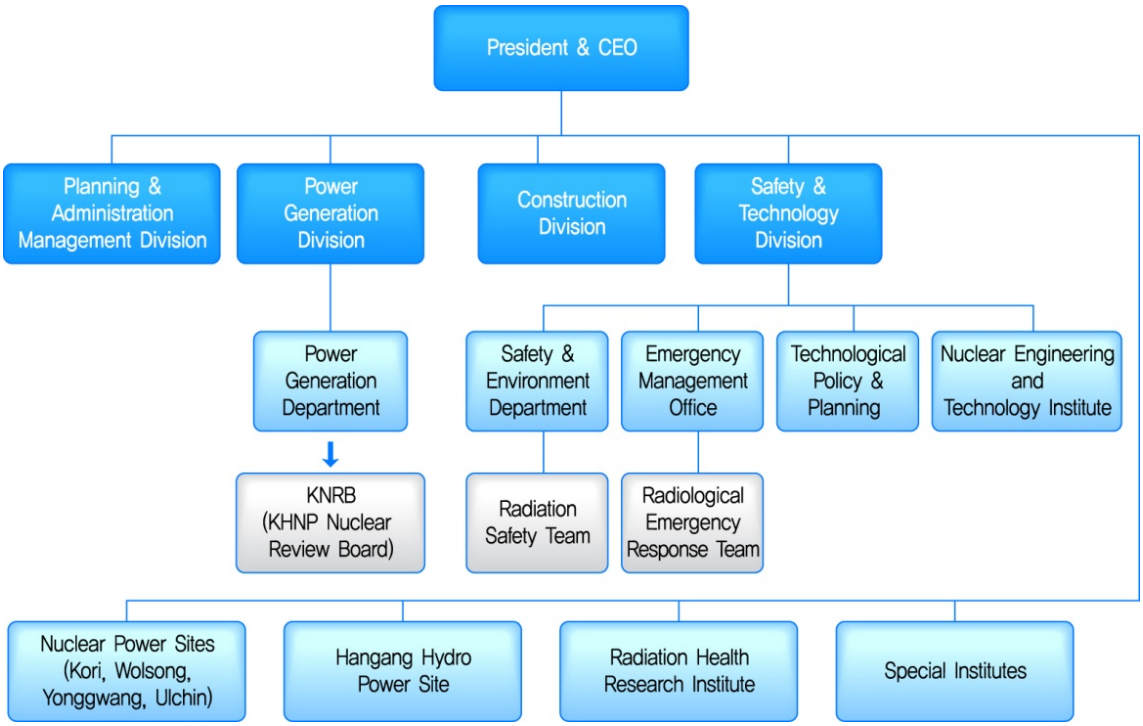


Figure F.2-1. Organization chart of the KHNP headquarters office
(as of May 31, 2011)

NPP has an Emergency Preparedness & Environment Team under the General Administrator Department to take exclusive charge of radiological emergency measures such as emergency management exercises to cope with NPP accidents and the training of emergency staff. The nuclear power reactor facility operating organization is shown in Figure: F.2-2.

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

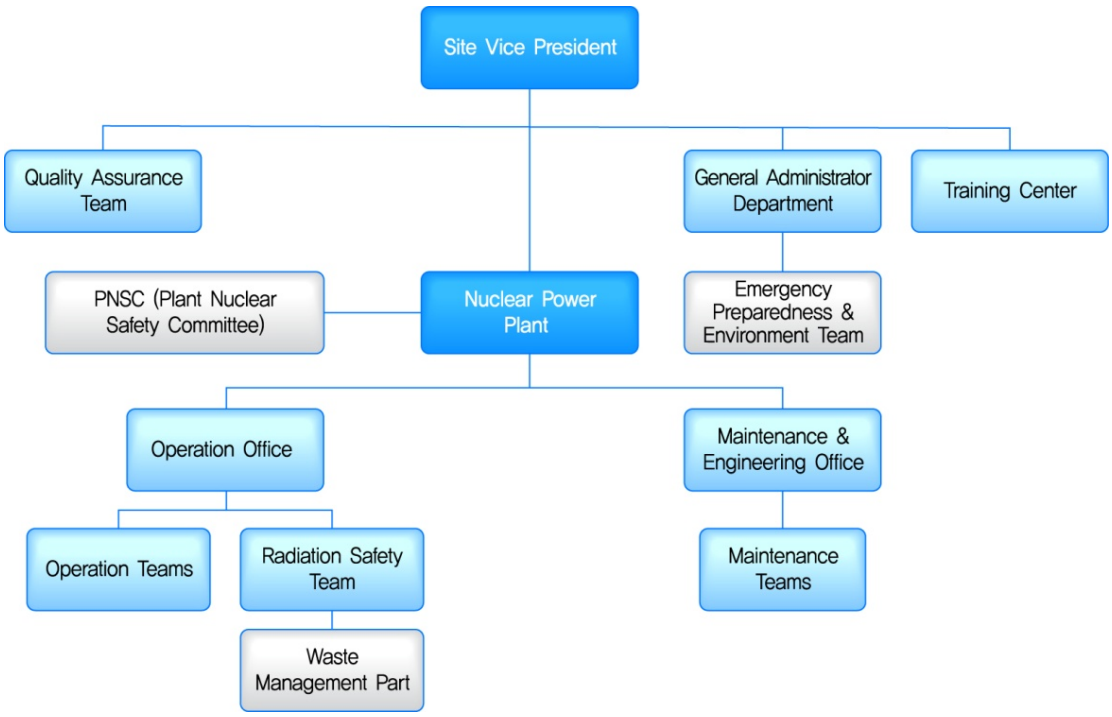


Figure F.2-2. Organization chart of nuclear power site (as of May 31, 2011)

## Financial resources

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

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

NPP licensees also deposit the cost of plant decommissioning on a yearly basis and they have accumulated this cost as in-house liability.

## F.2.2 Research facilities

The KAERI has several facilities related to the management of spent fuel and radioactive waste, including the HANARO facility, the PIEF, and radioactive waste treatment and storage facility. Figure F.2-3 presents KAERI's spent fuel and radioactive waste management organization.

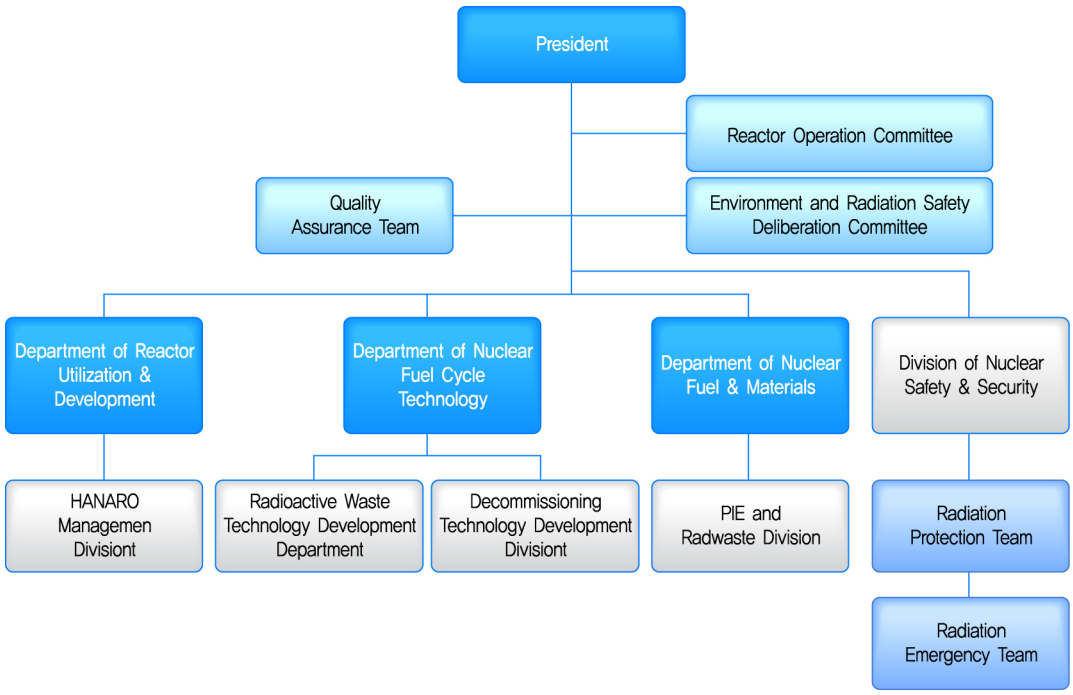


Figure F.2-3. Radioactive waste related organization chart of the KAERI
(as of May 31, 2011)

### Human resources

#### HANARO research reactor

With 40 staff members, the HANARO Management Division of the Research Reactor Utilization and Development Department operates the research reactor and carries out the maintenance work. Radioactive waste generated from HANARO is 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.

### Post-Irradiation Examination Facility (PIEF)

The PIE and Radwaste Division of the Nuclear Fuel and Materials Development Department of the KAERI operates the PIEF. This facility is operated and maintained by nine operating and examining/managing staff members whose work scopes are assigned according to their specialties and backgrounds. Operating staff members are responsible for the operation of utilities and supporting equipment as well as internal and external inspections including nuclear material accounting and licensing, whereas examining/managing staff are in charge of post-irradiation examination for spent fuels and management of the relevant examination facilities. Additionally, they carry out radiation safety management, environmental radiation monitoring, water supply control, and nuclear material safeguards and management in cooperation with related KAERI departments.

### Radioactive waste treatment and storage facility

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

### Combustible waste treatment facility

Beginning 2011, the Decommissioning Technology Development Division of the Nuclear Fuel Cycle Technology Development Department is planning to operate a combustible waste treatment facility with five staff members to reduce the volume of combustible waste generated in the course of decommissioning research reactors 1 and 2 and the UCF. In addition, radiation safety management, environmental radioactivity management, and quality assurance will be provided through the support and cooperation of related KAERI departments.

## Financial resources

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

## F.2.3 Nuclear fuel fabrication facility

### Human resources

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

The Radiation and Environment Safety Team consists of 12 staff members responsible for health physics, dose control, and measurement and transport of radioactive material. The Safeguards Team has 7 staff members responsible for nuclear material accounting and physical protection. In addition, the Waste Environment Team was newly established on March 26, 2011 to manage radioactive waste effectively and develop the related technology for safe treatment and disposal by allocating 3 staff members in charge of waste management, waste disposal technology development, and environmental radiation/radioactivity management in order to manage radiation safety and radioactive waste generated from the nuclear fuel fabrication facility. The operation and maintenance of radioactive waste treatment facilities are carried out with the support of a professional radiation safety management company.

### Financial resources

Under the RWMA, the radioactive waste generator shall pay to the disposal site radioactive waste management expenses at the delivery point of radioactive waste. In order to cope with the disposal of wastes generated, the KEPCO NF has been reserving expenses for radioactive waste every quarter.

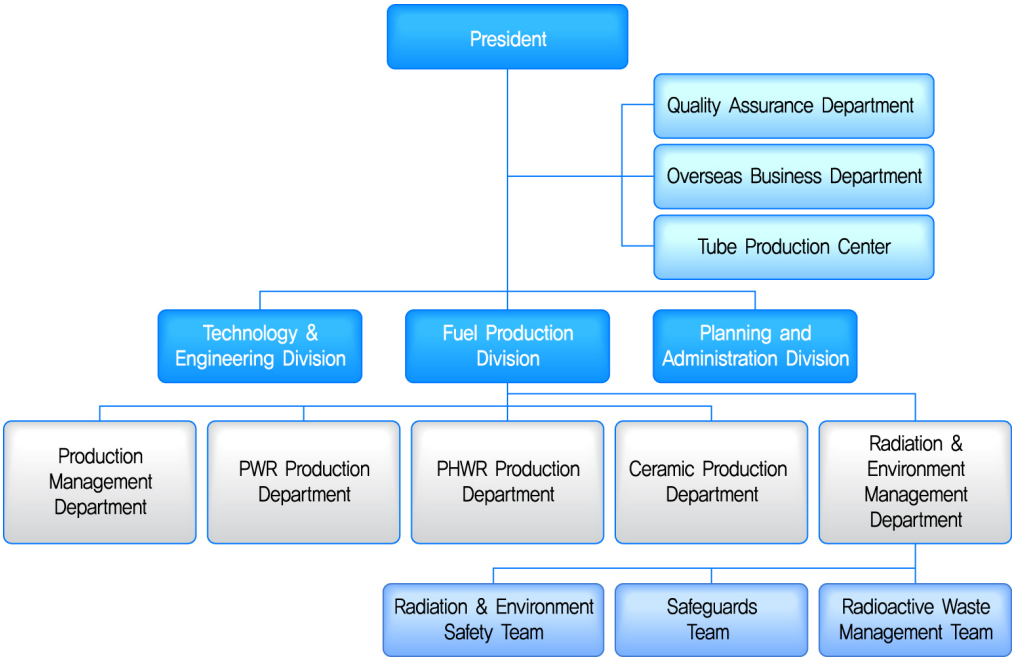


Figure F.2-4. Organization chart of the KEPCO NF (as of May 31, 2011)

## F.2.4 LILW disposal facility

The KRMC is composed of a head office which has 3 divisions and-the Wolsong LILW Disposal Center, and the Fund Management Center which is the annexed agency for managing the Radioactive Waste Management Fund as shown in Figure: F.2-5 as of the end of June 2011.

The KRMC is currently constructing the LILW disposal facility and planning to complete phase 1 of the construction by the end of December 2012. Since the end of 2010, the corporation has been operating a radwaste receipt/storage building it constructed inside the disposal facility to store and manage radioactive waste from some NPP storage facilities that are already saturated.

### Organization and human resources

The KRMC has a total of 254 staff members; 165 in the head office, 80 in the Wolsong LILW Disposal Center and 9 in the Fund Management Center. At the main office, the Projects Division which supervises and supports the construction and operation of the LILW disposal facilities is comprised of approximately 40 staff members, the Technology & Strategy Division has 30 or more staff members engaged in R&D.

The Wolsong LILW Disposal Center is in charge of the construction and operation of the LILW disposal facilities. With approximately 35 people, the Construction Management Office carries out the construction of the disposal facility. The Receipt & Operation Office consists of 12 staff members and handles the receipt, storage, treatment and transport of radioactive waste. The Radiation Safety & Environment Team has 12 staff members and handles radiation safety management, environmental surveys, and emergency exercises of the disposal facility.

Other human resources of the head office and centers are engaged in management and administration support, public relations and local cooperation, quality assurance, spent fuel management program preparation. The departments of the head office and centers maintain an organic cooperation system

## Financial resources

The RWMA requires that the radioactive waste generator bear incurring management expenses incurred in relation to waste treatment and disposal at the point of waste delivery to the KRMC as the disposal licensee.

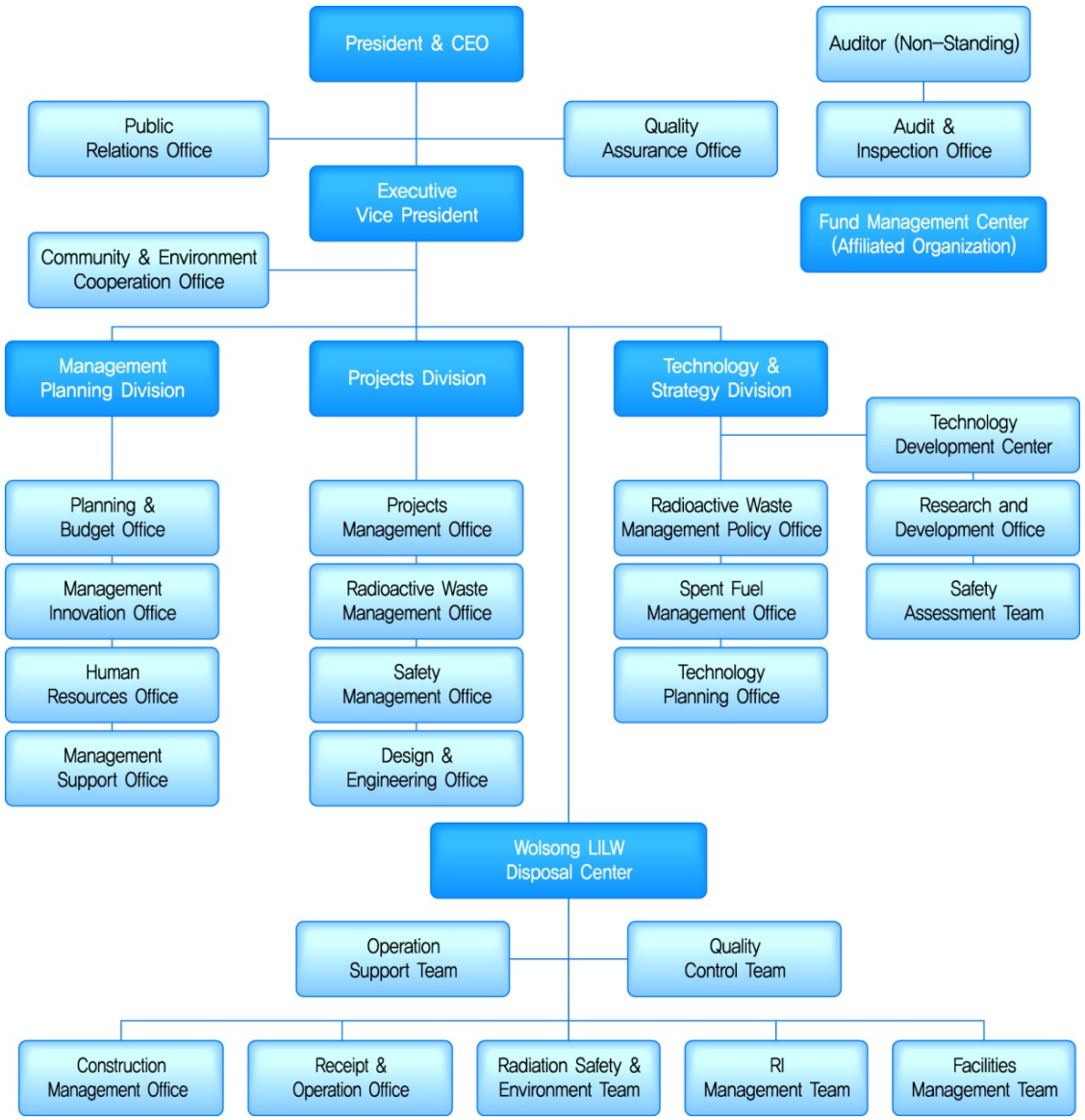


Figure F.2-5 Organization chart of the KRMC

## F.2.5 RI waste management facility

### Human resources

RI waste management facility is operated and managed by the RI Management Team of Wolsong LILW Disposal Center of the KRMC comprised of 8 staff members and is in charge of safe storage and management of all RI waste with the cooperation of the other sections

Financial resources

The RWMA stipulates that the radioactive waste generator bear incurring management expenses incurred in relation to waste treatment and disposal at the point of delivering waste to the KRMC as the disposal licensee.

### F.2.6 Securing of financial resources for management after the closure of a radioactive waste disposal facility

Long-term management for the post-closure of the radioactive waste disposal facility is essential, including assuring the cost for the post-closure of disposal facilities. In this regard, the Enforcement Decree of the RWMA demands that the scope of the Nuclear Waste Management Business include the post-closure management and mandates that 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 programs concerning the safety of spent fuel and radioactive waste management are established and implemented.

### F.3.1 Quality assurance policies

The AEA 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.

Notice of the MEST Notice No. 2009-37 (Waste.010, Quality Assurance Standards for Radioactive Waste Management Facilities) shall be applied to establish a QA system of the LILW disposal facility. Another Notice of the MEST No. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities) also specifies the overall QA requirements to be observed by the licensee for the operation and management of the LILW disposal facility.

According to this provision, 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 of complying with the QA program during the construction and operation of each facility.

In case that a Quality Assurance Program (QAP) is to be modified after the issuance of Construction Permit (CP) or Operation License (OL), the licensee shall report the modification to the Minister of the MEST, except the licensee shall obtain prior approval from the Minister of the MEST if related with changes in quality assurance organization.

The licensee has the responsibility to abide by the approved QAP in the design, construction and operation of nuclear installations, and the regulatory body shall audit the status and effectiveness of QAP implementation by licensee and its main contractors.

## 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. 2009-37 (Waste.010, Quality Assurance Standards for Radioactive Waste Management Facilities) 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, a constructor and operator of the LILW disposal facilities, and all contractors participating in site characterization, design, manufacture, 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 so that all participants implement the QA program.

All contractors involved in the LILW disposal facilities projects, including the design, manufacture, construction, maintenance, Etc., are required to implement the specific quality assurance procedures prepared in accordance with the regulatory requirements.

Evaluation for the implementation and effectiveness of the QA program is periodically conducted by the licensee to verify whether the activities are properly implemented by the licensee itself, as well as by the contractors and subcontractors with the approved QA program.

The method of assessing 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 internal organizations and external contractors considering the characteristics of activities.
- Quality trend analysis is conducted to revise the QAP 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 of QAP effectiveness is periodically conducted by the quality assurance organization to maintain the suitability of QAP for the features of nuclear installations. Major considerations given to the assessment for QAPs include the issuance and amendment of related regulatory requirements, corrective actions or recommendations made by the regulatory body, changes in quality assurance policy, 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 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, following the in-depth evaluation of effectiveness.

## F.3.4 Regulatory activities

Regulatory control activities concerning the quality assurance of radioactive waste disposal are conducted through reviews and inspections by the KINS, as entrusted by the government. To review the safety of the QAP of the radioactive waste disposal facility construction operator, the KINS confirms the appropriateness of implementation of the plan. The main objectives of regulatory activities for the radioactive waste disposal project are to verify whether each organization participating in the design, manufacture, construction, and operation of related facilities has performed quality activities in accordance with the QA program, and whether the program has been implemented effectively so as to ensure the safety and reliability of related facilities. These activities are performed based on the AEA, safety review guidelines on the safety analysis report (SAR) of radioactive waste disposal and 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 AEA and the safety review guidelines. It also verifies whether the QA procedures for the implementation of the QA program are properly established and are practicable.

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

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

### Quality management system within the regulatory body

The 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) to improve public trust and 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 the quality management of regulatory activities is arranged in four sections as follows:

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

## 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 that generate spent fuel and radioactive waste are specified in the AEA and its Enforcement Decree, and Enforcement Regulation of the MEST and Notices of the MEST. These Regulations and requirements meet IAEA standards and they are summarized as follows:

### Atomic Energy Act (AEA)

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 the human body, materials, and public from radiation hazards that may accompany the operation of nuclear facilities,
- provisions on the designation of exclusion areas to protect human body, materials, and public from possible radiation hazards, when 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,
- requirements for the education and training of human resources exposed to radiation.

### Enforcement Decree of the AEA

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

- radiation dose limits related to radiation protection (The defined dose limits 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 the human body, materials, and the public from radiation hazards, that may accompany the operation of nuclear facilities,

- provisions to minimize the exposure of workers employed in nuclear facilities, persons who frequently access said installations, and 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 the 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.,
- detailed provisions on the education and training of persons who engage in radiation work or who access 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.

※ For radiation workers whose pregnancy is confirmed through a pregnancy report to the employer, the equivalent dose limit from the surface of the lower abdomen shall be kept to 2mSv from the point when the pregnancy was confirmed to the point of child delivery and the limit of radionuclide intake during this period shall be 1/20 of the Annual Limit of Intake (ALI). In the event the subject is exposed both internally and externally, the sum of respective factions of 2mSv and ALI/20 must not exceed 1.

## Enforcement Regulation

The Enforcement Regulation 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 the detailed procedures and methods necessary for implementing the AEA and its Enforcement Decree, 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 the 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 MEST

Notices of the MEST present the detailed technical standards of radiation protection specified in the AEA and its Enforcement Decree, and the Enforcement Regulation of the MEST. The principal Notices related to radiation protection are as follows:

- Standards on Radiation Protection, Etc.
- Notice on Materials exempted from RI, Etc.
- Notice on Uses and Capacity exempted from Radiation Generating Devices
- Radiological Protection Criteria for Long-term Safety on LILW Disposal
- Regulation on the 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 LILW 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 the corresponding facilities are specified.

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

### ALARA activities for the 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 are exposed within the applicable limits:

- radioactive equipment to be installed separately in a shielded room with a partition,
- installation of shields to attenuate fully the radiation from pipes and equipment containing large amounts of radioactivity,
- use of remotely 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,

- appropriate zoning and access control.

### 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 or longer),
- a course for personnel of frequent access (first 4 hours or longer),
- a refresher course (Radiation workers: 6 hours a year, Personnel of frequent access: 4 hours a year respectively).

The training duration is different for each course in consideration of the specialty of each course. The training covers safety management relating to the utilization of nuclear facilities, handling of radioactive substances, protection against radiation hazards, radiation safety management regulations and related laws and if necessary, training required by the user. If the results of the evaluation are above the pre-established level, personnel will be qualified.

### 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.

### Dose reduction

The KHNP establishes and operates target values for reducing occupational radiation exposure according to the 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

### 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.

### Personnel dosimetry service and performance testing

All persons engaged in personnel dosimetry services, including the KHNP, transacts dosimetry services with the 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 the TLD reader conducted every 6 months. TLD periodically undergoes standardized performance inspection and periodic inspection that meets the international criteria in order to secure objectivity and reliability in personnel dosimetry.

### 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 KRIA is in charge of managing exposure history of radiation workers. Based on the records, online information system, and RIS (Radiation workers Information System), KRIA has been operating since August, 2005. The KINS established the National Safety Management Center for Radiation Workers, on November 27, 2002, with support the of the MEST.

The center operates the Korea Information System on Occupational Exposure (KISOE), which is an internet-based expert system that enables the 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 the optimization of occupational exposure through the analysis of the individual exposure dose,
- feedback of matrix information on the 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 to 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

### Legal requirements

The MEST stipulates that direct or indirect measuring equipment that can monitor the concentration of radioactive materials shall be installed in the drainage and air vents of the 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 control, airborne or liquid radioactivity concentration at the 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.

### Measures in the design stage

In the design stage for the implementation of legal requirements to prevent any unplanned/uncontrolled release, there 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 the radioactivity levels or leakage by systems. The effluent radiation monitor and sampling equipment shall be installed in the main release path, if any, and the environmental release of effluents whose radioactivity exceeds the legal limit shall be controlled through the securing of an interlock function to suspend release automatically in case an alarm is triggered. Additionally, in the design stage, there is a need to check every effluent release path and spot, and to create a design that enables the prevention of possible effluent release in any other path and spot other than that intended, during the operation of a nuclear facility.

### Measures in the operation stage

Before starting the operation of a nuclear facility, the operator formulates an effluent management plan, with due regard to the characteristics of the facility, this includes the

detailed procedures for 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 orally report the incident to the MEST within 4 hours and submit detailed reports to the regulatory body within 60 days. When radioactivity released into the environment from the relevant facilities concerned exceeds the ECL, operators likewise must also report the incident to the regulatory body within 8 hours and submit reports to the regulatory body within 60 days. Information on such unplanned/uncontrolled release must also be included in regular the quarterly reports submitted to the regulatory body.

## F.4.3 Release restriction system for nuclear facilities

The AEA prescribes that the permission for the construction and operation of nuclear facilities shall be given on the condition that the prevention of radioactive hazards to the public health and the environment is ensured.

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

The Enforcement Decree of the AEA and the MEST Notice No. 2009-37 (Radiation.001, Standards for Radiation Protection, Etc.) prescribe the discharge limits of gaseous and liquid radioactive effluents to be released from nuclear facilities into the environment, along with the 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 nuclear facility unit 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 NPPs 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 using the Off-site Dose Calculation Manual (ODCM). The assessments are based on the radioactivity of the released liquid and gaseous effluents, atmospheric conditions, metabolism, and social data including agricultural and marine products of the local community within an 80 km radius.

## 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 the 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 prior to 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.

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 | | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Kori | Liquid (TBq) | 2.8E-5 | 2.8E-5 | 2.2E-5 | 3.4E-5 | 2.6E-5 |
| | Gaseous (TBq) | 6.6E+0 | 4.8E+0 | 2.0E+0 | 2.0E+0 | 1.7E+0 |
| | Annual dose (mSv/y) | 6.6E-3 | 1.5E-2 | 4.6E-3 | 2.4E-3 | 1.1E-3 |
| Yong -gwang | Liquid (TBq) | 1.2E-2 | 7.6E-4 | 5.1E-4 | 8.0E-4 | 3.3E-5 |
| | Gaseous (TBq) | 2.7E-2 | 9.8E+0 | 2.9E+1 | 3.5E+0 | 4.3E-2 |
| | Annual dose (mSv/y) | 4.9E-3 | 6.0E-3 | 9.6E-3 | 4.3E-3 | 2.1E-3 |
| Ulchin | Liquid (TBq) | 7.2E-4 | 5.8E-4 | 3.6E-4 | 1.8E-4 | 1.9E-4 |
| | Gaseous (TBq) | 1.8E-1 | 6.7E-2 | 9.3E-2 | 1.1E-1 | 6.5E-1 |
| | Annual dose (mSv/y) | 1.7E-3 | 2.1E-3 | 1.9E-3 | 2.1E-3 | 2.6E-3 |
| Wolsong | Liquid (TBq) | 4.5E-4 | 6.9E-4 | 7.6E-4 | 1.5E-3 | 1.8E-3 |
| | Gaseous (TBq) | 3.7E+1 | 5.1E+1 | 4.8E+1 | 1.4E+1 | 9.4E+0 |
| | Annual dose (mSv/y) | 3.5E-3 | 5.8E-3 | 8.3E-3 | 7.1E-3 | 5.2E-3 |

* Annual released radioactivity data do not include tritium release
* Off-site dose calculation includes tritium effect
* Figures for Kori reflects the influence of Shin- Kori Unit 1

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 | | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Daejeon | Liquid (MBq) | 4.8E-5 | 1.9E-5 | 8.0E-4 | 1.2E-3 | 1.1E-3 |
| | Gaseous (MBq) | 1.9E+0 | 2.6E+0 | 4.4E-6 | 3.4E-6 | 5.6E-6 |
| | Annual dose (mSv/y) | 1.0E-2 | 5.9E-4 | 8.1E-4 | 1.2E-3 | 1.1E-3 |

* The gaseous radioactivity in this table is the sum of radioactivity in the gaseous effluents released from the KAERI's HANARO, PIEF, and radioactive waste treatment facility, and conversion facility, KEPCO NF's fuel fabrications facility, and the KRMC's RI waste management facility, all of which are located at Daedeok site.

# 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 "Act on Physical Protection and Radiological Emergency" and the "Basic Act of Disasters and Safety Control" which stipulates the national preparation against radiological accidents and Basic Act of Civil Defense.

Under the Basic Act of Disasters and Safety Control, the MEST is responsible for formulating the radiological emergency measures in the master plan for national safety control every 5 years and a yearly national radiological emergency plan based on the master plan.

The local governments and agencies concerned make their own detailed implementation plans according to the National Radiological Emergency Plan. Detailed criteria for the establishment of Radiological Emergency Measures are specified in the MEST Notice No. 2009-37 (Radiation.003, Notice on Radiological Emergency Preparedness for Nuclear Licensee) including the following matters and this notice which was formulated in 1996 was revised mainly for the particulars of emergency planning zones, emergency response facilities, types and contents of emergency exercises and time to submit the exercise plans and results in August 1998, August 2003, June 2004, April 2008 and September 2009.

- Emergency planning zone and general provisions
- Duties and organization of emergency preparedness organizations
- Criteria for the announcement of radiological emergency
- Emergency response facilities
- Response activities for emergency
- Recovery and reentry
- Emergency training and exercises
- Public education and information
- Maintenance and management of emergency plan

The emergency plan for facilities related to spent fuel and radioactive waste is made based on 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 involves the Central Response Committee chaired by the Prime Minister, National Emergency Management Committee (NEMC), 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 KHNP-Emergency Operation Center (Figure.5-1).

The central government has the responsibility of controlling and coordinating the countermeasures against a radiological disaster. In particular the OEMC, which consists of experts dispatched from the central government, local governments and designated administrative organizations, has responsibility of performing coordination of the 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 the 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.

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

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

personnel.

In addition, the central government establishes the national radiological emergency medical system for the coordination and control of radiological medical services. It consists of the National 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, operating the national radiological emergency medical system during radiological disasters.

If any accident occurs in the nuclear facilities, the operator shall immediately report the emergency situation to the MEST and local government, in accordance with the MEST Notice No. 2009-37 (Radiation.003, Notice on Radiological Emergency Preparedness for Nuclear Licensee).

The operator is also responsible for providing the local government with advice and information on the protective measures for the public during radiological emergencies. The operator maintains contracts with the 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 on 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 during radiological emergencies.

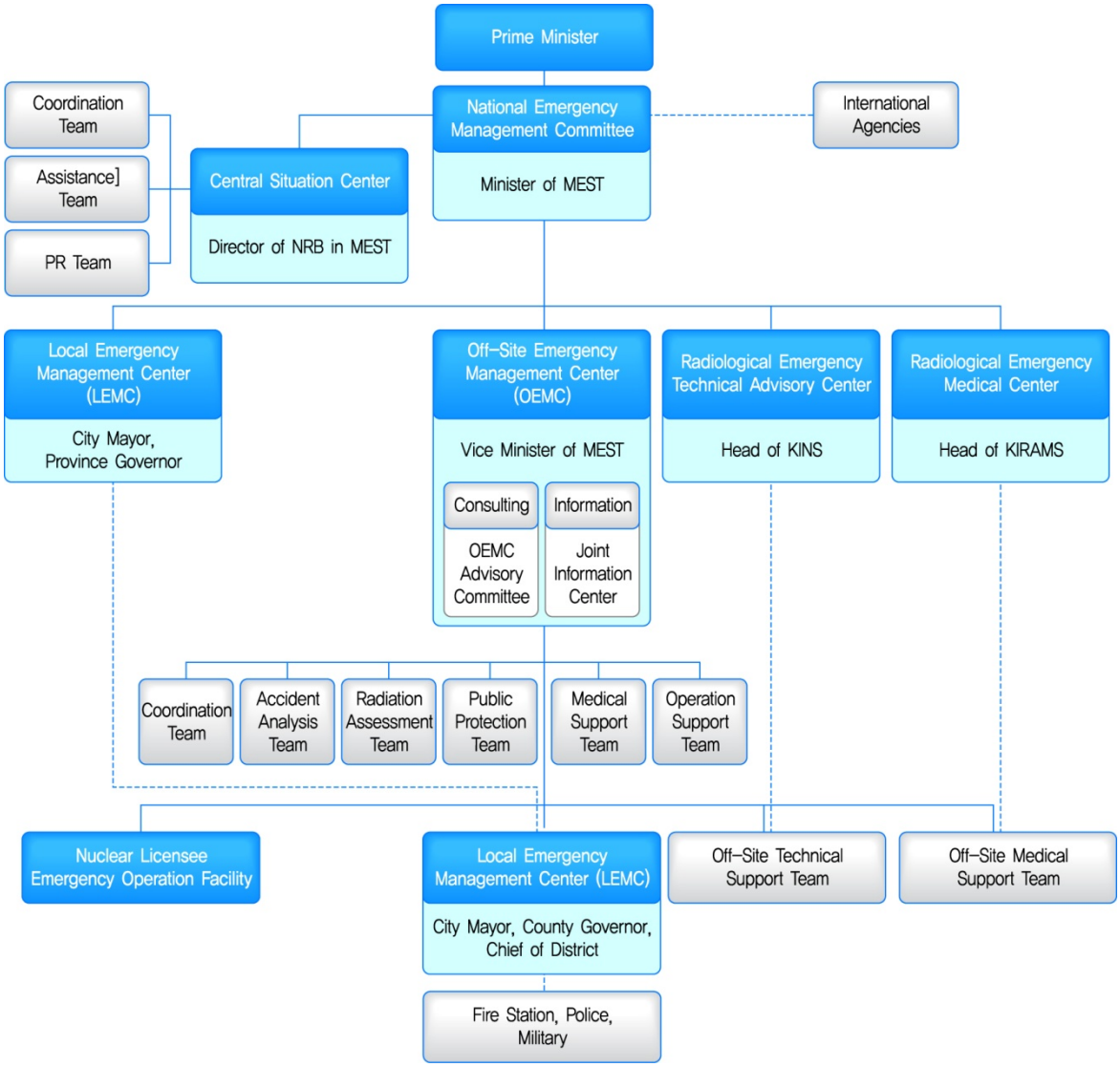


Figure F.5-1. National radiological emergency response scheme

## F.5.3 Training and exercises

The operator of nuclear installations shall periodically conduct training and exercises for emergency personnel to qualify them by providing thorough knowledge of the 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 and the KRMC formulate and implement an independent training program, considering the specialty of radiological accidents, for 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 that must be participated in by on-site and off-site emergency preparedness organizations must participate, are held as follows:

- Partial drills shall be conducted for two plants at least once every quarter with the participation of emergency organizations in nuclear reactor facilities.
- On-site emergency exercises shall be conducted for two plants at least once a year with the participation of all emergency organizations in nuclear reactor facilities.
- Integrated emergency exercises shall be conducted once every 4 years with the participation of all emergency organizations in nuclear facilities, the MEST, and local governments as well as all radioactive disaster prevention-related organizations.
- Unified emergency exercises shall be conducted once every 5 years with the participation of all domestic radioactive disaster prevention-related response organizations including central administrative organizations.
- Initial emergency exercises drills shall be conducted as on-site emergency exercise or integrated emergency exercise to verify the emergency preparedness before the nuclear reactor facilities are used (before an initial rated thermal power of 5%). The integrated emergency exercise is conducted when constructing nuclear reactor facilities on the new site.
- Joint drills shall be conducted once every 4 years with the participation of all emergency organizations in nuclear facilities, the MEST and local governments, as well as all radioactive disaster prevention-related organizations.
- Combined drills shall be conducted once every 5 years with the participation of all domestic radioactive disaster prevention-related response organizations including central administrative organizations.

Radiological emergency exercises are conducted for the disposal facility with internal or external emergency management organizations

- The drill is conducted with internal emergency organization teams participating partially semiannually.
- The exercise is conducted with full internal emergency organization at least once every 2 years.
- The initial exercise is conducted before the disposal facility is put to use

During drills, the appropriateness of the radiological 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 cooperative system among related organizations are reviewed. During on-site, integrated, and united emergency exercises, exercise scenarios that hypothesize accidents requiring evacuation and evacuation of residents in radiological emergency areas are established and radioactive disaster preparedness drills are performed. The first Wolsong Unified Emergency Exercise was held in May 2007 and more integrated exercises were held at the KAERI (February 2008), Kori (May 2008), Ulchin (October 2008), Yonggwang (May 2009), Shin-Kori (May 2010), the KAERI (May 2011), and Wolsong (July 2011). In addition, the initial exercise (on-site emergency exercise) was held in June 2010 at the LILW disposal facility of the KRMC and on-site emergency exercise at the RI waste management facility in November 2010.

## F.5.4 Environmental radioactivity monitoring

The monitoring of environmental radioactivity around nuclear utilization facilities seeks to promote the health and safety of the residents living in the peripheral areas of the facilities by making sure the exposure dose due to radioactive materials discharged from the corresponding facility is sufficiently under the dose limit specified in the AEA.

For this, the nuclear utilization facility constructor and operator must take primary responsibility for preserving the environment around the corresponding facility and evaluate the environmental impact of radiation due to environmental exposure and the operation of facilities and report to the MEST. In such case, the MEST and KINS conduct the verification and monitoring of environmental radioactivity around the facilities to manage and supervise the environmental radioactivity monitoring activities of the facility constructor and operator.

Such government-level independent verification and monitoring make for a quality assurance measure to check whether the monitoring activities of the nuclear utilization facility constructor and operator are implemented appropriately and also to enhance the reliability of environmental monitoring through technical guidance on the radiation measurement and radiation analysis and evaluation. Moreover, routine inspections on the environment management facilities of the facility constructor and operator and their management are performed to ensure the efficiency of the environment management operation of the nuclear utilization facility constructor and operator.

The legal basis for the environmental radioactivity monitoring of the peripheral areas of nuclear utilization facilities is Article 104.6 (Preservation of the Environment). The

constructor and operator of the corresponding facilities must establish an environmental monitoring plan in accordance with the Regulation on the MEST Notice No. 2010-32 (Reactor.019, Regulation on Reporting and Public Announcement of Accidents and Incidents for Nuclear Power Utilization Facilities) and report the plan implementation result to the MEST. The MEST has the KINS conduct environmental monitoring independently from the constructor and operator of nuclear utilization facilities and checks the appropriateness of the monitoring activities through the comparison and evaluation of the monitoring data of the corresponding facility constructor and operator and also objectively confirms and evaluates the radioactive contamination of the environment around the facilities through regulatory review.

Apart from the above, the KINS monitors the environmental radioactivity and space gamma-ray rate level variation in real time and also continuously measures the radioactive contamination of airborne dust, fallout, rainwater, livestock products, agricultural products, soil, service water and milk to detect abnormal circumstances or signs due to radioactive impact in the early stages and respond appropriately. In addition, the KINS has been operating since 1997 the Integrated Environmental Radiation Network (IERNet), which is connected online with 71 radiation monitoring posts throughout the country centering on the central monitoring post of the KINS (Figure: F.5-2). In particular, the unmanned automated environmental radioactivity monitor was installed in Dokdo on April 1, 2011. The KINS also trains monitoring personnel from local radiation monitoring posts every year and routinely conducts the cross analysis of domestic and foreign environmental radioactivity to manage the quality of environmental radioactivity monitoring results.

The KINS also developed and is operating the ‘System for Identifying Radiation in Environments Nationwide (SIREN)’ which integrates the monitoring networks operated to monitor environmental radioactivity and radiation to combine monitoring results by each monitoring network and enhances domestic and foreign radiological emergency early detection capacity. The SIREN which combines the monitoring results of various radiation and radioactivity monitoring networks is effectively used as the system capable of continuously monitoring environmental radioactivity in the entire territory before and after an emergency situation and detects abnormal conditions in its early stages.

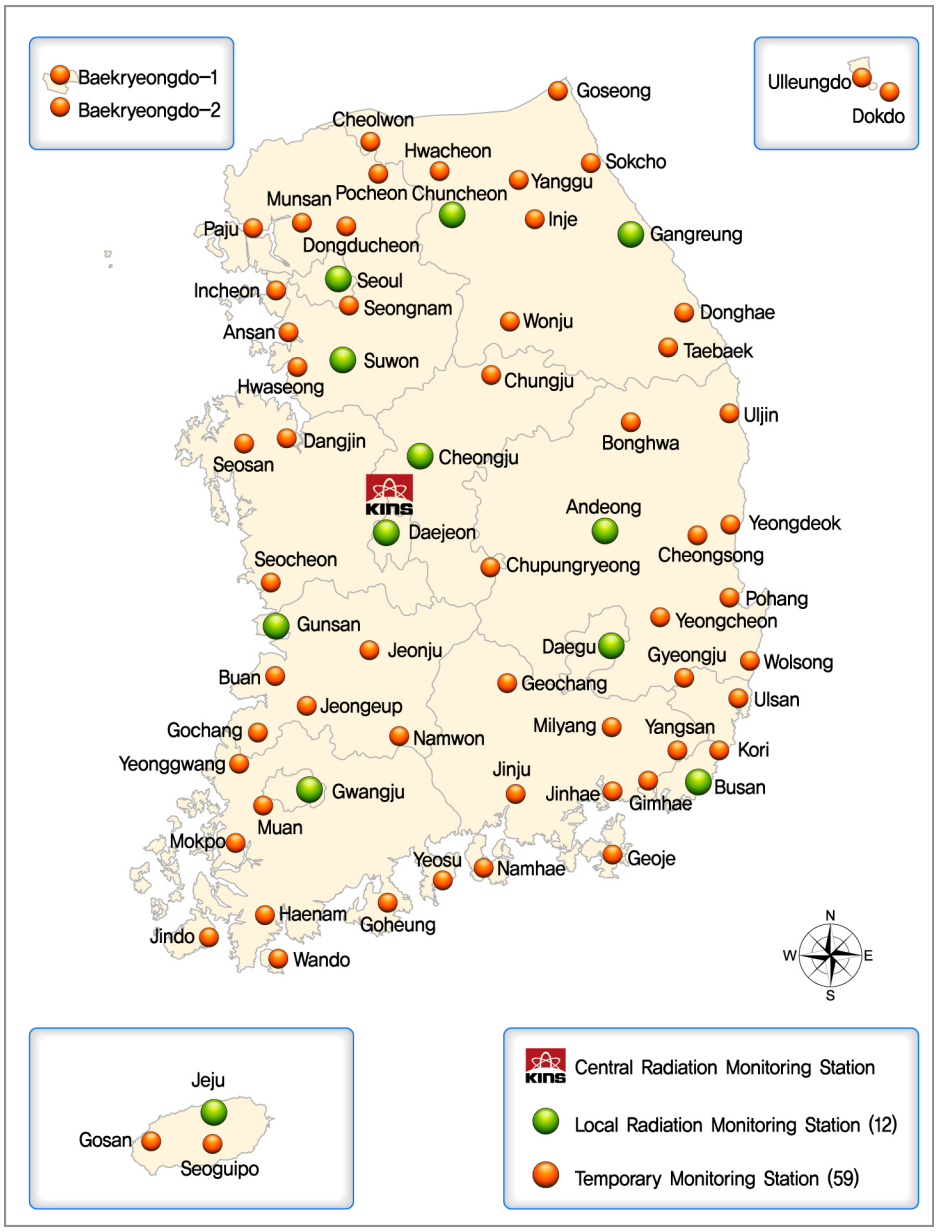


Figure F.5-2. National environmental radioactivity monitoring network

## F.5.5 International arrangements

The notification of an accident and the request for 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 Support during Nuclear Accidents or Radiological Emergencies”.

The MEST and the USNRC maintain a radiological emergency cooperation scheme, by mutual consent, pursuant to the "Arrangement between the USNRC and the 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 have been concluded to maintain an early notification network that provides prompt notices when a nuclear accident occurs.

The KINS signed the MOC (Memorandum of Cooperation) with the National Nuclear Safety Administration (NNSA) of China to maintain cooperation for emergency measures in preparation to prepare for nuclear accidents and set up the emergency cooperation system with the China Institute for Radiation Protection in accordance with the "Agreement on Technological Cooperation for Nuclear Safety and Radiological Protection."

Korea, China and Japan also signed an MOC on Top Regulators Meeting (TRM) to enhance nuclear safety capacity in Northeast Asia.

Korea, China and Japan held a summit in May 2011 and reconfirmed that intensification of nuclear safety is of utmost importance, and that the sharing and exchange of nuclear safety related information is essential in maintaining reliability for the safe operation of nuclear facilities. For this, three countries agreed to consider intensifying cooperation for information sharing, developing early notification systems during emergency situations and exchanging information on airflow analysis and forecasts during nuclear accidents in real time.

# 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.

Currently, KRR-1, 2 and the UCF are being decommissioned. The decommissioning policy and strategy for KRR-1 and 2 and the UCF involve the following: (1) immediate decommissioning, (2) unrestricted release of the site and building from regulatory control upon completion of decommissioning, (3) minimization of decommissioning wastes, (4) preparation for the upcoming decommissioning of large nuclear facilities through the development of related technologies, and (5) transference of decommissioning techniques and experiences to industries. The characteristics of KRR-1, 2 and uranium conversion facility are shown in Annex C.

The decommissioning of KRR-1 and 2 began in January 1997. In 2007, it was decided that KRR-1 would be reserved as a monument commemorating the application of nuclear energy in Korea. However, that the execution of decommissioning of KRR-1 was decided in 2009. Such decommissioning activity for KRR-1 was started in July, 2011.

The UCF, which is located at the Daejeon KAERI site, was constructed in 1982 for the development of fuel fabrication technologies for PHWR. Its capacity was 100 tons of uranium oxide per year. Its decommissioning plan was submitted to the MEST in October 2002 and approved in July 2004. All decommissioning work will be completed by the end of 2011.

The KAERI is in charge of the decommissioning of KRR-1 2 and the UCF. The KAERI

is also performing decommissioning technology development for the safe decommissioning of nuclear facilities including nuclear power plants. The KHNP as a licensee of Korean NPP is engaged in the preliminary review for the decomissioning of NPPs and related R&D.

The RWMA requires NPP licensees to reserve fund every year in preparedness of the upcoming decommissioning of NPPs and to submit a yearly reservation plan to the MKE.

The MEST specifies the licensing procedures and related articles in nuclear laws to ensure safety in nuclear facility decommissioning such as approval of the decommissioning plan, verification and inspection of the decommissioning status and obligations for safety measures against the closure of decommissioning activities. Based on the laws, the KINS is implementing safety regulations on the decommissioning of nuclear facilities and performing R&D on the safety evaluation for the decommissioning of large nuclear facilities through nuclear R&D projects funded by the government

## F.6.1 Regulations and requirements

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

A decommissioning plan shall include the following:

- methods of decommissioning the nuclear facilities, and work schedule,
- methods of removing radioactive materials and methods of decontamination,
- radioactive waste treatment and disposal methods,
- necessary measures against radioactive hazards,
- assessment of environmental impact and measures for its minimization,
- QA program with regard to decommissioning,
- others, as specified by the MEST

## F.6.2 Human and financial resources

### Nuclear power plants

#### Human resources

There has yet to be a power reactor that requires decommissioning. Therefore, there is no specific organization for the decommissioning of NPPs in Korea. NPP operators plan to create an organization with the operating staff members for the decommissioning of NPPs in the future.

#### Financial resources

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

### Research reactors and the UCF

#### Human resources

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

#### Financial resources

KRR-1, 2 and the UCF, funded by the Korean government, were constructed and operated by the KAERI. The government provided all financial resources required for the safe decommissioning of the facilities. In 1996, the KAERI reported its basic plan to the MEST, received financial support from the government, and began to decommission research reactors in 1997. The decommissioning of a uranium conversion facility operated by the KAERI was also funded by the government.

## F.6.3 Radiation protection

In the decommissioning of the KRR-1 and -2 and UCF, the same regulations on the operation of the corresponding facilities, as described in Article 24 of the Joint Convention, are applied for radiation protection and safety. In the decommissioning plan of the facilities, the status of facilities, radiological conditions, and anticipated

waste are considered. The required human resources are described and the dose rate of workers under 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, radiation protection is controlled according to the detailed plan specific to the working conditions.

The regulations applied to the decommissioning site include the Notices on the Standards for Radiation Protection, Etc., the Regulation on the Packaging and Transport of Radioactive Materials, Etc., the Regulations on the 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 UCF, 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. Even in this case, however, it was assessed that the exposure rate could be minimized by securing sufficient times to seek shelter.

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

All decommissioning works are performed 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 the spread of radioactive materials outside the reactor building, the foregoing the need for the evacuation of residents around the KRR-1 and 2 and UCF to evacuate when such an accident occurs. Most of decommissioning works have been finished, and the assessment of residual radioactivity is currently being performed.

## 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 implementation of the decommissioning. Such records include documents related to 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 UCF has been collected by the Division of Decontamination and Decommissioning Technology Development at the KAERI. Such 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 managing the decommissioning waste in a systematic manner and reporting safety information to WACID, a DB system developed and operated by the KINS for managing nationwide safety information on radioactive waste management.

# G. Safety of Spent Fuel 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 maintain its safety function efficiently 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 the design limits with appropriate safety margin. The cooling water in the spent fuel management facility of PHWRs shall be maintained below 49°C if spent fuel equivalent to half spent fuel rod in the reactor core is stored in management facility. And the cooling water in PWRs spent fuel management facility shall be maintained below 60°C in condition of maximum heat load.

### Structural and seismic design

Structures, systems and components shall be designed such that they 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 protect sufficiently against the 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.

Currently, there is no independent storage facility for spent fuel in Korea. The spent fuel storage facilities in the nuclear power and research reactor (AR storage) are licensed and inspected for safety management as 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 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 done in accordance with the MEST Notice No. 2009-37 (Waste.005, Technical Standards for the Location of Interim Storage Facilities of Spent Nuclear Fuel), and technical standards for the site where the facility is located, including various conditions such as demographic, geological and seismological characteristics, and hazard of manmade 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 intending to obtain a permit for the construction and operation of spent fuel storage facility shall collect the opinions of the residents by preparing a “draft” radiological environmental report (RER) and making it 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 RER, which is to be submitted to the MEST as a part of the 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 release and uncontrolled effluent

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, i.e., concept 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 during normal operation including the anticipated operational transients, and inhibiting the release thereof, and to restrict the effects on 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 based 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 during the period of operation for the spent fuel management facility. The safety analysis report contains the results of a comprehensive safety evaluation including 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

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 requiring 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 license to the regulatory body;
(vi) programs to collect and analyses 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 operation license for spent fuel management facilities are specified in the AEA as follows:

- Technical and economic 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 Enforcement Regulation 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.
- 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 Operation 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 that administer engineering and technical support according to the facility features in all safety-related fields during its operating 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 KEPCO Engineering & Construction Company, INC (KEPCO E&C), 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 leakage or get destroyed by fire or any other incident.

The MEST Notice No. 2009-37 (Reactor.019, Regulation on Reporting and Public Announcement of Accidents and Incidents for Nuclear Power Utilization 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, and
- occurrence of release of radioactive material beyond 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 intending 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, i.e., it proceeds with the program considering the national policy and worldwide radioactive waste disposal technology development.

Establishing a long-term management policy covering the treatment and disposal of spent fuel, the establishment of short and medium term spent fuel management plans must precede. The government is conducting “Expert Service for Preparing Alternatives for the Management of Spent Fuel” as the preliminary stage for the promotion of this policy under national consensus. The purpose of this research is to have in-depth reviews of short, medium, and long-term management alternatives through spent fuel expert groups and develop a management roadmap, secure a scientific and technological foundation for spent fuel management alternatives and form a consensus concerning spent fuel management alternatives. The government will establish a national policy for spent fuel management by determining the time to publicize the matter, the method and schedule based on the results.

The development of the disposal technology for high level waste and spent fuel began in 1997 and the Korea Reference disposal System (KRS) was developed through research in the fields of safety evaluation, deep geological environments of Korea, engineered barriers and nuclide movement. Currently, the development of a KRS which is an integrated disposal system for the safe long-term management of waste based on a variety of physical and chemical characteristics such as the high level waste anticipated from the dry treatment process of spent fuel and CANDU spent fuel and long-lived waste is in process based on the technologies developed.

For the verification of the disposal system technology, the KAERI Underground Research Tunnel in the crystalline rock bed inside the KAERI was completed in November 2006 after a two-year-long period of site surveys, design, and licensing that actually began in 2003. This facility has been conducting field tests such as the test of

key disposal system technologies, the testing of deep geological environment characteristics to build the verification basis, thermal behavior of rock beds, characteristics of damage zone, disposal facilities material-underground water behavior characteristics and solute movement and colloid characteristics.

Prior to site selection for the deep geological disposal of spent fuel generated in Korea and the evaluation of disposal site characteristics, the development of technology for quantitatively evaluating the deep geological environment of Korea and study on the "Geological Environment Evaluation Technology for Deep Geological Disposal in the Korean Peninsula" to develop a database have been carried out since 2010 centering on the KRMC. This study is composed of the development of technology to quantify long-term geological features stabilizing elements, the technology to quantify earthquake and fault activity and natural barrier evaluation criteria and technology development for site selection centering on deep disposal environment evaluation and model development technology.

# H. Safety of Radioactive Waste Management

# H. Safety of Radioactive Waste Management

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

### ARTICLE 11. GENERAL SAFETY REQUIREMENTS

1. 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.1.1 Standards for permit

The permission criteria for disposal facilities designed to provide reasonable assurance that public health and environment are protected against radiation hazards during the construction, operation, closure, and institutional control periods of radioactive waste disposal facilities and thereafter are specified in nuclear laws as follows:

- Technical capability necessary for the construction and operation of disposal facility, Etc. as provided for in the Enforcement Regulation of the MEST shall be available.
- Location, structure, equipment, and performance of disposal facility, Etc. shall conform to such standards as prescribed by the Enforcement Regulation of the MEST such that there will not be any impediment to the prevention of hazards to human body, material and the general public caused by radioactive material, Etc.
- Construction and operation of disposal facility, Etc. shall conform to the standards prescribed by the Presidential Decree in order to prevent any harm to public health and the environment caused by radioactive material, Etc.
- It is required to secure the equipment and manpower prescribed by the Presidential Decree.

To ensure that the foregoing 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 safety analysis report and radiological environmental report. Specific regulations are provided in the Notices of the MEST.

## H.1.2 Safety analysis

LILW disposal facility constructors and operators shall prepare Safety Analysis Reports in accordance with the provisions of the AEA and submit reports to the MEST to secure safety in the overall construction and operation processes of a 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, site characteristics, design, construction, operation and maintenance of the facility, site closure and institutional control, safety evaluation and accident analysis, radiation protection, technical guidelines, Etc.

## H.1.3 Development and implementation of step-by –step management

The major technical areas that affect the performance of disposal facilities are site characteristics investigation, waste characteristics evaluation, and facility design. Since 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.1-1.

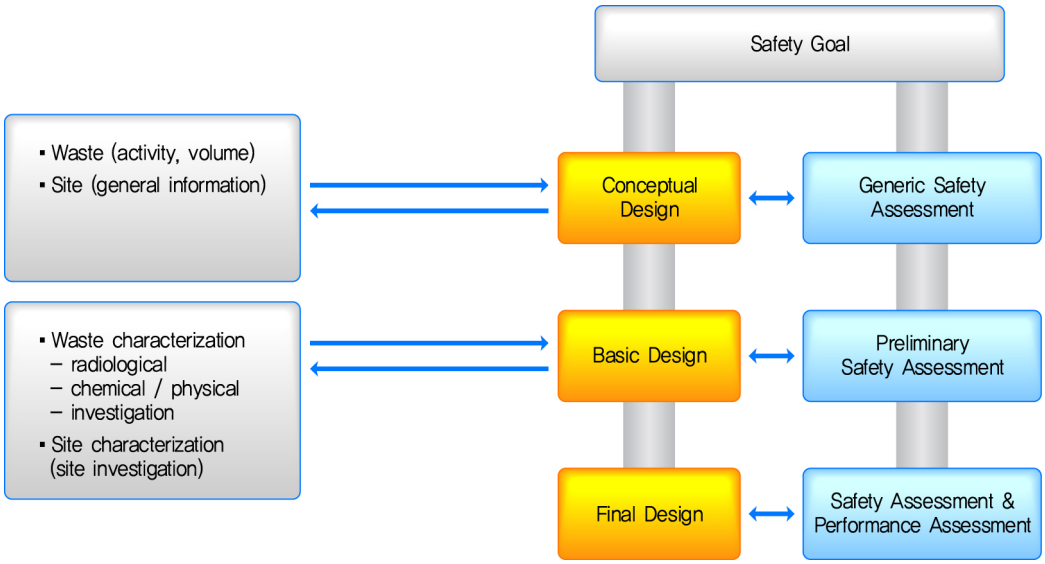


Figure H.1-1. Design approach for the LILW disposal facility

Consequently, a design system that can show and integrate the relationships among diverse areas and take into account the complex relationships among factors that affect each of these areas was established and implemented, as shown in Figure H.1-2.

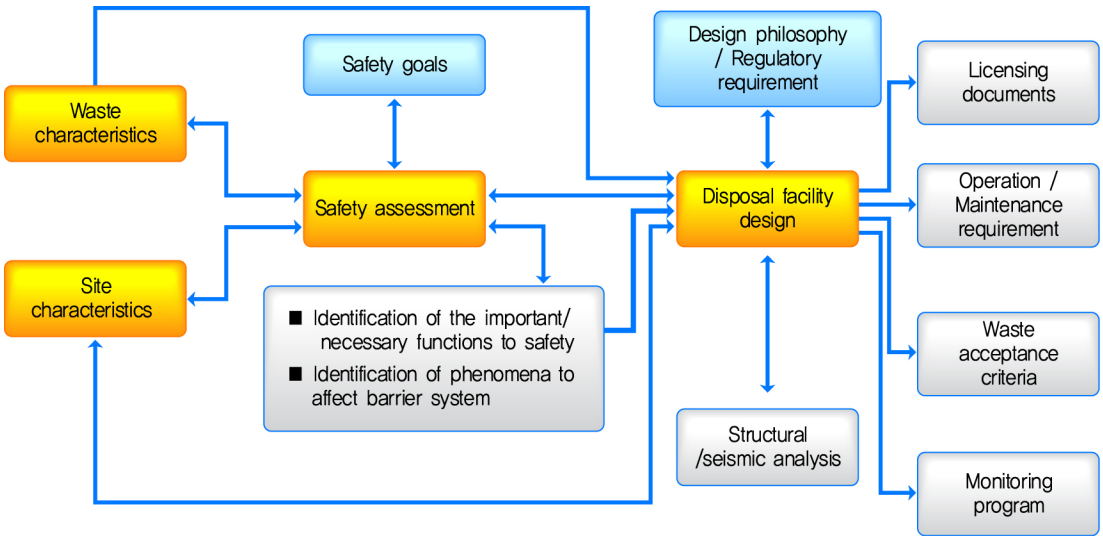


Figure H.1-2. Mutual interaction among various technical processes

## H.1.4 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, the improvement of radioactive waste treatment systems along with the introduction of new treatment technology should be considered.

### 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 heat generated by radiation irradiation. To make this possible, in accordance with the MEST Notice No. 2009-37 (Waste.007, 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.

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

In accordance with the Notice of the MEST, radiation monitoring systems shall be installed and 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 the set points or when abnormalities exist in the facilities, the systems shall have functions to activate the alarm and terminate the release automatically.

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 air vents or drainages established in obtaining the license for construction and operation. In addition, 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 the separation of radioactive waste management facilities from those designed to handle non- radioactive materials.

### Stability of waste package

In accordance with the MEST Notice No. 2009-37 (Waste.007, 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 visual inspection. Furthermore, the package shall be able to maintain its integrity under circumstances expected in disposal conditions, even when the internal pressure increases due to the generation of gas within the package.

### 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 environment. The standards for preventing environmental hazards regarding radioactive waste disposal facilities as 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.

Furthermore, there shall 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. 2009-37 (Waste.007, 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 affect 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 contained in waste shall be excluded or their contents shall be restricted according to the acceptance criteria of the disposal facility.

### Restriction of effects on future generations

The MEST Notice No. 2009-37 (Waste.011, 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 such that there is no predicted radiological impact from the disposal facilities. Additionally, such shall stay within the acceptable range in both the present and 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 issuance of licenses pursuant 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 to the AEA, such as revision authorizations for major revocation cases and revision reporting for minor revocation, shall be adhered to.

Starting on the effective date of the Joint Convention, the current conditions, operation history, and major accident and maintenance records of existing radioactive waste management facilities and major radioactive waste-generating facilities in operation in 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. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities) 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 Licensing procedure for site selection and related factors

Licensing procedures for the site selection of LILW disposal facilities under the AEA are described in section E.2.3. As the permission criteria for the selection of the site for disposal facilities, Etc., the general siting criteria of facilities are outlined in the Regulations on the Technical Standards for Radiation Safety Control. Regarding the detailed regulations, the MEST Notice No. 2009-37 (Waste.004, Technical Standards for the Location of Low and Intermediate Level Radioactive Waste Disposal Facilities) 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,

surface water, ground water, occurrence of earthquakes, ecological characteristics, use of water resources, other land uses for industrial or military purposes, and supplementary emplacement of engineering barriers are specified in the criteria.

The MEST Notice No. 2009-37 (Waste.013, Guidelines for the Preparation of Site Characteristic Report for Low and Intermediate Level Radioactive Waste Disposal Facilities) stipulates the following for the preparation of site characteristics reports:

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

## Factors of safety analysis

Safety analyses for the site of the LILW disposal facility are categorized into the environmental impact assessment applicable to the non-radiological aspects radiological environmental impact assessment and the safety analysis subject to 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 and Operation License of the LILW 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 on the surroundings thereof due to the operation of the facility, the environmental radiation monitoring program to be implemented during the construction and operation of the facility, the radiological impact on the environment resulting from the accidents and incidents during facility operation, and 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 the LILW disposal facility on the surrounding environment in compliance with the provisions of the "Act on the 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.

## Disclosure of information

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

The "Act on Special Cases Concerning Electric Source Development" prescribes to open the details of the project to the local residents for a certain period before the notice of designation of the final site and 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 LILW Disposal Facility" prescribes that the MKE make public the site selection plan and process as well as the results of site surveys and the LILW disposal facility construction plan, at the same time holding explanatory meetings or forums for the local residents.

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

### Consultation with neighboring countries

The Korean government has not concluded specific international agreements with foreign countries on site selection and the Korean peninsula is surrounded by sea on three sides and is isolated from neighboring countries. However, that an international agreement was concluded concerning radiological emergency measures. The contents of the agreement are described in section F.5.

## H.3.2 Implementation of site selection for the proposed facilities

The constructor and operator of the LILW disposal facility shall conduct safety analysis under the provisions of the AEA including preliminary surveys and detailed surveys on candidate sites for the site selection of the facility as well as prepare the Radiological Environmental Impact Assessment Report and the Site Survey Report based on the analysis results which must be submitted to the MEST when applying for the early site approval. The MEST issues the prior approval of the site on the basis of the results of the safety evaluation conducted by the KINS on the appropriateness of the reports. Site safety can also be evaluated through an application for construction and operation license without undergoing the prior approval procedure depending on the decision of the constructor and operator of the LILW disposal facility.

On March 11, 2005, the government formed the Site Selection Committee consisting of 17 experts from the private sectors and from various sector of society for transparent and fair site selection. The Site Selection Committee managed and supervised the overall site selection process.

On June 16, 2005, the government announced that the site for the LILW disposal facility would be selected by local referendum (Figure H.3-1)

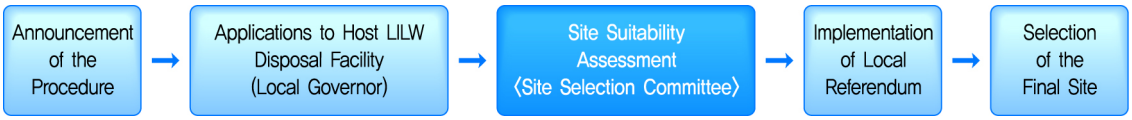


Figure H.3-1. Site selection procedures of the LILW disposal facility

On August 31, 2005, Gunsan, Gyeongju, Pohang, and Yeongdeok County applied for the hosting of the LILW disposal facilities through public subscription, and all of these sites were evaluated for hosting a disposal facility. Referendums were held by these four local governments. As a result, Gyeongju was finally selected as the site for the LILW disposal facility on November 3, 2005 among counties the highest number of favorable responses from residents (89.5%).

### H.3.3 Review of construction and operation license for the LILW disposal facility

The KHNP conducted site surveys and environment surveys on the finally selected site and submitted to the MEST the application for the construction and operation license of the LILW disposal facility based on the survey results in January 2007. The KINS conducted a safety review on the application for permit for the construction and operation license of the LILW disposal facility as well as attached documents including the Radiological Environmental Impact Assessment, the Safety Analysis Report, and the QA Program as in chapter F.

For systematic and thorough safety verification, 70 or more experts from 13 departments of the KINS participated in the safety evaluation and performed question and answer review until July 2008. The review of hydrogeology by IAEA expert teams was also performed in this process (October 20~30, 2007).

As a result of the evaluation, the application documents were found to be consistent with the conditions of license as required under the provisions of the AEA and the related regulations. Therefore the construction and operation license was issued by the MEST on July 31, 2008.

The license of the construction and operation of the disposal facility was transferred to the KRMC which was established in January 2009 under the provisions of the RWMA, and currently phase 1 of the disposal facility is under construction and the completion is scheduled for the end of December 2012.

# 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 Regulatory requirements related design and construction

Design-related factors to be considered for the LILW disposal facility are stipulated in the MEST Notice No. 2009-37 (Waste.006, Standards for the Structure and Equipment of Low and Intermediate Level Radioactive Waste Near-Surface Disposal Facilities) and the MEST Notice No. 2009-37 (Waste.022, Guidelines for Preparation of Safety Analysis Report for Low and Intermediate Level Radioactive Waste Disposal Facilities).

The LILW disposal facility shall be designed such that it maintains their structural and functional integrity during normal as well as abnormal operating conditions. Therefore, the design and construction of disposal facilities shall be based on proven engineering practices. In addition, equipment and components installed at disposal facilities shall be designed such that they can be regularly tested and inspected to confirm that they can continue to be used safely.

## H.4.2 Design and construction criteria

### Design goals

The radiation exposure of 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
  - external exposure by gas release : 0.05 mSv/y
  - dose by liquid release : 0.03 mSv/y
- Post-closure design goals
  - normal natural phenomena : 0.1 mSv/y
  - natural or manmade accidents : $10^{-6}$/y
  - inadvertent intruders : 1.0 mSv/y

### Design criteria

In accordance with the MEST Notices, major design criteria shall be established to minimize the radiological effects on radiation workers and public during normal operation or in case of accidents

**Radiological safety**

- By applying a multi-barrier concept, radioactive waste shall be isolated on a long term basis, and the facility shall be designed to render active post-closure repair unnecessary.
- The design and operation of the disposal facility shall be complied with the site closure and stabilization plans; thus, the performance objectives established for the post-closure period shall be met.
- The disposal facility shall be designed in accordance with the technical standards presented in the MEST Notice No. 2009-37 (Radiation.001, Standards for Radiation Protection, Etc.).
- The disposal facility shall be designed so that the post-closure radiation exposure of the local residents meets the performance objectives presented in the MEST Notice No. 2009-37 (Waste.011, Radiological Protection Criteria for Long-term Safety on Low and Intermediate Level Radioactive Waste Disposal).

- The radiation exposure to radiation workers and local residents shall comply with ALARA and the radiation absorbed dose of components should not exceed the limits of integrated dose.

### Structural stability

- The disposal facility shall be designed considering the site characteristics to enable supplementing and improving site characteristics.
- The flows of groundwater are restricted through the closure design by the sealing of concrete plugs in underground tunnels. Any and all changes in the surface geology and activities of organisms shall not degrade the safety-related function of the disposal facility.
- The disposal facility shall be designed considering site characteristic factors such as geology, earthquakes, meteorology, and hydrology as well as other manmade disasters.
- The disposal facility shall be designed to maintain their structural integrity with minimal maintenance and repair activities during the post-closure institutional control period.
- The disposal facility shall be designed to minimize the need for long-term maintenance and repair.

### Considerations for construction

The Notice of the MEST provides in detail the construction-related factors for the LILW disposal facility in detail. The construction of disposal facilities shall be based on proven engineering practices. When new construction methods are applied, their safety shall be proven with valid evidence. Detailed construction-related factors for the LILW disposal facility are specified in MEST Notice No. 2009-37 (Waste.006, Standards for the Structure and Equipment of Low and Intermediate Level Radioactive Waste Near-Surface Disposal Facilities) as follows:

- The construction of disposal facility shall adhere to the QA requirements.
- The disposal facility shall be constructed such that damage to the functions of natural barriers is minimized.
- 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.
- When the construction and operation stages overlap, construction shall be carried out so as not to wield any adverse effect on the operation safety of disposal facility.

### Considerations for closure

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

### Considerations for decommissioning

In terms of decommissioning, the radioactive waste management facility shall be considering of the following properties.

- Regarding liquid radioactive waste pipes, their length should be kept within possible limits, and care shall be taken to prevent the contamination of surrounding areas due to the leakage of liquid radioactive waste from the joints.
- Care shall 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 shall be secured to accommodate the remote handling components and safety monitoring components as necessary for future decontamination and decommissioning.
- For large tanks and components, a hoist shall be installed for easy decommissioning.
- Regarding piping systems transporting actually or potentially liquid radioactive materials, it shall be possible to use gravity for drainage.

## H.4.3. Implementation of design and construction related regulations

The LILW disposal facilities are divided into surface and underground facilities (see Figure H.4-1). Surface facilities consist of a receipt and storage building, radioactive waste processing buildings, service buildings and other supporting buildings. Here, radioactive waste is received from waste generators such as NPPs and verified to be consistent with the waste acceptance criteria. On-site treatment or conditioning is done, if necessary.

Underground facilities include construction tunnel, operation tunnel, access shaft,

unloading tunnel, and disposal silos. At first, six silos will be constructed approximately 80-130 meters below sea level to dispose of approximately 100,000 waste packages (see Figure H.4-2 Cross section view of the underground facilities). All disposal silos are reinforced with shotcrete and concrete lining. Most waste packages are packed using disposal concrete containers and subsequently disposed of in the disposal silos.

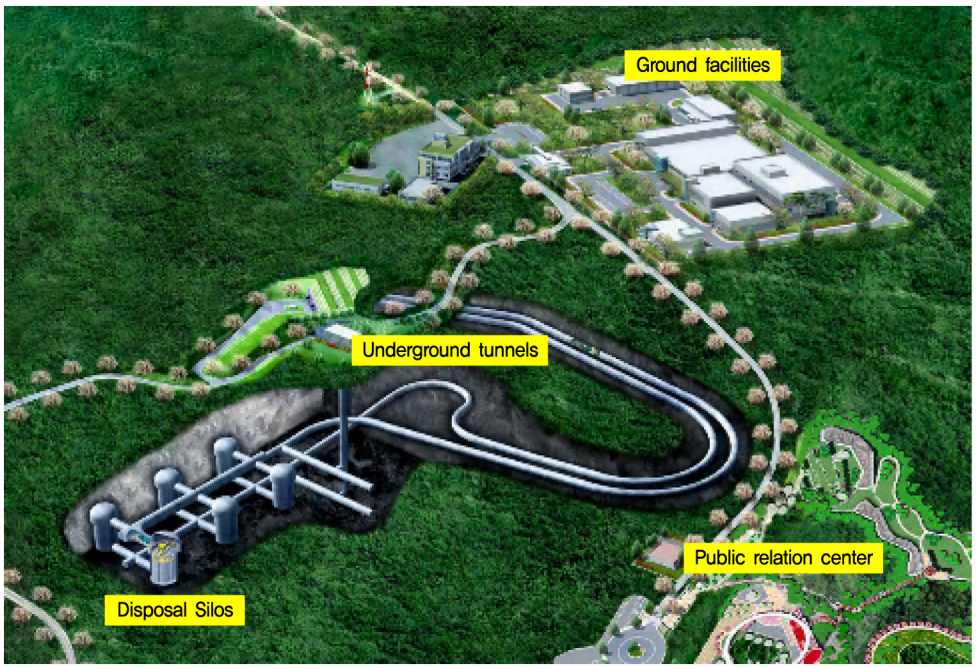


Figure H.4-1. Bird's eye view of the Wolsong LILW disposal center

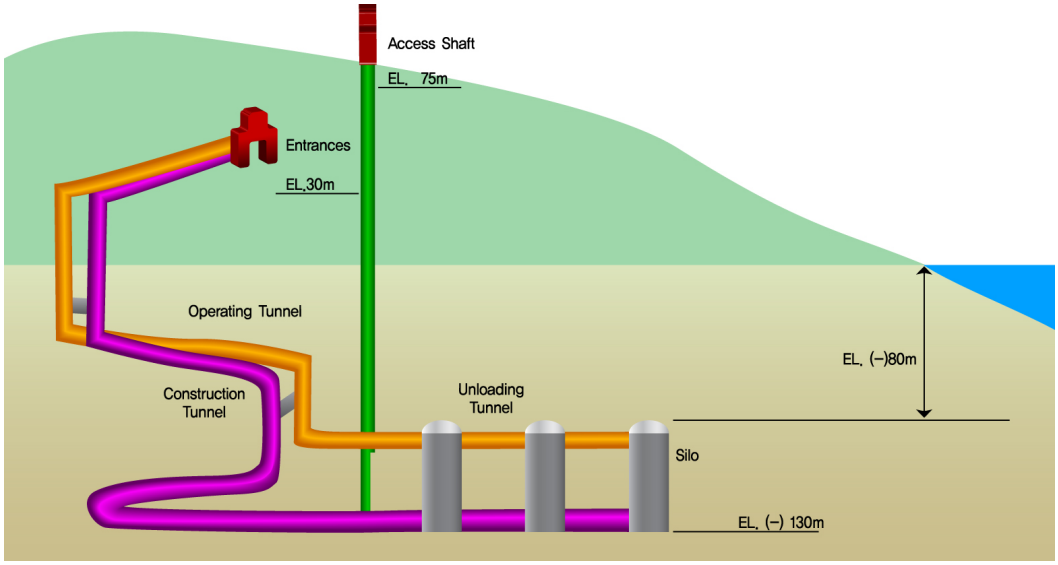


Figure H.4-2. Cross section view of the underground facilities

Among the underground facilities, excavation for the construction tunnel, operating tunnel and access shaft began in August 2008 and excavation of disposal silos started in February 2011. As of the end of June 2011, the construction tunnel, operating tunnel and access shaft are under excavation and concrete lining processes. The unloading tunnel and disposal silos are under excavation.

The constructor and operator of the LILW disposal facility shall have undergo preoperational inspection and performance in accordance with the provisions of the AEA. The purpose of the preoperational inspection is to check prior to operation whether the constructed disposal facility satisfies the related design and safety requirements. The disposal facility is considered to be qualified when it satisfies the provisions of the AEA and the related regulations.

The construction and operation license for the LILW disposal facility was issued in July 2008. Construction began in August. Preoperational inspection by the KINS began in September. Preoperational inspection for the LILW disposal facility is intended to check the appropriateness of the corresponding construction, performance and overall operation preparation status. The preoperational inspection consists of three stages; structural inspection in stage 1, system installation inspection in stage 2 and system performance inspection in stage 3.

# H.5 Safety assessment 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

The person who wishes to construct and operate radioactive waste disposal facilities shall submit in advance to the MEST an application for permit 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, safety evaluation of radioactive waste disposal facilities is conducted by permit applicants before the construction of facilities and by the regulatory body independently to determine whether to issue a permit after reviewing thoroughly and verifying the appropriateness of the safety assessment performed.

### Analysis through the safety analysis report

The SAR on radioactive waste disposal facilities mainly includes the results of safety assessment and accident analysis of anticipated events during the design, construction, operation, closure and post-closure institutional control of disposal facilities and auxiliary facilities. The main contents of the safety assessment and 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 thereafter,
- radionuclide leakage: under normal and abnormal conditions and in case of accidents,
- pathways through which radionuclides eventually reach the human body, and
- impact assessment and its compliance with the 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, the 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. When the predicted risk does not reach its maximum value within this period, however, verification that the leakage of radioactive materials into the surrounding environment will not increase drastically after this period, and that individuals will not be subject to acute radiation risk 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. 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 comprehensive evaluation shall be prepared and applied.

### Assessment through the radiological environmental report

The radiological environmental report on radioactive waste disposal facilities shall address the effects of 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 relevant site, and assessment of the predicted radionuclide concentration in groundwater release points located downstream of the site.

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

### Renewal of safety analysis

The MEST Notice No. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities) 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 relevant facilities 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 re-evaluated 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. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities) also stipulates that the following be reevaluated to verify the safety of radioactive waste disposal facilities prior to closure:

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

## H.5.3 Implementation of safety assessment and radiological environmental 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 SAR, radiological environmental report (RER), 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, the 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, with an in-depth review performed to confirm the suitability of the facility site and environment, appropriateness of the disposal system design and construction methods, and appropriateness of the safety assessment after the closure of the facility. It also determined technically whether the legal licensing standards have been met.

With a view to improving the public confidence and acceptability as to the safety of the first LILW disposal facility to be constructed in 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. As a result of the review, the IRT assessed the regulatory framework in place to be good and generally compatible with international standards. In addition, the IRT recommended and/or suggested that a few points be developed through the subsequent stages of the disposal facilities development in the area of safety assessment context. The IRT's comments had been prudently considered and reflected on the licensing safety review process, and additionally, the IRT is ensuring that safety is confirmed by reducing uncertainty in the construction and operation stage or that the disposal facility constructor and operator implements the subsequent actions after giving permission to matters requiring additional confirmation.

The KINS is reviewing the implementation results. The implementation and review of such subsequent actions are being conducted to secure objectivity and transparency for the long-term stability of the disposal system with a particular site characteristic (achieved in the course of constructing and operating the disposal facility) taken into account.

# 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 In-operation management standards

The MEST Notice No. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities) stipulates the standards for the in-operation management of disposal facilities, as follows:

### Performance of structures, systems and components (SSCs)

– For SSCs which are important to the safety of disposal facility and isolation of waste, they shall maintain the design performance stipulated by the MEST Notice on the structures and equipment of disposal facility and SAR of these facilities.

### Periodic surveillance

– SSCs of disposal facilities shall be surveyed in appropriate periods to confirm their agreement with the performance stipulated in 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 monitoring and controlling equipment,
- confirmation of performance of the radioactive waste management system,
- confirmation of performance of drainage equipment and ventilation equipment,
- confirmation of the performance of SSCs as necessary for 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 allowable 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 the disposal facility site in cases of actual contamination, the 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 abnormal state, the operators shall perform the necessary repair of the facilities to return them to 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 the disposal facilities, the environment surrounding these facilities shall be monitored in accordance with the regulations in the MEST Notices regarding radiological environmental investigations around nuclear reactor facilities and radiological environmental impact assessment.

**Emergency plans**

– Emergency plans that enable countering 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 humans, material, and public due to radiation. To make this possible, such standards shall include technical and administrative information on radiation safety control as necessary to receive, handle, store, transport, treat, 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,
- records and record keeping.

## H.6.3 Determination of operation-limiting conditions

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

- 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,
- physical protection.

## H.6.4 Operation procedures

The MEST Notice No. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities) stipulates the detailed technical standards described 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 requires facility operators to present the 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,
- institutional control standards, Etc.

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

### H.6.5 Engineering and technical support

The Technology Development Center of the KRMC is providing technical support through subsequent action following licensing and technology developments for preventing radiological hazards to public health and environment during the construction, operation, closure and institutional control period after closure, if necessary, by collaborating with external institutions.

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

To deliver radioactive waste packages to the operator of disposal facilities, the generator shall submit to the operator an "Application Form for the Consignment of receipt of Radioactive Waste" with a series of characterization data pertaining to the waste to be delivered. The major characterization data to be requested for the application for consignment are as follows:

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

The MEST Notice No. 2009-37 (Waste.007, Acceptance Criteria for Low and Intermediate Level Radioactive Waste) 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 the necessary safety measures and report to the MEST under the following cases:

- if radiological hazards occur,
- if failure occurs in nuclear facilities,
- 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. 2009-37 (Reactor.019, Regulation on Reporting and Public Announcement of Accidents and Incidents for Nuclear Power Utilization Facilities) stipulates in detail the incident reporting system. It includes the objects and means of and procedures for reporting, and classification of events and accidents. Particularly, the major objects for reporting as anticipated at radioactive waste management facilities are as follows:

- fire or leakage of radioactive materials during transport 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,
- release of radioactive materials exceeding the 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,
- 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. For its part, the MEST may take necessary measures including the collection of radioactive materials, the decommissioning of any and all contaminated facilities, and other such measures.

As established in the MEST Notice No. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities), when major systems and equipment are removed from radioactive waste management facilities, the safety of disposal facilities that are 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. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities) stipulates the requirements regarding the closure of radioactive waste disposal facilities. The closure of radioactive waste disposal facilities shall be carried out 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.

Prior to the actual closure of disposal facilities, various authorization and license documents including the safety analysis of the facilities shall reflect the latest revisions. In addition, the total amount of waste disposed of, records of abnormal events that have occurred during operation and with possible effect on 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 the predicted performance throughout the period stipulated in SAR upon at the completion of closure.

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

Based on 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.6.11 Implementation of safety regulations on the partial operation of disposal facility

The KRMC, established the partial operation plan for storing 1,000 drums of LILW of Ulchin NPP by constructing some of the ground facilities such as the radwaste receipt / storage building before the completion of the entire disposal facilities including the underground disposal storage (silo) to address the problem of insufficient storage space in the temporary radioactive waste storage inside the Ulchin NPP and applied for the alteration of disposal facility construction and operation permit in February 2009.

The KINS was entrusted by the MEST to check the terms of safety as well as whether all matters are appropriately prepared to store and manage waste using some ground facilities before the entire disposal facilities are completed. The results confirmed that all matters related to the partial operation of the radwaste receipt / storage building did not have safety problems and the MEST issued a permit for alteration in December 2009 through the review of a Special Committee on Nuclear Safety.

After obtaining the alteration permit for the disposal facility which allowed the partial operation of the radwaste receipt/storage building, the KINS conducted the preoperational inspection to confirm the safety of the partial operation of the radwaste receipt / storage building of the disposal facility in February 2010. The inspection involved examining the structure, radioactive waste system, power system, fire protection system and radiation monitoring system and confirmed that the radwaste receipt / storage building and related facilities (facilities to be used during the partial operation), were constructed in compliance with related regulations and procedures, and that they satisfied related safety requirements. Moreover, in November 2010, another application for an alteration permit was submitted to receive and store an additional 1,000 drums of LILW of the Wolsong NPP in the radwaste receipt / storage building to

resolve the problem of insufficient storage space in the Wolsong NPP. The safety matter was reviewed and the alteration permit was issued in December 2010. The radioactive waste currently stored in the receipt/storage building during the partial operation period will be examined through inspections to check the disposal suitability and will be disposed of after December 2012 when the underground storages (silo) of the disposal facility are completed.

After the outbreak of the nuclear accident in Fukushima, Japan (March 2011) caused by the earthquake in the northeastern region of Japan and the tsunami, KRMC carried out safety inspections in April 2011 in areas including the construction and operation of disposal facilities and prevention of radioactive disasters. The result of inspection in the design and construction area, operation area, emergency response system, and natural disaster confirmed that the facilities are installed, constructed, and operated in compliance with related standards. In particular, the inspection on the impact of natural disasters reviewed the radiological consequences under various conditions such as earthquake with the magnitude of the design basis (0.2g) or greater, typhoon accompanied by localized torrential downpours, fire, and failure of all power systems.

The KRMC prepared the carrier, container and vehicles for the transport of radioactive waste and shipped 1,000 drums of LILW from the Ulchin NPP to the disposal facility using the carrier (HANJIN CHEONGJEONG NURI) and stored them in the radwaste receipt/storage building of the disposal facility after obtaining the alteration permit and passing the preoperational inspection for partial operation. It also transported 1,000 drums of the LILW from Wolsong NPP to the disposal facility by land and stored them in the radwaste receipt/storage building. The KRMC has 5 radioactive waste transportation trucks (15t) and 300 transportation containers (IP-2 type).

The LILW carrier was safely designed and constructed in compliance with international standards of IAEA and International Maritime Organization (IMO) as well as domestic standards such as the Ship Safety Act and the AEA and was approved by the Ministry of Land, Transport and Maritime Affairs (MLTM). The safety of the ship and the appropriateness of the operation procedure were confirmed through inspection by the KINS. The carrier is equipped with the latest navigation equipment such as collision prevention radar and an automatic ship identification device that prevents ship collision. In addition its double hull structure is designed to prevent sinking and damage to radioactive waste containers even under emergency situations (Figure H.6-1).

Radiation shielding boards are also installed on freight holds to which radioactive waste is loaded to block the leakage of radiation to the outside and radiation monitors are installed on major points of the carrier to check for radiation leakage in real time. The entrance to the cabin is designed to prevent the intrusion of outside personnel by using a security system that opens the door through an identification procedure using fingerprint recognition technology. The carrier is operating the emergency response plans and

radiation protection plans it established to cope with unexpected accidents during shipment such as fire, collision, sinking, typhoon and tsunami and operates routine training for the crew to understand thoroughly the emergency response procedures and methods.

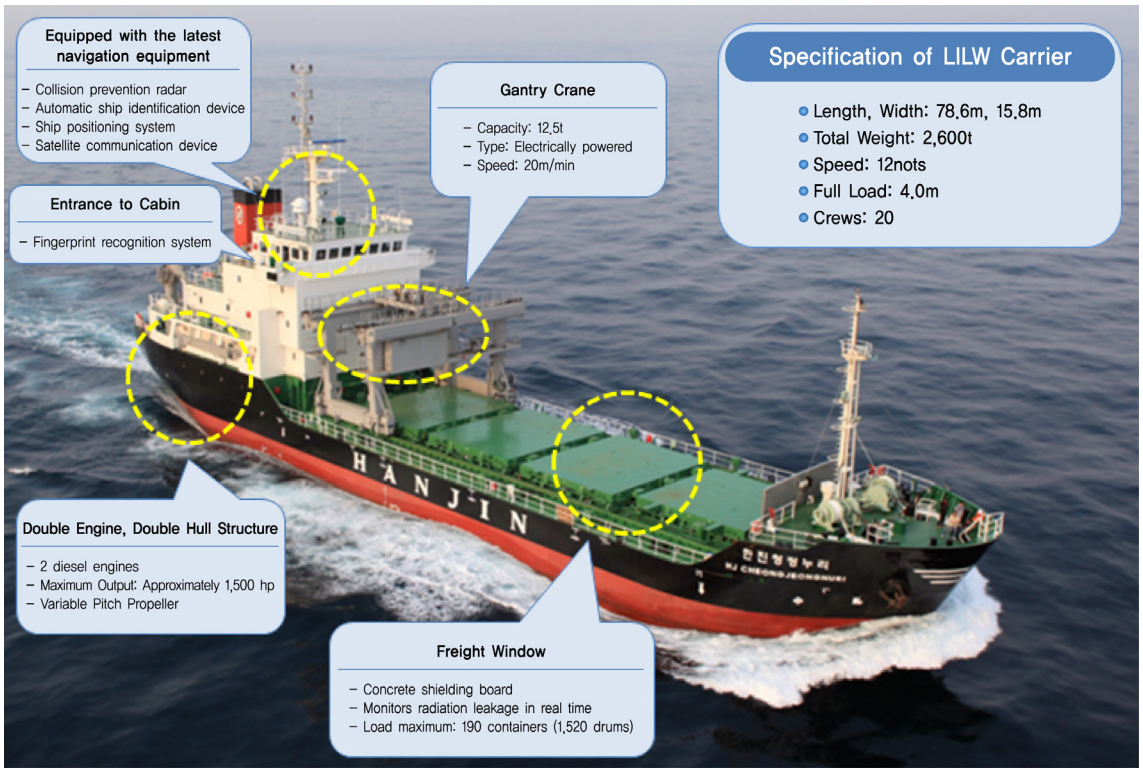


Figure H.6-1. Radioactive waste carrier

# 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:

records of the location, design and inventory of that facility required by the regulatory body are preserved;
active or passive institutional controls such as monitoring or access restrictions are carried out, if required; and
(i) 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. Related records, particularly, the location and design documents of the disposal facility are to be preserved in accordance with the QAP program.

With respect to the requirements regarding the keeping and preservation of records on radioactive waste disposal facilities, the items to be recorded, time when 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. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities). The major information to be recorded is as follows:

- radioactive waste-related records: manifest information, amount and type of relevant waste and disposal locations,
- radiation safety control-related records: radiation level of facilities and radiation workers' exposure dose,
- facility inspection records: preoperational inspection, regular inspection, and disposal inspection records,
- operation and maintenance records: results of inspection, surveillance, and maintenance of major equipment,
- 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 an annual basis: 1) site characteristics investigation documents; 2) facility design and construction-related data; 3) waste receipt 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 disposal facilities; 9) environmental monitoring records; 10) records of unintentional accidents during operation and after closure; 11) closure-related documents; 12) QA documents, and 13) institutional control plan and its results.

To preserve the records above, facility licensees shall establish the 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. 2009-37 (Waste.021, Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities), 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 the control plans, operators shall submit to the MEST a statement of the reasons for revision and revised control plans by June of the corresponding year before that when 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 relevant site,
- control methods (control items, control method per item),
- QA program regarding institutional control.

The institutional control period shall be established considering of the characteristics of the waste, engineering design, site characteristics of the disposal facilities, predicted social activities related to the relevant disposal facilities, 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 the performance objectives for the relevant disposal facilities.

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, that detailed control methods may be adjusted according to the results of systematic safety evaluation of the disposal facilities or the characteristics of the disposal facilities and site. Site monitoring shall meet the post-closure site monitoring plans regarding the disposal facilities in site characteristics reports or SAR.

### H.7.3 Intervention in 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 automatic blockage of relief valves shall be triggered when the 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 60 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)

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

The domestic regulations on 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 and the regulations based on this are applied to the transport of radioactive materials. Currently, Notices of the MEST related to the transport of radioactive materials are being revised in order to apply the latest version of the IAEA Regulations, published in 2009, to the transport of radioactive materials.

Articles related to the transport of radioactive materials are reflected in the AEA and its Enforcement Decree and Enforcement Regulations and Technical Standards of

Radiation Safety Management. Especially, Article 86 through 90, Article 90.2, and 90.3 of the AEA, Articles 235 through 239.2, 239.3, and 239.4 of its Enforcement Decree, Articles 90 through 99 of its Enforcement Regulations, Articles 83 through 122 of the Technical Standards for Radiation Safety Management provide the notification of transporting radioactive materials, the report of transport by foreign ship, the inspection of packing and transport, and the design approval, inspection for shipping cask

The detailed technical regulations on the safe transport of radioactive materials are described in the MEST Notice No. 2009-37 (Waste.002, Regulation on the Packaging and Transport of Radioactive Materials) and No. 2009-37 (Waste.019, Regulations for Manufactures and Periodical Inspection of Transport Containers for Radioactive Materials), respectively.

In addition, Korea joined the Antarctic Treaty in 1986 and the Protocol on Environmental Protection to the Antarctic Treaty in 1996, it has been conscientiously observing the obligations stipulated in the treaty and protocol (radioactive waste and radioactive material related articles, Etc.) in accordance with the Act on Antarctic Activities and the Protection of Antarctic Environment and its Enforcement Decree.

# I.2 Safety requirements

## I.2.1 General requirements

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

## I.2.2 Transport containers

The safety requirements for transport containers specify the safety requirements by type of transport container corresponding to the IP-type package, A-type package, B-type package, and packages containing fissile materials, at the same time 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 packaging limits by type of load, e.g., IP-type package, 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 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 said IAEA Regulations (ST-1).

The Enforcement Regulations of the AEA specify that the radioactive materials undergoing trans-boundary movement, should meet the regulation on packing and transport 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 less-dispersive radioactive material, and design approval for shipping casks specified in par. 801 IAEA ST-1, design approval for shipping casks, and special arrangements specified in par.312 IAEA ST-1. The MEST issues a design approval for radioactive material or shipping cask for which an application for design approval is made by model. As a rule, check the integrity of shipping casks through source surveillance when 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 manufacturing date to ensure safety in continued utilization.

### I.3.2 Report on transport

As for B-type packages, packages containing fissile materials, and packages requiring special arrangement approval 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 5 days before the date the transport is scheduled to commence, and the MEST should review said details, and issue an order to rectify factors apt to impair safety, if any, prior to transport. As for declared loads, transport surveillance or periodic inspections are conducted to check the possibility of violating transport regulations.

Moreover, a person who intends to have a ship or an airplane loaded with B(M)-type packages, B(U)-type packages containing large radioactive materials and packages requiring special arrangement approval upon arriving in any port or airport in Korea, or passing through Korean territorial waters or aerial routes shall notify the MEST accordingly not later than 7 days in advance to start operations after the loading of radioactive materials.

### I.3.3 Trans-boundary movement cases

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

# J. Disused Sealed Sources (Article 28)

# 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 RI waste management business for the safe treatment and storage of the RI wastes was established in October 1989. After the construction of the RI waste management facility at the KAERI, the RI waste was collected beginning August 1990, the RI waste management facility was operated until the end of 1996. The responsibility of RI waste management was transferred from the MEST to the MKE in 1996, currently the KRMC is responsible for the management and operation of the RI waste management facility according to the AEA and the EBA.

The RI waste management includes the storage and treatment of RI and radioactive waste generated from the licensees specified in Article 9 of the RWMA. The MKE is responsible for the administrative supervision of the management of RI wastes. Entrusted by the MEST, the KINS 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 KRMC by RI users directly, or through the 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 should have passed facility inspections by the KINS. Specifying matters on safety such as shielding, waste management, Etc. in the radiation safety report is compulsory including their safety management regulations with regard to the storage capacity of the facility, and to keep them safely. Currently, the KRMC safely stores and manages RI wastes in accordance with the AEA in the RI waste management facility of the KRMC located in Daejeon. The facility is annually inspected by the regulatory body.

## J.2.2 Management

### Procedures for 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 a RI utilization license issued by Minister of the MEST to import or purchase the RI or the radiation generating devices. The organizations of the RI utilization to import or purchase the RI or the radiation generating devices from abroad should meet the importation provisions of the KRIA. All the RI users or organizations to purchase the domestic RI 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 KRMC by RI users. Domestic RI users generating RI wastes as specified in the MEST Notice No. 2009-37 (Radiation.016, Regulations to be observed by Radioisotopes 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 of the KRMC, after the management cost is paid as provided for in the RWMA.

### Procedures for the operation & management of the RI waste management facility by the KRMC

The KRMC takes over disused sources of decayed radioactivity from RI users under Article 4 (Radioactive Waste Delivery Procedure and Method) of the Enforcement

Decree of the RWMA. In accordance with the MKE Notice No. 2009-195 (Regulation on the Calculation Standard for Radioactive Waste Management Expenses and Contribution to Spent Fuel Management), the KRMC operates the RI waste management facility and safely stores and manages RI wastes that have been received from RI users. The national RI waste management system is shown in Figure J.2-1.

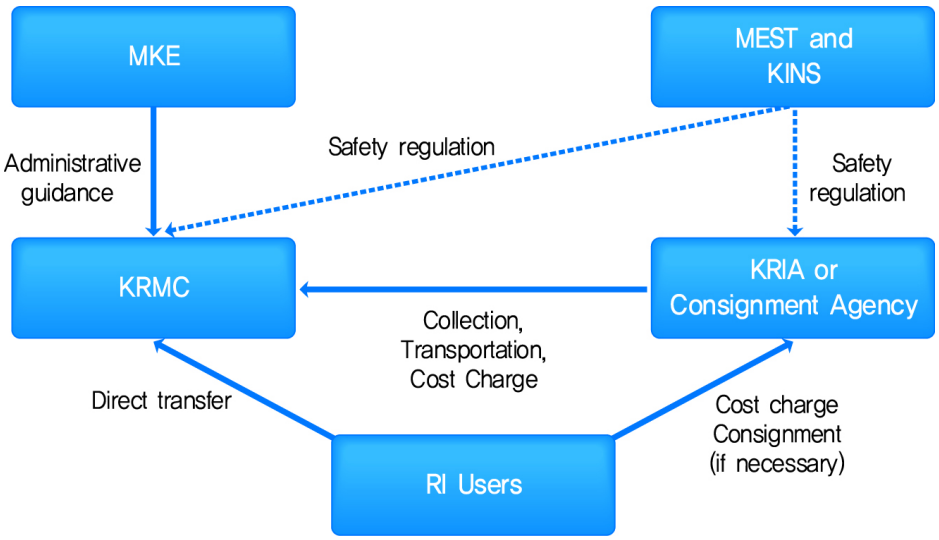


Figure J.2-1. RI waste management system

## J.2.3 Return

Currently, the sealed sources used in 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 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 can be returned to the seller in Korea. The return of disused sealed sources requires appropriate procedures that include meeting the import requirements set forth in the AEA. The disused sealed sources from abroad are then delivered to the KRMC RI waste management facility. To date, 1,181 disused sealed sources have been returned to Korea as of December 31, 2010.

# K. Planned Activities to Improve Safety

# K. Planned Activities to Improve Safety

## K.1 Establishment of national long-term road map for radioactive waste management technology

The government (MKE) will be completing the development of the "National Long-Term Road map for Radioactive Waste Management Technology" in 2011 to establish the technology development program covering a variety of technology fields required for the state control of radioactive waste. The purpose of this plan is to establish the road map for the overall technologies required for radioactive waste management, covering the transport, storage, treatment, and disposal of radioactive waste centering on the technological developments to be pursued until 2025. An effective investment strategy should also be established by distinguishing and prioritizing technology for domestic development or to be imported. The establishment of a long-term road map to reinforce international cooperation and cultivate professional manpower is made.

The technology fields and scope to be dealt with in the National Long-Term Road map for Radioactive Waste Management Technology until 2025 are as follows;

- step-by-step core technology development goals for each of the LILW transportation and disposal technologies including spent fuel transportation, storage, and disposal technologies,
- categorization of technologies and preparation of technology tree for achieving such goals,
- analysis of the current status of foreign technologies, comparison of domestic and foreign technologies,
- identification of the required (insufficient) technologies to enable the commercialization of domestic technologies,
- development of strategies and implementing system to secure the required (insufficient) technologies,
- identification of fields requiring international cooperation for the import of radioactive waste management technology,
- cooperation with the international society and its promotion system
- establishment of national technology road map reflecting the long-term human resources development program through industry-academe-research institute cooperation and project schedule.

## K.2 Development of HLW disposal requirements

Current nuclear laws in Korea specify the basic requirements for the deep geological disposal of HLW. Related technical standards (Notices of the MEST) are currently developed. Although system-specific characteristics such as domestic deep geological disposal sites are undefined, the Korea Institute of Nuclear Safety gives priority to the establishment of the generic criteria which is essential for the development of the disposal system considering the fact that the development of the corresponding technical standard is a matter of urgency for research and development on the deep geological disposal facility. In other words, the technical standard is being developed in the form of a comprehensive standard that reinforces the connection between the system and safety constructions which will become the basis of development of the disposal system with a view to developing such basis into a system-specific standard in the design stage for the future.

The following outlines the major draft details of this technical standard for which public opinion is being gathered as of June 2011 by reflecting on the standards and experiences of IAEA and the leading countries with the intent of enacting the standard in 2012.

- Define the concept of ‘deep’ into ‘more than 300 meters in depth’, concretizing the degree of sufficiency in two aspects, inside access and leakage outside. The site for a deep geological disposal facility must be an area with a low possibility of structural deformation and stabilized geologically throughout the performance compliance period.

- Apply the risk-based safety objectives and assessment methodologies considering the long-term hazard characteristics of HLW disposal. Make sure the total yearly risk of a single deep geological disposal facility does not exceed $10^{-6}$ to the representative person and also adjunctively limits the estimated exposure dose to the representative person from the single scenario down to 10 mSv or less a year. Set the safety assessment timeframe to 10,000 years for comparison of compliance with the safety objectives, but conduct the assessment over the period in which the performance of the disposal facility is required to prove that the acute radiation impact is not expected. Request for the development of auxiliary safety indicators such as natural analogues in order to improve the confidence of safety assurance.

- Have underground research facilities play a key role in the development of the disposal system. Pursue safety based on the intrinsic passive safety functions of

the disposal system. Consider the retrieval of waste during the operational phase, but develop the disposal system such that the need for and the possibility of retrieval after closure are minimized.

- Develop multiple-barrier and defense-in-depth in the manner of concretizing waste isolation performance of the barrier and intensifying its connection with disposal safety. Design engineered barriers to block the transport of the radioactive nuclides into the natural barrier along the flow of ground water under normal natural conditions for thousands of years after the closure of the disposal facility.

- Ensure system development, operational safety and disposal safety through a systematic construction of safety cases. Emphasize safety assessment and the recheck of safety functions in each step of the development of the disposal facility. In the context of the license application, prepare a basis for optimized system development, including alternative considerations, and the regulatory review in the development stage.

## K.3 Operation of the ATOMic Computerized technical Advisory system for a Radiological Emergency (AtomCare)

It is an important function of the nuclear power contingency measure to monitor the condition of a nuclear power plant in operation. In this respect, the ATOMic Computerized technical Advisory system for a Radiological Emergencies (AtomCare) plays a crucial function and role. The AtomCare system enables the KINS and the MEST, the national central regulatory authority, to monitor the status of nuclear power plants in real time by deploying a safety information network interlinking all of the local nuclear power plants currently in service.

This system has been established to identify the safety status of a power plant in the case of abnormal radiological events, predict radiological effects, and take prompt actions by collecting real-time data and performing radioactivity impact assessments and taking responsive measures. In addition, it incorporates the NPP Safety Information Display System (SIDS), IERNet, Radiological Emergency Meteorological Data Acquisition System (REMDAS), Radiation Source Term Assessment System (STES), Following Accident Dose Assessment System (FADAS), Geographical Information System (GIS), Automatic Information Notification System (AINS), and System Integration and Information Sharing System among Related Emergency Agencies.

Each module collects all data transmitted and confirms the safe operation of nuclear power plants in real-time on the net. If radioactive substances are released into the environment, the system predicts how far the substances will spread and provides contingency technical assistance to minimize damage to lives in the community and the environment.

AtomCare has expanded in accordance with the addition of new plants and new functions. To date, it has completed the integration of 21 nuclear power plants in Korea and HANARO. To streamline system maintenance and information systems, its operation is currently web-based. Figure K.3-1 shows the operation system of AtomCare.

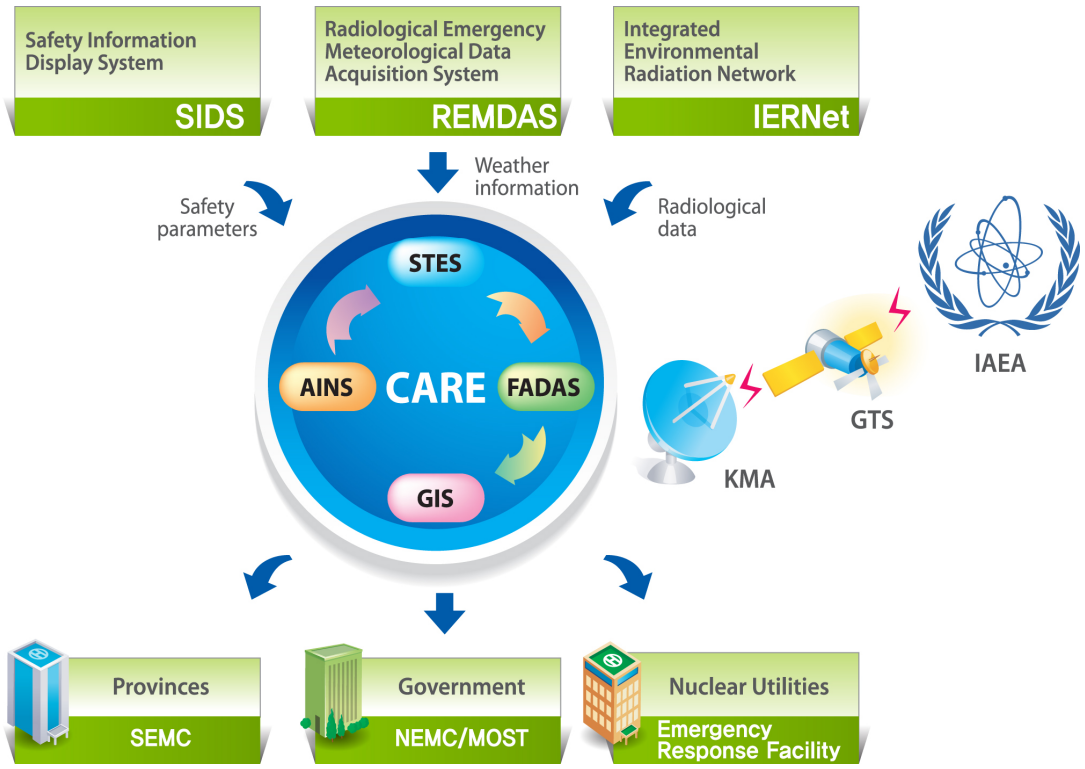


Figure K.3-1. System of the AtomCare

## K.4 Enactment of the Act on the establishment of the Nuclear Safety and Security Commission (NSSC)

The government will establish the Nuclear Safety and Security Commission (NSSC), an independent nuclear safety regulation agency directly responsible to the President, on October 26, 2011 for the separation and independence of nuclear safety operations. In June 2011, the National Assembly resolved revision of the AEA in relation to the establishment of the NSSC and the establishment and revision of related laws such as the Act on Establishment and Operation of NSSC, the Act on the establishment of Korea Institute of Nuclear Safety, Nuclear Safety Act, and Act on Measures for the Protection of Nuclear Facilities, Etc. and Prevention of Radiation Disasters.

Accordingly, the government is going to announce legislative bills for the establishment and revision of related laws in August 2011 through the revision of enforcement decrees and establish the NSSC as directly responsible to the President on October 26, 2011. NSSC will be exclusively in charge overall of safety regulations in nuclear areas such as the construction and operation of NPP, disposal and transportation of RI and radiation generating devices and licensing of nuclear fuel cycle management businesses. The commission will consist of 7~9 members including one chairman and one vice chairman. Experts from various parts of the society such as nuclear power and environment and health will also participate.

The establishment of the NSSC becoming independent from the MEST and the MKE which had been in charge of research and development of nuclear safety operations and the utilization of nuclear power is expected to make great contributions to the independence of nuclear safety and intensify professionalism.

## K.5 Outcomes of Integrated Regulatory Review Service (IRRS)

The Integrated Regulatory Review Service (IRRS) of the IAEA was carried out on July 10 ~ 22 to provide an objective evaluation of Korea's nuclear safety regulatory system and the effectiveness of its implementation in accordance with international safety standards.

IRRS reviews the regulatory framework, capacity, and activities of the applicant country to reinforce the Member State's nuclear safety regulation capacity and share the experience. Korea applied for the IRRS to the IAEA in August 2009, and the application was accepted by the IAEA in October in the same year. The Korean regulatory body prepared Advance Reference Materials (ARM) consisting of the written responses to approximately 1,250 standard questionnaires from the IAEA, self-assessment report, and other reference materials according to the schedule and submitted them to the IAEA, which in turn selected 20 nuclear safety experts from 14 Member States to form an IRRS Review Team for Korea.

The scope of this year's IRRS included the nuclear power reactor, research reactor, and the emergency preparedness and response. The IRRS Review Team provided a comprehensive, objective evaluation of ten modules including the Role of Government and Regulatory Body (responsibility, organization, and operation), Regulatory Activities (licensing, review and inspection, enforcement, regulations and guides), two Thematic Areas (periodic safety review and operating experience feedback), and five Policy Issues (Fukushima issues, independence, transparency and openness, continued operation, and aging management) within the scope. In particular, this year's IRRS is the first one organized after Japan's Fukushima Daiichi nuclear accident; thus drawing worldwide attention. Intensive, in-depth discussions on the relevance between the individual modules and the Fukushima issues continued throughout the IRRS Mission period.

The IRRS Review Team assessed Korea's nuclear safety regulation program as being implemented effectively through the activities of the MEST and KINS. Specifically, the Review Team evaluated Korea's response to the Fukushima nuclear accident as prompt and effective, and concluded that communications with the public, identification of actions for safety improvement, and international cooperation were of high quality.

The good practices identified by the IRRS Review Team are the clear and structured national approach for nuclear safety; strong supports to the global nuclear safety regime; high level of regulatory expertise and effective human capital program; comprehensive and integrated computerized information and data management system, and so on.

Likewise, continuous feedback of the review and assessment results, comprehensive safety evaluation based upon deterministic and probabilistic methods, comparisons to the IAEA safety standards in developing regulations and guides, and comprehensive response system to nuclear/radiological emergency received favorable evaluations. Nonetheless, there were also some issues that required improvement and supplementation in the future such as the regulatory system for the safe decommissioning of nuclear power plant, application of the quality assurance requirements for the education reactor, and so forth.

By preparing for and receiving the IRRS Mission, the Government could systematically examine whether the nuclear safety legislations and regulations, standards, and practices of Korea comply with the international standards as well as identify certain challenges that need to be improved in the future. The Government will also use the information obtained in the course of preparing for and receiving the IRRS Mission as important data for improving the effectiveness of the infrastructure for nuclear safety regulation.

The official results of the IRRS Mission to Korea will be received in the form of a Final Review Report around October 2011.

## K.6 Response of Korea to the Fukushima Accident

As a result of earthquake struck off the northeastern coast of Japan, the outer walls of the reactor buildings of Units 1, 2, 3 and 4 were damaged in those processes. And a large amount of radioactive materials was released to the environment, causing environmental radioactivity impact even on the countries near Japan, such as Korea.

In order to respond to the accident situations that occurred at Fukushima Daiichi Nuclear Power Stations of a neighboring country, Japan, Korea established emergency response organizational structures at government level. The MEST and KINS, being the regulatory body of Korea, set up an emergency operation center from March 11 and had been put on full alert to protect the general public from potential radiological impacts.

The Government established a task force team under the supervision of the Prime Minister's Office in order to control radiological emergency response capabilities of various government agencies. The roles of various pertinent agencies were coordinated through this task force, and each agency operates a necessary organization for emergency response. The MEST and KINS shared information everyday with pertinent agencies on the status of the Japanese nuclear accident, measured environmental radioactivity throughout Korea, daily meteorological data, results of contamination monitoring at airports and harbors, Etc. The information was also accurately disclosed to the general public through mass media. Following the Fukushima Daiichi accident, the MEST and KINS reduced the monitoring period for ambient dose rates from 15 minutes to 5 minutes at the 71 unmanned measurement centers of the country, and were disclosing the results through internet in real time. These efforts were made to set the general public at ease by disclosing these results.

As the contamination of Japan continues to get serious, a contamination monitoring had become necessary for all people entering Korea from Japan. Therefore, a contamination monitoring was carried out for those who were admitted into Korea from Japan through airports or harbors, starting from March 17 till June 8. Approximately a total of 300,000 were monitored, and out of these two persons were found to have been contaminated and so were decontaminated. The Ministry of Foreign Affairs and Trade (MOFAT) set up an emergency headquarters to respond to the Japanese accident, and performed protective actions for Korean people residing in Japan and Korean tourists to Japan through an emergency response team dispatched to the country.

Due to the severe accidents at Fukushima Daiichi Nuclear Power Stations in Japan, public concern about the safety of domestic nuclear power plants has greatly increased. The Government convened the Nuclear Safety Committee (NSC) on March, 21, 2011,

and decided to conduct a comprehensive Special Safety Inspection, based on the recommendation of the NSC, on the nuclear facilities in Korea. During the Special Safety Inspection, activities were focused on verifying if the nuclear facilities are adequately designed for responding to natural disasters, for preventing and mitigating severe accidents assuming the worst accident scenario resulting from natural disasters, and establishing a proper emergency response system for severe accidents.

The site inspection had been performed in nuclear power plants, research reactors and the nuclear fuel cycle facilities. The Special Safety Inspection team consists of 6 areas, 73 experts from industries, academic circles and research institutes. To ensure objectiveness and transparency of the inspection, the inspection plan was presented to the civil representatives before inspection, and collected opinions were reflected into the inspection scope. This Special Safety Inspection team conducts 27 inspection items deduced on the basis of extreme natural disasters, prevention of severe accidents, mitigation of severe accidents, emergency response. As for long-term in-service plants, the inspections confirming equipment integrity against aging degradation have been performed additionally.

The results of the Phase 1 Special Safety Inspection for nuclear power plants, research reactors and the nuclear fuel cycle facilities after the Fukushima Accident indicate that the nuclear power plants in Korea are safely designed and operated against the worst earthquake and tsunami predicted in the surveys and the researches so far. However, the Government has identified a total of 50 long- and short-term improvements for guaranteeing a cold shutdown of the nuclear power plants even in the worst natural disasters in view of the accident at the Fukushima Daiichi Nuclear Power Stations as shown in Table K.6-1.

As a Phase 2, the Government will start the measures for enhancing the safety regulation standards and guides for the nuclear power plants that are currently in operation and those under construction in view of the accidents at Fukushima. The action plan in Phase 3 will review the inspection results of the IAEA, EU stress test, and those in the U.S. and Japan.

The comprehensive emergency response activities of the Government to the Fukushima Accident were submitted to the IRRS Review Team, and an in-depth review was conducted throughout the IRRS Mission period as a major review area. The IRRS Mission Team concluded that Korea's response to the Fukushima accident as prompt and effective, and evaluated that communications with the public, identification of actions for improvement, and international cooperation were of high quality.

The Government will thoroughly implement 50 long- and short-term improvements

derived from the Special Safety Inspection of domestic nuclear power plants, and proceed with the follow-up reviews and research program in order to effectively reflect the lessons-learned from the Fukushima accident.

Table K.6-1. List of improvements from special safety inspection of nuclear power plants in Korea

| No. | Improvements | Action[1)] |
|---|---|---|
| 1 | Installing an automatic seismic trip system | short-term |
| 2 | Improving the seismic capacity of the safe shutdown system | mid- & long-term |
| 3 | Investigation and study on the maximum potential earthquake for NPP sites | mid- & long-term |
| 4 | Improving the seismic capacity of the main control room (i.e., the earthquake occurrence alarm window) | mid- & long-term |
| 5 | Improving the seismic capacity of the entrance bridge of Wolsong NPP | short-term |
| 6 | Extension of the height of the sea wall for Kori site | short-term |
| 7 | Investigation and study on the design basis sea water level of NPP sites | mid- & long-term |
| 8 | Investigating and researching NPP site's design basis sea water level | mid- & long-term |
| 9 | Enhancement of sea water intake capability and reinforcement of facilities in preparation of coastal flooding | mid- & long-term |
| 10 | Securing the availability of a portable electric power generator vehicle and batteries, Etc. | mid- & long-term |
| 11 | Upgrading design basis of AAC diesel generator | mid- & long-term |
| 12 | Fastening the spare transformers with anchor bolts and modifying the fuel injection port of emergency power supply system | short-term |
| 13 | Improving the management for switchyard facilities | mid- & long-term |
| 14 | Ensuring countermeasures against loss of the spent fuel pool cooling function | short-term |
| 15 | Preparing measures of the inundation prevention and restoration of the ultimate heat sink | mid- & long-term |
| 16 | Preparing countermeasures for damage of the outdoor tank | mid- & long-term |
| 17 | Preparing countermeasures for inundation of the main steam safety valve room and the emergency water pump room | mid- & long-term |
| 18 | Improving the fire protection plan and reinforcing cooperation systems | short-term |
| 19 | Improving fire protection facilities and response capability of plant firefighting team | mid- & long-term |
| 20 | Introducing a performance-based fire protection design | short-term |

| No. | Improvements | Action[1)] |
|---|---|---|
| 21 | Installation of passive hydrogen removal equipment | mid- & long-term |
| 22 | Installation of filtered vent system or depressurizing facilities in the containment buildings. | mid- & long-term |
| 23 | Installation of reactor injection flow paths for emergency cooling water injection from external sources | mid- & long-term |
| 24 | Reinforcing education and training for severe accidents | short-term |
| 25 | Revision of the Severe Accident Management Guidelines to enhance the effectiveness | short-term |
| 26 | Development of Low-Power Shutdown Severe Accident Management Guidelines | short-term |
| 27 | Securing additional radiation protection equipment for protecting residents near NPP | short-term |
| 28 | Amending the emergency plan to include such events as the simultaneous emergency at multiple units | short-term |
| 29 | Securing additional protective equipment in preparation for prolonged emergency | short-term |
| 30 | Securing additional equipment of emergency medical institutes | mid- & long-term |
| 31 | Reinforcing radiological emergency exercises | short-term |
| 32 | Devising a means of securing the necessary information in case of a prolonged loss of electrical power | mid- & long-term |
| 33 | Securing countermeasures for protecting maintenance workers | short-term |
| 34 | Improving the emergency response facilities | mid- & long-term |
| 35 | Amending the information disclosure procedure in the event of a radiation emergency | short-term |
| 36 | Evaluating protective measures for residents who live beyond the emergency plan zone | mid- & long-term |
| 37 | Reinforcing the performance of emergency alarm facilities | mid- & long-term |
| 38 | Drastically reinforcing the safety inspections, such as regular inspections | short-term |
| 39 | Reinforcing the in-service inspection of the main components and pipes | short-term |
| 40 | Establishing and implementing an integrated management method for the aging management program | short-term |
| 41 | Reinforcing the management of the performance parameter of the main active components | short-term |

| No. | Improvements | Action[1)] |
|---|---|---|
| 42 | Install a fatigue monitoring system to reinforce quantitative fatigue management | mid- & long-term |
| 43 | Reinforcing the fatigue integrity of the pressurizer lower head | short-term |
| 44 | Increasing the reliability of shutdown-inducing equipment | short-term |
| 45 | Evaluating the adequacy of operators | mid- & long-term |
| 46 | Increasing the reliability of station power supply systems | mid- & long-term |
| 47 | Reinforcing the quality assurance on purchasing components important to safety | short-term |
| 48 | Evaluating the seismic capacity and improving the main control room | short-term |
| 49 | Re-evaluating the site's inundation depth for HANARO and additional facilities | short-term |
| 50 | Amending the radiological emergency plan to reflect the complicated radiological emergency conditions | short-term |

1) short-term: to be finished in 2012, mid- & long-term: to be finished in 2013-2015

## K.7 Establishment of spent fuel management policies

The government decided to "establishment through with LILW disposal facility and spent fuel interim-storage facility sites separately while going ahead with spent fuel management under national consensus based on medium- and long-term review considering the direction of national policies and trend of domestic and foreign technology development" at the 253rd AEC in December 2004.

According to this decision, the government organized the task force team for spent fuel stakeholder consensus and Conflict Management Committee under the National Energy Commission headed by the President in April 2007 and proceeded with reviews and discussions on stakeholder consensus for spent fuel. The task force team summarized the results of discussions on the vision and principles to collect public opinion by involving the public in resolving the issue of spent fuel management considering the circumstances of Korea, subject of stakeholder consensus and methodology, and schedule and submitted the "recommendation report of stakeholder consensus" to the government in April 2008.

In addition, this requirement report cited the practicality of giving priority to the interim-storage management plan for stakeholder consensus until the best and verified final management plans are drawn since it takes quite a bit of time for the final decision to be made and implemented as to how to manage spent fuel.

The government originally intended to push through with stakeholder consensus in full scale based on this requirement report beginning the second half of 2009, only to change its policy for the stakeholder consensus plan since there was increasingly strong opinion that stakeholder consensus must be preceded by the establishment of a legal basis for stakeholder consensus and in-depth review of alternatives for spent fuel management centering on expert groups.

The government amended the RWMA in December 2009 to provide the basis for pushing through with stakeholder consensus. It has been engaged in collecting expert advice since December 2009 to provide scientific and technological basis for the management of spent fuel and form a consensus within expert groups.

This project seeks to provide an in-depth review of the short-, medium-, and long-term management alternatives through spent fuel expert groups, develop a management road map, secure a scientific, technological foundation for spent fuel management alternatives, and form a consensus on spent fuel management alternatives within expert

groups. For its part, the government will establish a national policy for spent fuel management by determining the appropriate time for pushing through with stakeholder consensus and its method and schedule based on the results of this project.

# Annexes

# Annex A List of Spent Fuel Management Facilities (as of December 31, 2010)

Annex A-1. Spent fuel storage facilities at NPP sites

| Facility | Location | Storage Type | Inventory [MTU] | Total Capacity (*) [MTU] | Reactor Type |
|---|---|---|---|---|---|
| Kori Unit 1 | Gijang-gun, Busan | Wet | 109.4 | 164 | PWR |
| Kori Unit 2 | | Wet | 301.7 | 313 | PWR |
| Kori Unit 3 | | Wet | 763.4 | 888 | PWR |
| Kori Unit 4 | | Wet | 650.5 | 888 | PWR |
| Shin-Kori Unit 1 | | Wet | 0 | 219 | PWR |
| Yonggwang Unit 1 | Yonggwang-gun, Jeollanam-do | Wet | 525.8 | 888 | PWR |
| Yonggwang Unit 2 | | Wet | 410.2 | 420 | PWR |
| Yonggwang Unit 3 | | Wet | 295.4 | 470 | PWR |
| Yonggwang Unit 4 | | Wet | 277.8 | 470 | PWR |
| Yonggwang Unit 5 | | Wet | 153.1 | 219 | PWR |
| Yonggwang Unit 6 | | Wet | 150.2 | 219 | PWR |
| Ulchin Unit 1 | Ulchin-gun, Gyeongsangbuk-do | Wet | 398.9 | 404 | PWR |
| Ulchin Unit 2 | | Wet | 370.4 | 382 | PWR |
| Ulchin Unit 3 | | Wet | 257.5 | 552 | PWR |
| Ulchin Unit 4 | | Wet | 279.1 | 552 | PWR |
| Ulchin Unit 5 | | Wet | 126.9 | 219 | PWR |
| Ulchin Unit 6 | | Wet | 104.2 | 219 | PWR |
| Wolsong Unit 1 | Gyeongju, Gyeongsangbuk-do | Wet | 757.2 | 801 | PHWR |
| Wolsong Unit 2 | | Wet | 695.3 | 801 | PHWR |
| Wolsong Unit 3 | | Wet | 743.9 | 801 | PHWR |
| Wolsong Unit 4 | | Wet | 714.1 | 801 | PHWR |
| Wolsong Dry Storage | | Dry | 3,285.4 | 6,237 | PHWR |

* : except for emergency cores

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

| Facility | Location | Storage Type | Fuel Type | Total Capacity (MTU) | Inventory [MTU] |
|---|---|---|---|---|---|
| HANARO spent fuel storage pool | Yuseong-gu, Daejeon | Wet | HANARO 36 element fuel assembly | 1.3 | 0.5 |
| | | | HANARO 18 element fuel assembly | 0.6 | 0.2 |
| PIEF spent fuel storage pool | Yuseong -gu, Daejeon | Wet | PWR spent fuel assembly | 10.5 | 3.3 |

# Annex B List of Radioactive Waste Management Facilities (as of December 31, 2010)

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

| Facility | Location | Purpose | Operation Year | Capacity [200 Liter Drum] | Inventory [200 Liter Drum] |
|---|---|---|---|---|---|
| Kori No. 1 | Gijang-gun, Busan | Temporary storage of radioactive wastes generated from Kori Units 1~4 | 1978 | 10,000 | 9,319 |
| Kori No. 2 | | | 1979 | 6,000 | 5,999 |
| Kori No. 3 | | | 1987 | 11,200 | 10,092 |
| Kori No. 4 | | | 1993 | 23,000 | 14,444 |
| Managed areas and other facilities | | - | - | - | 816 |
| Kori Total | | | | | 40,670 |
| Wolsong No. 1 | Gyeongju, Gyeongsang buk-do | Temporary storage of radioactive wastes generated from Wolsong Units 1 ~ 4 | 1983 | 9000 | 9,749 |
| Managed areas and other facilities | | - | - | - | 53 |
| Wolsong Total | | | | | 9,802 |
| Yonggwang No. 1 | Yonggwang -gun, Jeollanam-do | Temporary storage of radioactive wastes generated from Yonggwang Units 1, 2 | 1986 | 13300 | 10,872 |
| Yonggwang No. 2 | | Temporary storage of radioactive wastes generated from Yonggwang Units 1~6 | 2002 | 10000 | 8,670 |
| Managed areas and other facilities | | - | - | - | 1,583 |
| Yonggwang Total | | | | | 21,125 |
| Ulchin No. 1 | Ulchin-gun, Gyeongsang buk-do | Temporary storage of radioactive wastes generated from Ulchin Units 1, 2 | 1989 | 7400 | 5,857.5 |
| Ulchin No. 2 | | Temporary storage of radioactive wastes generated from Ulchin Units 1~ 6 | 1997 | 10000 | 5,561.5 |
| Managed areas and other facilities | | - | - | - | 4,160 |
| | | | | | 15,579 |
| Total | | | | | 87,176 |

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 [200L drum] |
|---|---|---|---|---|
| Storage | Yuseong -gu, Daejeon, | LILW generated in research facility | KAERI | 16,018 |

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

| Facility | Location | Purpose | Operation Year | Facility Feature | |
|---|---|---|---|---|---|
| | | | | Process | Throughput |
| Radioactive waste treatment facility (RWTF) | Yuseong -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. Combustible waste treatment facility at the KAERI

| Facility | Location | Purpose | Operation Year | Treatment Capacity | |
|---|---|---|---|---|---|
| Combustible waste treatment facility | Yuseong-gu, Daejeon | Incineration:<br>- RI waste<br>- Radioactive waste generated from the KAERI | 2011 | Combustible waste | 20 kg/h |

Annex B-6. Storage facilities for radioactive waste

| Facility | Location | Purpose | Operator | Operation Year | Capacity [200L drum] | Inventory [200L drum] |
|---|---|---|---|---|---|---|
| 2nd floor of storage No. 1 | Yuseong-gu, Daejeon | Storage of radioactive waste | KEPCO NF | 1993 | 3,000 | 3,748 |
| 1st floor of storage No. 1 | | | | 2004 | 1,900 | |
| Storage No. 2 | | | | 1998 | 4000 | 2,298 |
| Total | | | | | | 6,046 |

Annex B-7. Radioactive waste treatment systems in nuclear fuel fabrication facility

| Facility | Location | Purpose | Operator | Operation Year | Characteristics | |
|---|---|---|---|---|---|---|
| | | | | | Throughput | Main Process |
| PWR liquid waste treatment system in Plant 1 | Yuseong-gu, Daejeon | Liquid waste treatment | KEPCO NF | 1988 | 18 $m^3$/d | Lime precipitation and centrifuge |
| PWR liquid waste treatment system in Plant 2 | | | | | | |
| PHWR liquid waste treatment system in Plant 2 | | | | | | 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-8. RI waste management facility

| Facility | Location | Purpose | Operator | Operation Year | Capacity [200L drum] | Inventory [200L drum] |
|---|---|---|---|---|---|---|
| RI waste management facility | Yuseong-gu, Daejeon | RI waste interim storage | KRMC | 1993 | 9,750 | 3,488 |

Annex B-9. LILW disposal facility (radwaste receipt / storage building)

| Facility | Location | Purpose | Operator | Operation Year | Storage Capacity [200-Liter Drum] | Inventory [200-Liter Drum] |
|---|---|---|---|---|---|---|
| LILW disposal facility (radwaste receipt / storage building) | Gyeongju, Gyeongsang buk-do | Radioactive waste receipt / storage | KRMC | 2010 | 4,000 | 2,000 |

# Annex C List of Nuclear Facilities under Decommissioning (as of December 31, 2010)

| Facility | Location | Licensee | Specification | Year | | Status | Estimated Radioactive Waste | |
|---|---|---|---|---|---|---|---|---|
| | | | | Operation | Closure | | Weight [ton] | Total Radio-activity [TBq] |
| KRR-1 | Nowon-gu, Seoul | KAERI | TRIGA Mark-II (250 kWth) | 1962 | 1995 | Under decommiss-ioning | 54.1 | 1.7E-3 |
| KRR-2 | | | TRIGA Mark-III (2 MWth) | 1972 | 1995 | | 380.9 | 6.9E-1 |
| UCF | Yuseong-gu, Daejeon | | ADU [1] AUC [2] (100Ton/y) | 1982 | 1992 | | 1,689 | 4.9E-5 |

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.

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

**Regulation on the Packaging and Transport of Radioactive Materials (No. 2009-37, MEST.waste.002)**

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.

**Technical Standards for the Location of Low and Intermediate Level Radioactive Waste Disposal Facilities (No. 2009-37, MEST.waste.004)**

The criteria specify the minimum technical criteria on site conditions of near-surface disposal facilities for the LILW with the provision of the Enforcement Decree of the AEA.

**Technical Standards for the Location of Interim Storage Facilities of Spent Nuclear Fuel (No. 2009-37, MEST.waste.005)**

The regulation aims to specify the minimum technical criteria on site conditions of the interim storage facility for spent fuel with the provision of the Enforcement Decree of the AEA.

**Standards for the Structure and Equipment of Low and Intermediate Level Radioactive Waste Near-Surface Disposal Facilities (No. 2009-37, MEST.waste.006)**

The criteria stipulate the minimal requirements on structure and equipment that must be considered in relation to the construction and installation of the LILW Disposal Facilities.

**Acceptance Criteria for Low and Intermediate Level Radioactive Waste (No. 2009-37, MEST.waste.007)**

The criteria purpose to define delivery methods, plan and procedures and other necessary details needed upon consignment of the delivery of disposal of the LILW to operator as well as specific guideline of waste acceptance which should satisfy at the time of disposal of waste.

**Quality Assurance Standards for Radioactive Waste Management Facilities (No. 2009-37, MEST.waste.010)**

This criteria purpose to define the necessary details on QAPs for the LILW disposal facilities and spent fuel interim storage facility. The criteria applies to the site characteristics investigation, design, operation, closure and institutional control of the LILW disposal facilities and site characteristics investigation, design, construction and operation for spent fuel interim storage facility, respectively.

**Radiological Protection Criteria for Long-term Safety on Low and Intermediate Level Radioactive Waste Disposal (No. 2009-37, MEST.waste.011)**

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 the LILW 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.

**Guidelines for the Preparation of Site Characteristic Report for Low and Intermediate Level Radioactive Waste Disposal Facilities (No. 2009-37, MEST.waste.013)**

The regulation defines the matters regarding site characteristics report for the LILW disposal facilities. This regulation will be applied to near-surface disposal and rock-cavity disposal for the LILW 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.

**Guidelines for Preparing the Report on the Site Characteristics of Interim Storage Facilities for Spent Nuclear Fuel (No. 2009-37, MEST.waste.014)**

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.

**Acceptance Criteria for Spent Nuclear Fuel (No. 2009-37, MEST.waste.015)**

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.

**Regulations on the Clearance of Radioactive Waste (No. 2009-37, MEST.waste.016)**

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.

**Incineration Criteria of Low and Intermediate Level Radioactive Wastes (No. 2009-37, MEST.waste.018)**

This criteria purpose is to provide technical details for incinerator facilities of the LILW in order to secure the operational safety at the time of incineration treatment of radioactive waste.

**Regulations for Manufactures and Periodical Inspection of Transport Containers for Radioactive Materials (No. 2009-37, MEST.waste.019)**

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.

**Technical Standards for the Structure and Equipment of Radioactive Waste Disposal Facilities (No. 2009-37, MEST.waste.020)**

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 the LILW.

**Technical Requirements for the Operation and Control of Low and Intermediate Level Radioactive Waste Disposal Facilities (No. 2009-37, MEST.waste.021)**

The regulation purposes to manage disposal facilities safely, prevent disasters due to disposal facilities, and protect the environment by defining detailed technical standards regarding the management of disposal facilities for the LILW. This regulation will be applied to the management, closure, and institutional control of disposal facilities of the LILW and their safety assessment on normal and abnormal events which are likely occurred during the operation, closure, and institutional control of disposal facilities.

**Guidelines for Preparation of Safety Analysis Report for Low and Intermediate Level Radioactive Waste Disposal Facilities (No. 2009-37, MEST.waste.022)**

This guide purposes to define the matters related to the composition of the safety analysis report for the LILW disposal facilities. This guide will be applied to the safety evaluation and accident analysis for the design, construction, and management of the disposal facilities for the LILW and of their accompanying facilities, and for problems anticipated during the institutional control period.

**Regulations for the Inspection on Disposal of Low and Intermediate Level Radioactive Waste (No. 2009-37, MEST.waste.023)**

The Regulation aims to establish requirements needed to inspect the disposal of the LILW 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.

**Technical Standards for the Radiation Safety Control, Etc. of the Vessel used for carrying Low- and Intermediate-Level Radioactive Waste (No. 2009-37, MEST.waste.024)**

The regulation purposes to provide technical details for radiation safety management of the LILW transport ships.

## Radiation

**Standards for Radiation Protection, Etc. (No. 2009-37, MEST.radiation.001)**

The purpose of the standards lies in establishing standards related to radiation protection according to the regulations for radiation protection in the AEA. Especially included is classification of radioactive waste, definition of effluent control limits, and radiological design limits to prevent human and environments from radiation hazards, which applies to the design of the radioactive waste management facilities.

## Reactor Facilities

**Standard Format and Content of Radiation Environmental Report for Nuclear Power Utilization Facilities (No.2009-37, MEST.reactor.006)**

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 Survey of Radiation Environment and Assessment of Radiological Impact on Environment in Vicinity of Nuclear Power Utilization Facilities (No. 2010-32, MEST.reactor.007)**

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 Reporting and Public Announcement of Accidents and Incidents for Nuclear Power Utilization Facilities (No. 2009-37, MEST.reactor.019)**

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 Notices of the MKE Applicable to Radioactive Waste Management

**Regulation on the Calculation Standard for Radioactive Waste Management Expenses and Contribution to Spent Fuel Management (No. 2009-195)**

The regulation purposes to describe the necessary details regarding cost of radioactive waste management expense, the contribution to spent fuel management, and the liability for NPP decommissioning expenses.

**Regulation on the Utilization and Management of Radioactive Waste Management Fund (No. 2011-26)**

The regulation purposes to describe the necessary details regarding utilization and management of the radioactive waste management fund.

**Regulation on Radioactive Waste Receiving Method (No. 2011-27)**

The regulation purposes to describe the necessary details regarding receiving method and procedure required by radioactive waste management operators in receiving the LILW and RI waste generated from nuclear facilities.

# Annex H References

## ❑ Domestic

1) Atomic Energy Commission, National Radioactive Waste Policy, 1998

2) Ministry of Education, Science and Technology (MEST), Nuclear Safety Policy Statement, September 1994

3) MEST, White Paper on Nuclear Safety, April 2010

4) Ministry of Knowledge Economy (MKE) / Korea Hydro and Nuclear Power Co., White Paper on Nuclear Development, August 2008

5) Special Act on Supporting the Local County Around the low and intermediate level Radioactive Waste Disposal Facility, March 2005

## ❑ 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

The MEST/KINS Joint Working Group prepared this report on behalf of the Ministry of Education, Science and Technology, Republic of Korea, in consultation with and incorporating contribution from organizations below.

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Keyword : Radioactive Waste Safety Convention, Radioactive Waste Management,
Spent Fuel Management, National Report, International Safety System, Nuclear Facilities

ISBN 978-89-93507-18-8 (Print, Korean),
ISBN 978-89-93507-19-5 (Print, English)
ISBN 978-89-93507-20-1 (e-book, Korean),
ISBN 978-89-93507-21-8 (e-book, English)

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|---|---|
| Date of issue | 2011.10.14 |
| Publisher | Lee, Ju-Ho |
| Editor | Ministry of Education, Science and Technology |
| Published by | Korea Institute of Nuclear Safety<br>62, Gwahak-ro, Yuseong-gu, Daejeon, Korea 305-338,<br>Tel: +82-42-868-0296<br>http://www.kins.re.kr |
| Book No. | ISBN 978-89-93507-18-8 (Print, Korean),<br>ISBN 978-89-93507-19-5 (Print, English)<br>ISBN 978-89-93507-20-1 (e-book, Korean),<br>ISBN 978-89-93507-21-8 (e-book, English) |

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9 788993 507195
ISBN 978-89-93507-19-5