Korean Seventh National Report

under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

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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 instruments of ratification on September 16, 2002.

This National Report was prepared in accordance with the "Guidelines Regarding the Form and Structure of National Reports (INFCIRC/604/Rev.3)" under the Joint Convention and described the implementation status by reflecting the observations given in the Summary Report of the 6th Review Meeting. 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 March 31, 2020, 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, 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 Nuclear Safety and Security Commission (NSSC), Korea Institute of Nuclear Safety (KINS), Korea Radioactive Waste Agency (KORAD), Korea Atomic Energy Research Institute (KAERI), Korea Hydro & Nuclear Power Co., Ltd (KHNP), Korea Electric Power Corporation Nuclear Fuel Co., Ltd (KEPCO NF).

CONTENTS

List of Abbreviation

ADAMO	Accident Dose Assement Model
AEC	Atomic Energy Committee
AEPC	Atomic Energy Promotion Committee
AFR	Away From Reactor
ALARA	As Low As Reasonably Achievable
APPRE	Act on Physical Protection and Radiological Emergency
AtomCARE	Atomic Computerized Technical Advisory System for the Radiological Emergency
CANARE	Convention on Early Notification of a Nuclear Accident
CENNA	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
CP	Construction Permit
DAW	Dry Active Waste
EAB	Exclusion Area Boundary
ECL	Effluent Control Limit
EOF	Emergency Operating Facility
EPZ	Emergency Planning Zone
ERIX	Emergency Response Information eXchange system
FSAR	Final Safety Analysis Report
HANARO	High-flux Advanced Neutron Application Reactor
HEPA	High-Efficiency Particulate Air
HLW	High Level Radioactive Waste
IAEA	International Atomic Energy Agency
IERNet	Integrated Environmental Radiation Network
INES	International Nuclear Event Scale
INSS	International Nuclear Safety School
IRRS	Integrated Regulatory Review Service
KAERI	Korea Atomic Energy Research Institute
KEPCO NF	Korea Electric Power Corporation Nuclear Fuel Co., Ltd
KHNP	Korea Hydro & Nuclear Power Co., Ltd.
KINS	Korea Institute of Nuclear Safety
KINAC	Korea Institute of Nuclear Nonproliferation and Control

CONTENTS

List of Abbreviation

KIRAMS	Korea Institute of Radiological and Medical Science
KoFONS	Korea Foundation of Nuclear Safety
KORAD	Korea Radioactive Waste Agency
KRR	Korea Research Reactor
KRMC	Korea Radioactive Waste Management Corporation
LEMC	Local Emergency Management Center
LILW	Low and Intermediate Level Radioactive Waste
ME	Ministry of Environment
MOEL	Ministry of Employment and Labor
MOLIT	Ministry of Land, Infrastructure and Transport
MOST	Ministry of Science and Technology
MOTIE	Ministry of Trade, Industry and Energy
MSIT	Ministry of Science and ICT
NEMC	National Emergency Management Committee
NREMC	National Radiation Emergency Medical Center
NPP	Nuclear Power Plant
NSA	Nuclear Safety Act
NSSC	Nuclear Safety and Security Commission
NSIC	Nuclear Safety Information Center
OEMC	Off-site Emergency Management Center
OL	Operation License
PAZ	Precautionary Action Zone
PECOS	Public Engagement Commission on Spent Nuclear Fuel Management
PGIS	Public protective Geographic Information System
PHWR	Pressurized Heavy Water Reactor
PIEF	Post-Irradiation Examination Facility
POMS	Plant Operation Monitoring System
PSAR	Preliminary Safety Analysis Report
PSR	Periodic Safety Review
PWR	Pressurized Water Reactor
QA	Quality Assurance
QAP	Quality Assurance Program

List of Abbreviation

RAWIS	Radiation Workers Information System
RCA	Radiation Control Area
REDMAS	Radiological Emergency Management Data Acquisition System
RER	Radiation Environmental Report
RI	Radioisotope
RWMA	Radioactive Waste Management Act
SAR	Safety Analysis Report
SIDS	System Information Display System
SIR	Site Investigation Report
SIREN	System for Identifying Radiation in Environments Nationwide
SSC	Structures, Systems and Components
STES	Source Term Evaluation System
UCF	Uranium Conversion Facility
UPZ	Urgent protective action Planning Zone
WACID	Waste Comprehensive Information Database

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

List of Tables

CONTENTS

List of Figures

A Introduction

A.1 Preface

Since Kori Unit 1 started commercial operation in April 1978, Korea has continued to construct and operate nuclear power plants (NPPs), and as of March 31, 2020, has 24 units in operation.

Kori Unit 1, Korea's 1st pressurized water reactor (PWR) was permanently shut down in June 2017, and is now under preparation for decommissioning. Wolsong Unit 1, Korea's 1st pressurized heavy water reactor (PHWR) was also shut down permanently in December 2019, and is under preparation for decommissioning.

After the Fukushima accident in 2011, the Korean government established the Nuclear Safety and Security Commission (NSSC) under the President in October 2011 to enhance the independence and transparency of nuclear safety regulation. (Later the commission was transferred under the Prime Minister's Office in March 2013.)

In March 2008, the Radioactive Waste Management Act (RWMA) was enacted for safe and efficient management of radioactive waste, and in January 2009, Korea Radioactive Waste Management Corp. (KRMC, later renamed into Korea Radioactive Waste Agency (KORAD) in July 2013) was established as a dedicated organization to radioactive waste management. KORAD has been operating the 1st phase rock-cavern type disposal facility for low- and intermediate-level radioactive waste (LILW) since December 2014 after passing the regulatory body's pre-operational inspection. KORAD also submitted an application for a construction permit (CP) and operation license (OL) for the 2nd phase engineered vault type disposal facility to the NSSC in December 2015, which is now under regulatory review.

The Korean government held the 2nd meeting of Atomic Energy Promotion Committee (AEPC) in November 2012 and decided on the Execution Plan for Spent Fuel Management to carry out public engagement activities regarding spent fuel management. Then, the Public Engagement Commission on Spent Nuclear Fuel Management (PECOS) which was operated for 20 months from

October 2013 to June 2015 submitted a set of recommendations on spent fuel management and community supports. Based upon the recommendations, the government established the Basic Plan on High-level Radioactive Waste Management in late July 2016. As opinions were raised that it was needed to hear voices of the public and residents in the vicinity of nuclear power plants, however, a review committee of spent fuel management policy was created in May 2019 and is currently in operation.

Spent fuel generated from nuclear power plants has been stored in on-site wet storage facilities or dry storage facilities (only applies to PHWRs). LILW generated from nuclear power plants has been stored in on-site storage facilities and then transported to the disposal facility of KORAD after on-site inspection carried out by KORAD.

LILW generated from the 30 MWth research reactor, High-flux Advanced Neutron Application Reactor (HANARO) of the Korea Atomic Energy Research Institute (KAERI) in Daejeon has been either stored on-site or transported to the disposal facility of KORAD. Spent fuel generated during operation of HANARO has been stored in the spent fuel pool connected to the reactor pool. Two research reactors, the Korea Research Reactor 1 and 2 (KRR-1 and 2), located at the former KAERI site in Seoul are currently under decommissioning by KAERI after permanent shutdown. In addition, an application was submitted for a construction permit of a 15 MWth research reactor at Gijang-gun, Busan in November 2014 to produce radioactive isotopes for medical and industrial purposes as well as power semiconductor devices, and the construction permit was granted in May 2019.

Nuclear fuel for nuclear power plants is fabricated by the Korea Electric Power Corporation Nuclear Fuel Co. Ltd. (KEPCO NF) in Daejeon, and radioactive waste generated during the fabrication process is stored at the radioactive waste storage facility of KEPCO NF.

The number of radioisotope (RI) and radiation generating devices users in the medical, research and industrial areas has steadily increased to around 8,800 as of March 2020, generating various types of radioactive waste. RI waste was stored at the RI waste management facility of KORAD in Daejeon until June 2015 and is transported to the LILW disposal facility in Gyeongju from July 2015 onwards.

As of March 2020, the locations and operational status of nuclear facilities and radioactive waste management facilities in Korea are shown in Figure A.1-1.

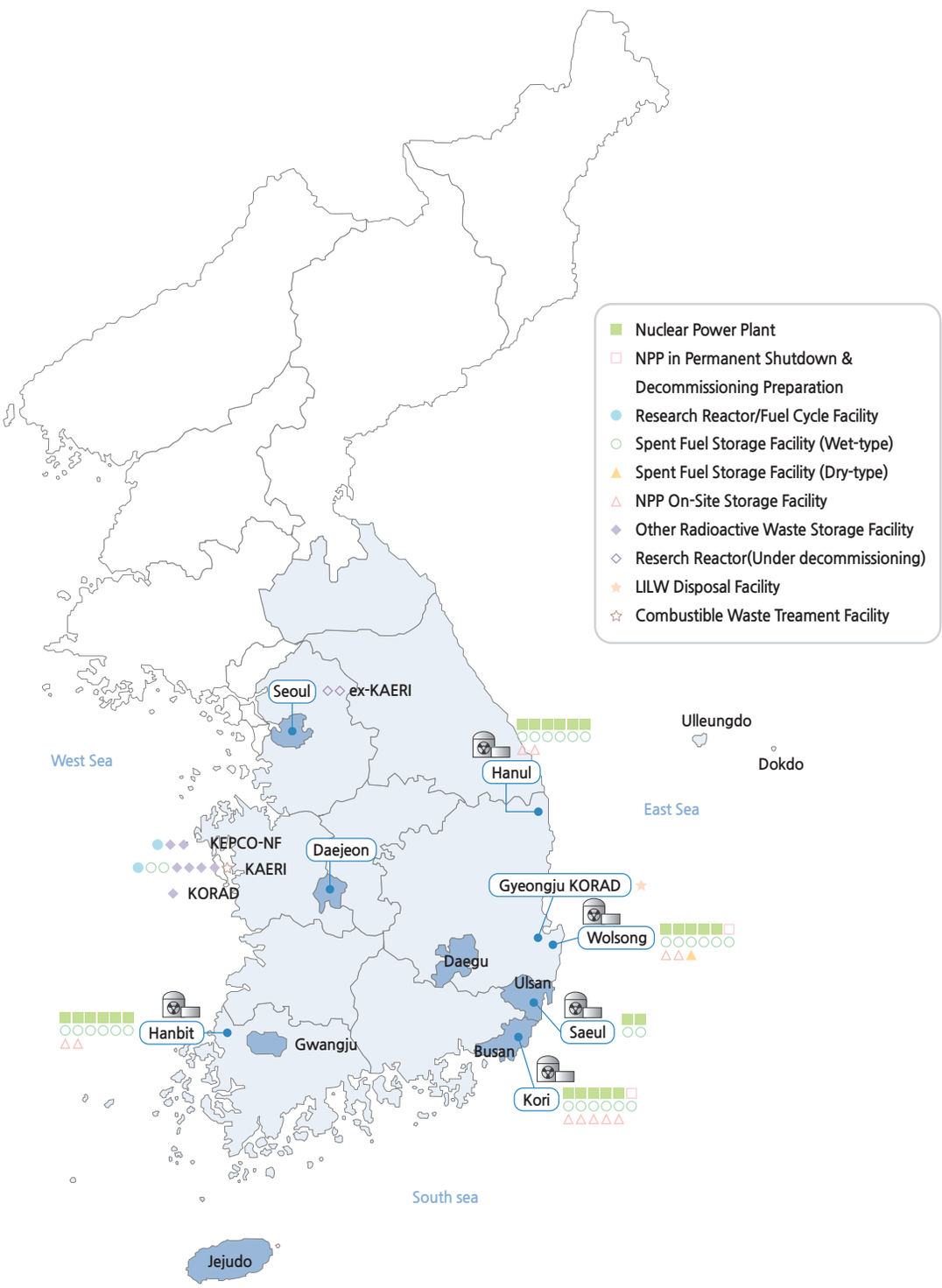

Figure A.1-1 Locations and Operational Status of Nuclear Facilities Including Radioactive Waste Management Facilities (As of March 31, 2020)

A.2 Major Changes and Improvements since the 6th Review Meeting

Improvement of Nuclear Safety Regulations Related to Radioactive Waste Management Facilities

The government has worked on legislation and amendment of the nuclear safety-related Act and subordinate statute in such way that the safety regulation system for operating radioactive waste management facilities, etc. is consistent with international standards.

Major legislative changes are: introduction of periodic safety review (PSR) of a radioactive waste management facility, etc. based on the findings of IAEA Integrated Regulatory Review Service (IRRS) mission to Republic of Korea in 2014 and overseas precedents; obligations for safety measures by the operator of a radioactive waste management facility, etc.; establishment of regulatory procedures for termination of operation (decommissioning of radioactive waste treatment and storage facilities, and closure and post-closure institutional control of disposal facilities) which reflects characteristics of each facility; and introduction of design approval and manufacture inspection for spent nuclear fuel cask to improve efficiency of the regulatory review for CP and OL of a spent fuel storage facility and to respond to demands for development of spent nuclear fuel cask.

- Introduction of PSR, safety measures, termination of use, etc. to a radioactive waste management facility, etc.
- Establishment of regulatory procedures for termination of operation of a radioactive waste management facility, etc. (decommissioning of radioactive waste treatment and storage facilities, and closure and post-closure institutional control of disposal facilities)
- Introduction of design approval for spent nuclear fuel cask

The partial amendment to the Nuclear Safety Act (NSA) was deliberated and passed at the 106th meeting of the NSSC in August 2019, and the pre-announcement of legislation (announcement no. 2019-55) was made from September to November 2019. Currently, the related legislative process is in progress. Detailed information on legislation and amendment of the NSA and subordinate statute are described in K.1 (Improvement of Safety Regulation System for Radioactive Waste Management).

Permanent Shutdown and Preparation of Decommissioning of Nuclear Power Plants

Kori Unit 1, Korea's 1st commercial reactor was permanently shut down on June 19, 2017 as a permit for operating license amendment which the Korea Hydro & Nuclear Power Co., Ltd. (KHNP) applied for was finally issued by the NSSC on June 9, 2017. Subsequently, a change permit for the operating license of Wolsong Unit 1 for permanent shutdown, Korea's 1st PHWR (CANDU reactor) was also granted in December 24, 2019.

Pursuant to the NSA which stipulates submission of a decommissioning plan within five years after permanent shutdown, the KHNP should apply for approval for decommissioning of Kori Unit 1 by 2022. The KHNP plans to complete preparation of a final decommissioning plan and a decommissioning quality assurance program (QAP) for Kori Unit 1 and collect opinions from local residents and then file an application for Kori Unit 1 decommissioning to the NSSC by no later than the end of 2020. To be prepared for submission of Kori Unit 1 final decommissioning plan, the NSSC has developed safety review guidelines in June 2020 and plans to review the application for Kori Unit 1 decommissioning in accordance with the guidelines. More details on permanent shutdown and preparation of decommissioning nuclear power plants are described in F.6 (Decommissioning) and K.3 (Securement of Safety of Permanent Shutdown and Decommissioning of NPPs).

Review of Basic Plan on High-level Radioactive Waste Management

With regard to the Basic Plan on High-level Radioactive Waste Management established in late July 2016, the government launched a review committee on spent fuel management policy including the Basic Plan on High-level Radioactive Waste Management in May 2019 as opinions were raised that it was needed to hear voices of the public and local residents comprehensively. The review committee has been collecting public opinions on spent fuel management policies including directions and procedures and based on which, plans to make policy recommendations to the government. More details on the review of the basic plan are presented in K.2 (Expansion of Capacity of Storage Facilities and Review of Management Policy for Spent Fuel).

A.3 Implementation of the Challenges and Proposed Good Practices

A.3.1 Implementation Status of Challenges from the 6th Review Meeting

Policy-Making and Preparation of Implementation Plan on Spent Fuel Management

The government established the Basic Plan on High-level Radioactive Waste Management in July 2016 which mainly addresses methods and procedures for safe management of spent fuel. The basic plan outlines construction of underground research laboratory, interim storage facility, and permanent disposal facility at a same site; timely securement of core management technologies to raise stakeholder trust on the safety of spent fuel management; effort to raise public acceptance based on transparent and objective approach in spent fuel management and better communication with local residents; and construction of additional on-site spent fuel storage facilities.

With regard to the basic plan, the government, newly launched in May 2005, adopted as one of its national agenda a policy review of spent fuel management as opinions were raised that it was needed to hear voices of the public and residents in the vicinity of nuclear power plants comprehensively. To that end, the government created and operated a review preparation group for spent fuel management policy from May to November 2018 to discuss ways for the policy review with communities near nuclear power plants, civic groups and nuclear communities. Based on conclusions from the discussion, the preparation group submitted to the government a policy proposal. As recommended, the government has launched and operated a Review Committee for Spent Fuel Management Policy since May 2019. More details are described in K.2 (Expansion of Capacity of Storage Facilities and Review of Management Policy for Spent Fuel).

Permanent Shutdown and Preparation of Decommissioning of Kori Unit 1

Kori Unit 1, Korea's 1st commercial reactor, started its commercial operation in April 1978 with 30 years of design life and continued its operation for the additional 10 years after a permit from MOST (at present, NSSC) in December 2017.

In June 2017, Kori Unit 1 was permanently shut down and spent fuels were withdrawn from the reactor and safely stored in the spent fuel pool inside the fuel building of Kori Unit 1. Pursuant to the NSA which stipulates submission of a decommissioning plan within five years after permanent shutdown, the KHNP should apply for approval for decommissioning of Kori Unit 1 by June 2022. The KHNP has currently worked on preparation of Kori Unit 1 final decommissioning plan and opinion gathering from local residents in accordance with the NSA. The operator plans to complete the final decommissioning plan which incorporates the results of opinion gathering from local residents, and file an application for Kori Unit 1 decommissioning to the NSSC by no later than the end of 2020. Details on Kori Unit 1 decommissioning are described in F.6 (Decommissioning) and K.3 (Securement of Safety of Permanent Shutdown and Decommissioning of NPPs).

Open Issues regarding Challenges from the 5th Review Meeting

Open issues regarding challenges from the 5th review meeting are as follows:

- Expansion of capacity of spent fuel storage facilities
- Preparation of decommissioning of nuclear power plants
- Compliance of waste generated prior to 2004 with the waste acceptance criteria of a disposal facility

With regard to the expansion of capacity of spent fuel storage facilities for PHWR plants, a dry storage facility (MACSTOR) is planned to be additionally constructed. A change permit for the operating license was issued by the NSSC in January 2020 and the construction commenced in August 2020 with a completion target by 2022. As for PWR plants, high density storage racks are planned to be additionally installed in the open space inside the spent fuel pools of Shin-Hanul Units 1&2 and Shin-Wolsong Units 1&2. Spent fuel from a research reactor, HANARO is stored in the pool inside the reactor building. Once the government finally decide on a spent fuel management policy, the spent fuel will be properly managed in accordance with the management policy. Detailed information is described in K.2 (Expansion of Capacity of Storage Facilities and Review of Management Policy for Spent Fuel).

Regarding decommissioning of nuclear power plants, preparation of related procedures for Kori Unit 1 permanently shut down in June 2017 and Wolsong Unit 1 permanently shut down in December 2019 is in progress, and more information on the project and regulatory activities is described in F.6 (Decommissioning) and K.3 (Securement of Safety at the Stages of Permanent Shutdown and Decommissioning of NPPs).

When it comes to compliance of waste generated prior to 2004 with the acceptance criteria of a disposal facility, the KHNP continues its efforts on compliance verification including development of a scaling factor to assess radionuclide inventory for all waste to be transported for disposal including one generated prior to 2004. Details are described in K.4 (Enhancement of Verification of Suitability for Disposal of LILW).

A.3.2 Proposed Good Practices

Systematic Safety Requirements with Consideration of Characteristics of Each Radioactive Waste Management Facility

The legislation and modification of the nuclear safety related Act and subordinate statute are underway in such way that the safety regulation system for operating radioactive waste management facilities, etc which store, treat, or dispose of radioactive waste incorporates characteristics of each facility and is consistent with international standards.

Major legislative changes are introduction of a PSR of a radioactive waste management facility, etc.; obligations for safety measures by the facility operator; and establishment of regulatory procedures for termination of operation (decommissioning of radioactive waste treatment and storage facilities, closure and post-closure institutional control of a disposal facility) with consideration of characteristics of each facility, which aim to create a safety regulatory system covering all stages of the life cycle of a radioactive waste management facility, etc. Additionally, a design approval and a manufacture inspection of spent nuclear fuel cask will be incorporated in the NSA and subordinate statute with intentions to improve the efficiency of regulatory review of construction permit and operating license of a spent fuel storage facility and to respond properly to demands for development of spent nuclear fuel cask.

With regard to that, the partial amendment to the NSA was deliberated and passed at the 106th meeting of the NSSC in August 2019 and the related legislative process is in progress. In addition to the NSA and subordinate statue, about 20 Regulations and Notices of the NSSC including NSSC Regulations on Technical Standards for Radiation Safety Control, etc. and NSSC Notice Technical Standards for Radioactive Waste Management Facilities, etc. are in the process of legislation and modification. More detailed information is described in K.1 (Improvement of Safety Regulation System for Radioactive Waste Management).

Improvement of Safety Regulation with Consideration of Operation Experience of Disposal Facility

Efforts to improve safety regulation are underway with regard to verification of disposal suitability of radioactive waste, after taking into account the operating experience of the LILW disposal facility in Gyeongju which has been operating since 2015. In September 2018, it was found that some errors existed in radiological data (radionuclide concentration value) of some radioactive wastes delivered for disposal. Afterwards, the NSSC and Korea Institute of Nuclear Safety (KINS) comprehensively inspected the actual conditions of safety management from generation, acceptance to disposal of LILW. The regulatory body developed an improvement plan for the existing safety regulation system with consideration of future expansion and diversification of radioactive waste to be disposed of, and modified the Enforcement Rules of the NSA and related technical standards (NSSC Notices).

Major improvements regarding verification of suitability for disposal are as below, and details are described in K.4 (Enhancement of Verification of Suitability for Disposal of LILW).

- Introduce procedures to specify standards for, and verify and inspect characterization of radioactive waste: a person who accepts radioactive waste (a disposal facility operator) should specify and present standards for a method for characterization of radioactive waste to a generator and reviews the characterization plan of the generator.
- Introduce quality assurance (QA) obligation for radioactive waste management: a generator's quality assurance obligation for radioactive waste management across the board, and a disposal operator's responsibilities to present standards for quality assurance of radioactive waste management and inspect the generator's quality assurance program before acceptance.
- Improve implementation of disposal inspection: clear description of methods, items, contents/scope of disposal inspection, with consideration of operating experience of the disposal facility.

Multi-ministry Cooperation on R&D Regarding Storage and disposal of Spent Fuel

As the capacity of currently available interim storage facilities is predicted to be reached in the near future, there is a rising need to timely secure and demonstrate technologies for interim storage and permanent disposal which are options for spent fuel management after on-site temporary storage as well as regulatory technologies. Accordingly, the government has taken a close look at the needs for securing the safety of storage and disposal of spent fuel. With an aim to secure key storage and disposal solutions needed for the safety management system for spent fuel, the NSSC responsible for nuclear regulation, MOTIE in charge of management policies and projects for nuclear power plants and radioactive waste management, and the MSIT taking charge of development of nuclear science and technology work together to conduct a multi-ministry cooperation project for nine years (2021 to 2029). As the feasibility of the project has been approved by the financial authority, the research and development project is planned to commence in 2021 with aims to develop core storage and disposal technologies and to secure enabling technologies for demonstration in a deep geological disposal environment and regulatory technologies prior to demonstration of the underground research laboratory.

In order to respond to the saturation of spent fuel storage facilities and to implement a mid- and long-term spent fuel management policy which will be decided in the near future, it is imperative to provide technical support through stepwise development and securement of related technologies. Therefore, government authorities such as the NSSC, MOTIE and the MSIT cooperate closely with aims to secure advanced technologies for demonstration of safety and performance of spent fuel storage and disposal, and to respond actively to environmental and policy changes at home and abroad. By doing so, the government plans to create a society where the public feel safer. In particular, such multi-ministry cooperation project is expected to increase cooperation and linkage among the concerned authorities which will contribute to establishing a foundation to develop and manage core technologies necessary for storage and disposal of spent fuel. Based on the foundation, it will be possible to secure core technologies for a deep geological repository, thereby ultimately improving the competitiveness of the nation. In addition, the project will reduce the period of time required for securing a disposal facility through organic linkage and application of research results. When it happens, it is expected that a deep geological repository customized to the environment of Korea will be timely established with proven safety and performance. More detailed information is described in K.5 (Enhancement of R&D for Safety of Storage and Disposal of Spent Fuel).

Radioactive Waste Tracking System (WTS)

KORAD has deployed and operated a radioactive waste tracking system (WTS) to manage data on radioactive waste systematically in accordance with Article 67 (Records and Keeping) of the NSA and the Safety Analysis Report (SAR) of the LILW disposal facility.

The WTS is designed to track and manage locations and data generated in a series of stages related to LILW that cover request for acceptance, inspection, transportation, disposal, and post-closure institutional control. The system is composed of functions such as history management, location management, and information provision of radioactive waste.

Since the disposal facility in Gyeongju is planned to be developed into a complex disposal facility where rock-cavern type, engineered-vault type, and landfill type facilities coexist with the combined capacity of 800,000 drums, in the long-term, the WTS is also planned to be developed into an integrated radioactive waste tracking system. More detailed information is described in K.6 (Development and Operation of Radioactive Waste Tracking System).

A.4 Overview Matrix

The overview matrix on radioactivity waste and spent fuel in Korea is depicted in Table A.4-1.

Table A.4-1 Overview Matrix of Radioactive Waste and Spent Fuel

Type of Liability	Long-term Management Policy	Funding of Liabilities	Practice/Facilities	Planned Facilities
Spent Fuel	- Plan to deveop a plan based on opinions collected by the review committee - Onsite storage until operation of an interim storage facility	Generators' pay (Generators bear the expenses for management of spent fuel which are deposited to the Radioactive Waste Management Fund)	- Stored in the onsite wet storage facility for each nuclear power plant - However, spent fuel from PHWR is also stored in the on-site dry storage facility	- Plan to deveop a plan based on opinions collected by the review committee - Onsite storage until operation of an interim storage facility
Nuclear Fuel Cycle Wastes	Disposal at the LILW disposal facility	Generators' pay (Generators bear the expenses for management of radioactive waste which are deposited to the Radioactive Waste Management Fund)	Waste generated from Nuclear Fuel Cycle is treated and stored, and then disposed of at the LILW disposal facility	CP and OL for the 2nd phase LILW disposal facility under regulatory review (engineered vault type)
Application Waste	Disposal at the LILW disposal facility	Generators' pay (Generators bear the expenses for management of radioactive waste which are deposited to the Radioactive Waste Management Fund)	- RI Waste (including disused unsealed sources) in Daejeon is received at the LILW disposal facility - Waste from KAERI is treated and stored, and then disposed of at the LILW disposal facility	CP and OL for the 2nd phase LILW disposal facility under regulatory review (engineered vault type)
Decommissioning	Immediate dismantling of NPP	- Decommissioning cost of NPPs is accumulated by KHNP every year - Decommissioning cost for research reactors is funded by the government	- KRR 1 and 2 under decommissioning since 1997 - Decommissioning of KAERI's UCF completed in 2012 and license was terminated	- Kori Unit 1 permanently shut down and under preparation for decommissioning - Wolsong Unit 1 permanently shut down and under preparation for decommissioning
Disused Sealed Sources	Research on management policy and options underway	Generators' pay (Generators bear the expenses for management of radioactive waste which are deposited to the Radioactive Waste Management Fund)	- Disused sealed sources are stored in the RI waste storage facility in Daejeon - Stored in the disposal facility in Gyeongju from July 2015	CP and OL for the 2nd phase LILW disposal facility under regulatory review (engineered vault type)

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 Policy for Radioactive Waste and Spent Fuel Management

B.1.1 Basic Policy

LILW

The basic policy defined in the low- and intermediate-level Radioactive Waste Management Plan which was adopted in the 4th meeting of Atomic Energy Promotion Committee (AEPC) held on January 30, 2015, is as follows:

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

- Safety on top priority
  - Radioactive waste shall be safely managed in due consideration of ecological and environmental impacts so as to protect human health and the environment from harmful effects.

- Radioactive waste shall be managed in compliance with domestic and international norms on safe management of the waste.

- Execution under the public trust
  - Radioactive waste shall be managed transparently and openly so as to improve the understanding and trust of the general public.
  - Radioactive waste management projects shall be executed in such a way to contribute to harmony and development of local communities.
- Generators' pay principle
  - The cost incurred in managing radioactive waste shall be borne by the generator at the point of generation, without imposing undue burdens on future generations.
- Enhancement of efficiency of radioactive waste management
  - The generation of radioactive waste shall be minimized and the development of related technologies shall be encouraged.
  - The efficient use of a LILW disposal facility and the differentiated methods for disposal depending on radiation levels shall be implemented in the mid- and long-term.

Spent Fuel

The basic policy defined in the Basic Plan on High-level Radioactive Waste (HLW) Management which was adopted in the 6th meeting of AEPC held on July 25, 2016, is as follows:

- Direct management by the government
  - HLW which needs long-term safe management, shall be managed safely under the responsibility of the government, in compliance with domestic and international norms on safe management of the waste.
- Safety of the public and protection of the environment on the highest priority
  - HLW shall be managed in an ecologically and environmentally safe manner so as to protect human health and the environment from harmful effects.
- Execution under the public trust
  - Information on HLW management shall be disclosed transparently to the public.
  - HLW management shall be executed in such a way to contribute to the development of local communities and sustainable use of nuclear energy.

- Due burden on present generation
  - Present generation who benefits from nuclear energy shall take the responsibility of HLW management.
  - Cost for HLW management shall be paid by the generators.
- Efficient management of HLW
  - Technologies necessary for efficient management of HLW with regard to transportation, storage and disposal, and reduction of volume and radio-toxicity shall be continuously developed.

With respect to the above basic plan, the government has been conducting a policy review and plans to develop a basic plan with full consideration of policy recommendations made by the review committee.

B.1.2 Strategy and Management Plan

Low- and Intermediate-Level Radioactive Waste

The Atomic Energy Committee (at present, AEPC) decided on construction of a LILW disposal facility with a capacity of 800,000 drums (100,000 drums in the 1st phase) according to the decision of the 249th and 253rd meetings (September 30, 1998 and December 17, 2004 respectively). Accordingly, the construction of the 1st phase facility (underground silo type) was completed in December 2014. In January 2015, the 4th AEPC approved the Basic Plan on Low- and Intermediate-level Radioactive Waste Management which includes the operation of the 1st phase facility from 2015 and the plan for construction of the 2nd phase engineered vault type disposal facility with a capacity of 125,000 drums and construction of near surface disposal facilities from the 3rd phase onwards, in principle. However, the timings for construction of the 3rd and the following phases disposal facilities will be decided later in consideration of the utilization and efficiency of the existing disposal facilities.

Based on that, the Implementation Plan on Low- and Intermediate-Level Radioactive Waste Management was established which is outlined as follows: gaining public trust based on safe operation of the 1st phase underground silo type facility; timely initiating the 2nd phase construction for efficient disposal of radioactive waste; raising the public acceptance of radioactive waste management based on mutual growth with local communities; and developing core technologies for safe management of radioactive waste.

Spent Fuel

Discussion on options and strategies for spent fuel management started in the AEC in 1988. In the 253rd meeting (December 17, 2004), the AEC changed its position that a national policy on spent fuel management including construction of interim storage facility should be established considering domestic and international progress in technology development and be based on public consensus reached.

Based upon the recommendations made by PECOS, the government established the Basic Plan on High-level Radioactive Waste Management which defines methods and procedures on safe management of spent fuel. The basic plan was approved by the AEPC in July 2016 and is outlined as follows: constructing an underground research laboratory, an interim storage facility and a deep geological repository at a same site; making efforts to raise public acceptance based on transparent and objective management of spent fuel and communication with local residents; and constructing additional on-site storage facilities.

As opinions were raised that it was needed to hear voices of the public and residents in the vicinity of nuclear power plants comprehensively, the government has worked on the review of the basic plan. Details on the review of spent fuel management policy are described in K.2 (Expansion of Capacity of Storage Facilities and Review of Management Policy for Spent Fuel).

B.2 Spent Fuel Management Practices

Spent fuel in Korea has been generated from 24 nuclear power reactors and one research reactor, HANARO. The current status of spent fuel management practices is summarized in Figure B.2-1.

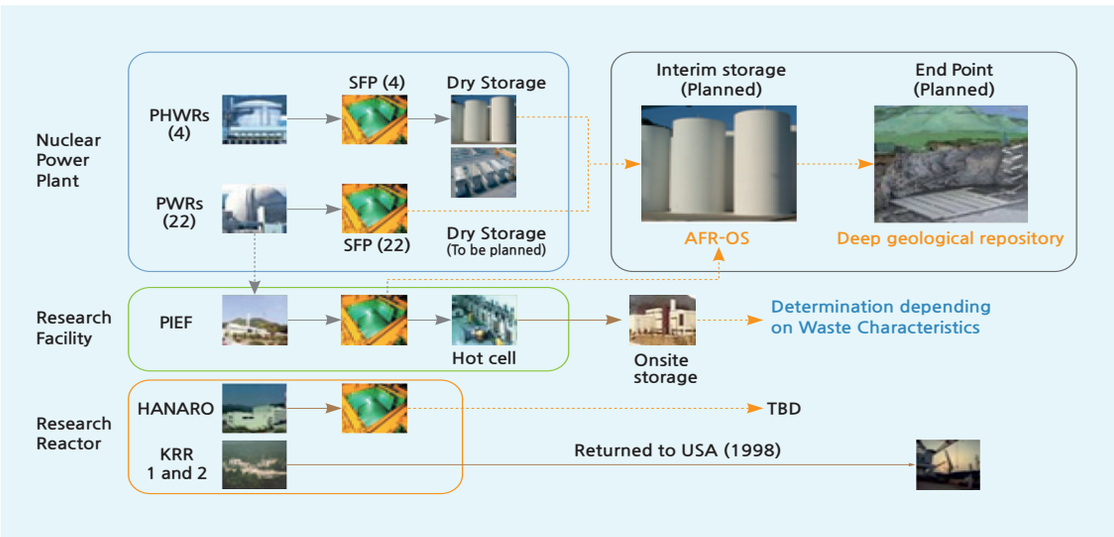

Figure B.2-1 Spent Fuel Management System (including Kori Unit 1 and Wolsong Unit 1 which are permanently shut down)

B.2.1 Nuclear Power Plants

Spent fuel generated from nuclear power plants is stored and managed on site. Diverse methods have been implemented to increase on-site storage capacity or to postpone the saturation of on-site facilities until a separate interim storage facility is built.

Pressurized Water Reactor (PWR)

Spent fuel generated from PWRs is stored in a spent fuel pool of each unit. Almost all PWR plants continue to implement measures to address the lack of wet storage capacity such as installing high-density storage racks or transshipping spent fuel to the storage pool of the neighboring units.

Pressurized Heavy Water Reactor (PHWR)

Spent fuel generated from PHWRs which are Wolsong Units 1, 2, 3 and 4, is cooled down in spent fuel pools for six years or longer and then transferred to the dry storage facility on site. Since construction of the first 60 dry storage canisters (silos) at Wolsong site in 1992, silos have been additionally built two times, and currently there is a total of 300 silos (with the total capacity of 162,000 bundles or 3,061.8 tons) in place. Additionally, seven modules of high-density dry storage facility (MACSTOR/KN-400) with the capacity of 168,000 bundles were constructed at Wolsong site in February 2011 and are currently in operation. Besides, an application for operating license amendment was submitted in April 2016 to build additional seven (7) modules of dry storage facilities with the same capacity of existing one and underwent a regulatory review and finally approved by the NSSC in January 2020.

B.2.2 Nuclear Research Facilities

KRR-1 and 2

As the US government initiated a program under which eligible spent nuclear fuel from research reactors could be shipped to the US in May 1996 and the Korean government agreed on the program, all of the 299 spent fuel rods from KRR-1 and 2 were sent back to the US in July 1998 prior to commencement of decommissioning of the research reactors.

HANARO

Spent fuel from operation of High-Flux Advanced Neutron Application Reactor (HANARO) and irradiated test fuel from HANARO are stored in the spent fuel pool connected to the reactor pool of HANARO

Post-Irradiation Examination Facility

Spent fuel generated and transported from PWRs for use in post-irradiation examination and research is stored in the storage pool of the post-irradiation examination facility (PIEF) which is currently run by KAERI. Post-irradiation examination is carried out in the PIEF hot cells, and the remaining part of the fuel rods after examination is packaged in rod-cuts containers and stored in the spent fuel pool.

B.3 Radioactive Waste Management Practices

B.3.1 Nuclear Power Plants

The current status of management of radioactive waste from nuclear power reactors and related facilities operated by the KHNP is as follows:

Gaseous Radioactive Waste Management

Gaseous radioactive waste is mainly generated in the deaeration process of the reactor coolant system during operation of nuclear power plants. The gaseous radioactive waste is treated using a gas decay tank or a charcoal delay bed to reduce radioactivity levels which are then confirmed through sampling and radioactivity analyses conducted periodically or prior to discharge. The gaseous radioactive waste is discharged into the atmosphere via the continuous monitoring system. Meanwhile, gaseous radioactive waste collected from major systems inside buildings is treated through high-efficiency particulate air (HEPA) filters and charcoal filters of the ventilation system, and is discharged into the atmosphere via the continuous monitoring system. Estimated off-site doses and radionuclide concentrations due to gaseous effluents discharged into the atmosphere should satisfy the annual dose limits and the effluent control limits (ECLs) at the exclusion area boundary (EAB) defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Liquid Radioactive Waste Management

Liquid radioactive waste is mainly generated from the cleanup or maintenance process of the reactor coolant and related systems. In general, liquid radioactive waste is treated with evaporators, demineralizers, filters and/or reverse osmosis (RO) equipment. The effluent is discharged to the sea when the measured radioactivity level is below the ECL, which is also under continuous monitoring system. Estimated off-site doses and radionuclide concentrations due to the liquid effluents discharged to the sea should satisfy the annual dose limits and ECLs at the EAB, defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Solid Radioactive Waste Management

Solid radioactive waste consists mostly of dry active wastes (DAWs) (component parts, decontamination papers, clothes, gloves, shoes, etc.) generated in the maintenance and repair process of facilities, and spent resins and spent filters generated in the treatment process of liquid and gaseous radioactive waste. The DAWs are compacted by a conventional compactor and packaged. Prior to packaging, high-moisture DAWs including decontamination papers are dried naturally or in the waste dryer. For Hanul Units 5 & 6, combustible miscellaneous solid waste is vitrified using a LILW vitrification facility. Concentrated liquid waste and spent resin are dried in the dryer and packaged into the high-integrity containers or equivalent. In several nuclear power plants (Shin-Wolsong Units 1&2 and Shin-Kori Units 1, 2, 3&4), high-moisture solid waste such as concentrated waste liquid and spent resin is dried and dehydrated and then polymer solidified before it is packaged into a drum. Spent filters are stored in properly designed shielding containers.

B.3.2 Nuclear Research Facilities

The below is the current status of management of radioactive waste from the research reactors (HANARO), post-irradiation examination facility (PIEF), fuel fabrication facility for research reactors, and a combustible waste treatment facility operated by KAERI.

Gaseous Radioactive Waste Management

The ventilation system of each nuclear facility is equipped with filters to treat radioactive gas prior to discharge into the atmosphere. The stack as a final outlet has a continuous monitoring system. Estimated off-site doses and radionuclide concentrations due to the gaseous effluents discharged into the atmosphere should satisfy the annual dose limits and ECLs at the EAB defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Liquid Radioactive Waste Management

Liquid radioactive waste generated from research facilities is collected in the tanks of the facilities and delivered to an evaporator for concentration. The evaporation condensate is treated in the solar evaporation facility and the residue such as evaporator concentrate is bituminized.

Solid Radioactive Waste Management

Solid radioactive waste is transported to the radioactive waste treatment facilities and then the radioactive waste storage facilities. Solid radioactive waste with high radiation dose is packaged in a 50-liter stainless steel drum, and kept in a concrete structure providing adequate shielding. Solid radioactive waste with low radiation dose is compacted and packaged in a 200-liter steel drum, and kept in a storage building. Combustible waste generated from the decommissioning process of KRR-1 and 2 and the uranium conversion facility (UCF) was incinerated.

B.3.3 Nuclear Fuel Fabrication Facilities

The below is the current status of management of radioactive waste generated from the nuclear fuel fabrication facilities for PWRs and PHWRs.

Gaseous Radioactive Waste Management

Radioactive material from gaseous effluent should be treated through filters in the ventilation system before its release into the environment through the stack. Gaseous radioactive effluent is continuously monitored. Estimated off-site doses and radionuclide concentrations due to the gaseous effluents discharged into the atmosphere should satisfy the annual dose limits and ECLs at the EAB defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Liquid Radioactive Waste Management

Liquid waste is categorized into two types: the waste from PWR fuel fabrication process and that from PHWR fuel fabrication process. Liquid waste is treated by treatment systems such as evaporation, reverse osmosis or centrifugation depending on its characteristics. Estimated off-site doses and radionuclide concentrations due to the liquid effluents discharged to the environment should satisfy the annual dose limits and ECLs defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Solid Radioactive Waste Management

Solid wastes from fuel fabrication facilities are categorized into DAWs (protective equipment such as clothes and gloves), metals, synthetics, wood and glass, and packaged in a 200-liter drum, which is then stored in a waste storage facility after measuring their radioactivity, weight, surface contamination level, and radiation dose rate.

B.3.4 Radioisope (RI) Waste Management Facility

The below is the current status of management of radioactive waste generated from the RI waste management facility (in Daejeon) operated by KORAD.

Gaseous Radioactive Waste Management

Gaseous radioactive waste generated from the facility in operation is discharged into the atmosphere through radioactive discharge monitors after treatment by HEPA and charcoal filters. Estimated off-site doses and radionuclide concentrations due to the gaseous effluent discharged into the atmosphere should satisfy the annual dose limits and ECLs at the EAB defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Liquid Radioactive Waste Management

Liquid radioactive waste generated in the process of decontamination, treatment, etc. is collected in the collection tanks and treated after sampling and analysis.

Solid Radioactive Waste Management

Solid radioactive waste has been delivered to the RI waste management facility in Daejeon until June 2015, and to the LILW disposal facility in Gyeongju since July 2015. Solid radioactive waste consists mostly of DAWs such as decontamination papers and clothes generated from a segregation process and is packaged into a 200 liter drum and stored thereafter.

B.3.5 LILW Disposal Facility

The below is the current status of management of radioactive waste at the LILW disposal facility operated by KORAD.

Gaseous Radioactive Waste Management

Gaseous radioactive waste generated from facility operation is discharged into the atmosphere through radioactive discharge monitor after treatment by HEPA and charcoal filters. Estimated off-site doses and radionuclide concentrations due to the gaseous effluents discharged into the atmosphere should satisfy he annual dose limits and ECLs at the EAB defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Liquid Radioactive Waste Management

Liquid radioactive waste generated from facility operation is collected through an active drainage system and then treated using a demineralizer system. Estimated off-site doses and radionuclide concentrations due to the liquid effluents discharged to the environment should satisfy the annual dose limits and ECLs at the EAB defined in the NSSC Notice. It should be assessed by the facility operator and reported to the regulatory body periodically.

Solid Radioactive Waste Management

Solid radioactive waste generated from facility operation consists mostly of DAWs (decontamination papers, clothes, gloves, shoes, etc.), spent resins and spent filters. The waste is segregated into waste streams aforementioned, treated by compaction or solidification, packaged into a 200 liter drum, and stored thereafter.

B.4 Definition and Classification of Radioactive Waste

The NSA defines "Radioactive Waste" as radioactive material(s) or materials contaminated by radioactive material(s) which is subject to disposal, including spent fuel declared to be disposed of in accordance with Article 35 (Permit, etc. for Nuclear Fuel Cycle Business) of the same Act as well. The Enforcement Decree of the NSA defines HLW as the radioactive waste, of which the radioactive concentration and the heat generation rate are higher than levels prescribed by the NSSC. LILW means the radioactive waste other than HLW. HLW should meet both criteria on radioactivity and heat generation rate specified in the NSSC Notice Standards for Radiation Protection, etc. as follows:

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

LILW is to be categorized by radioactivity concentration criteria and the details of sub-categorization are described in the NSSC Notice Regulations on the Criteria for the Classification and Clearance of Radioactive Wastes. According to the Notice, LILW is classified into three sub-categories: very low level radioactive waste (VLLW), low level radioactive waste (LLW) and intermediate level radioactive waste (ILW). This classification system of LILW and radioactivity concentration limits are developed considering the current status of the radioactive waste management in Korea, the plan for radioactive waste disposal facility development, and the IAEA Safety Standards Series No. GSG-1 (Classification of Radioactive Waste) published in 2009.

The subordinate statute of the NSA allows the clearance of radioactive waste with radioactivity concentration below the lower limit of VLLW. The dose criteria for the clearance are less than 10 μSv/y for individual dose and less than 1 person-Sv for collective dose which are values developed considering IAEA General Safety Requirements (GSR) Part 3 (2014).

C Scope of Application (Article 3)

ARTICLE 3. SCOPE OF APPLICATION

i. 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.

ii. 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.

iii. 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.

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

C.1 Radioactive Waste within the Scope of the JC

The scope of this national report according to the Joint Convention is the radioactive waste defined in accordance with the NSA and subordinate statutes. This national report covers spent fuel and radioactive waste generated from nuclear power plants and nuclear research facilities as well as radioactive waste generated from nuclear fuel cycle facilities and RI users.

The definition and classification of radioactive waste are specified in B.4 (Definition and Classification of Radioactive Waste).

C.2 Reprocessing of Spent Fuel

In accordance with Article 3 (Scope of Application) of the Joint Convention, reprocessing of spent fuel is out of the scope of this National Report because spent fuel is not reprocessed in Korea.

C.3 Naturally Occurring Radioactive Materials

Pursuant to Article 3.2 of the Joint Convention, this National Report includes the naturally occurring radioactive waste generated from the industrial use of fertile material. However, this report doesn't cover waste which contains naturally occurring radioactive materials controlled in accordance with the Act on Protective Action Guidelines against Radiation in the Natural Environment and is not generated from the nuclear fuel cycle.

C.4 Radioactive Waste within Military or Defense Programs

Pursuant to Article 3 (Scope of Application) of the Joint Convention, the RI waste transported to the RI management facilities from military or defense facilities is incorporated in the inventories mentioned in this National Report.

D Inventories and Lists (Article 32, Paragraph 2)

ARTICLE 32. REPORTING

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 Facilities

D.1.1 Nuclear Power Plants

Spent fuel withdrawn from a nuclear reactor is stored in a spent fuel pool at each unit for a certain period, and efforts to avoid saturation of the pool have been made through expansion of on-site storage capacity and transshipment of spent fuel to the spent fuel pools of neighboring units. Annex A-1 shows the location, characteristics, and inventory of spent fuel storage facilities at each plant. The inventories and types of spent fuel stored at nuclear power sites are given in Table D.1-1.

Table D.1-1 Inventory of Spent Fuel Stored at NPP Sites

(As of March 31, 2020)

Site	Reactor Type	Storage Type	Inventory [MTU]
Kori	PWR	wet	2,636.63
Saeul	PWR	wet	81.61
Hanbit	PWR	wet	2,682.89
Hanul	PWR	wet	2,493.27
Wolsong	PWR	wet	214.83
	PHWR	wet	2,712.46
		dry	6,098.91

D.1.2 Nuclear Research Facilities

HANARO

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

The spent fuel pool of HANARO has the capacity to store fuel loaded into the reactor core as well as spent fuel generated during normal operation of HANARO. Annex A-2 provides details of the spent fuel pool of HANARO. Table D.1-2 shows the inventory of spent fuel generated from HANARO.

Post-Irradiation Examination Facility (PIEF)

The PIEF is constructed for performance testing and evaluation of spent fuel and for cause investigation of damaged fuel from nuclear power plants. It consists of three pools (for reception, unloading and testing of the spent fuel assembly for PWR), four concrete hot cells for testing of fuel rod coupon, a chemical analysis laboratory. Annex A-2 shows the details of the spent fuel storage pool in the PIEF.

As of the end of March 2020, some spent fuel transported from PWR plants is stored at the PIEF in the form of assemblies, spent fuel rods, and specimens to carry out post-irradiation examinations. Table D.1-2 shows the inventory of spent fuel stored at the PIEF.

Table D.1-2 Inventory of Spent Fuel in the Storage Pool of Research Facilities

(As of March 31, 2020)

Facility	Inventory (MTU)
HANARO	0.904
PIEF	3.320

D.2 Radioactive Waste Management Facilities

D.2.1 Nuclear Power Plants

Nuclear power plants are equipped with gaseous, liquid, and solid waste treatment and storage facilities on-site to ensure safe management of radioactive waste generated during 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 is composed of spent resin drying system, polymer solidification system, spent filter treatment system, packaging system and waste compactor. The on-site radioactive waste storage facility is a concrete slab-type building with separate storage spaces for solid wastes according to radiation level, and is equipped with radiation monitoring systems. The location and characteristics of these facilities are listed in Annex B-1 and B-2.

Solid radioactive waste generated from nuclear power plants as of the late March 2020 is 108,927 drums (200 liter drum). Among these, 18,269 drums of radioactive waste from Hanul (5,600 drums), Hanbit (5,400 drums), Kori (2,700 drums) and Wolsong (4,569 drums), compliant with the requirements of the NSSC Notice General Acceptance Criteria for Low- and Intermediate-Level Radioactive Waste, were transported for permanent disposal to the disposal facility operated by KORAD. The remaining 90,658 drums (200 liter drum) are stored and managed at the on-site storage facilities. As of late March 2020, the inventory of and major radionuclides in solid radioactive waste are given in Table D.2-1.

Table D.2-1 Inventory of Radioactive Waste Stored at NPP Sites

(As of March 31, 2020)

Site	Inventory [200 liter drum]	Major Radionuclide
Kori	42,662	^{3}H, ^{60}Co, ^{137}Cs, ^{14}C, etc.
Saeul	247	^{3}H, ^{60}Co, ^{137}Cs, ^{14}C, etc.
Habit	20,969	^{3}H, ^{60}Co, ^{137}Cs, ^{14}C, etc.
Hanul	16,010	^{3}H, ^{60}Co, ^{137}Cs, ^{14}C, etc.
Wolsong	10,770	^{3}H, ^{60}Co, ^{137}Cs, ^{14}C, etc.
Total	90,658	-

D.2.2 Nuclear Research Facilities

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

Liquid radioactive waste generated from KAERI is treated with an evaporation process. The resultant concentrate is solidified by a bituminization process, whereas post-treatment condensate and very low level radioactive liquid waste are treated by a solar evaporation process. Solid waste is treated for volume reduction with a compactor and stored on-site.

Table D.2-2 shows the inventory of radioactive waste at KAERI's storage facilities along with major radionuclides as of late March 2020.

KAERI has been operating a combustible waste treatment facility since 2011, in order to reduce the volume of combustible waste generated from the UCF, KRR-1 and 2 decommissioning process. Table D.2-2 shows the inventory of combustible waste stored in the 1st and 2nd storehouse and the storehouse of the combustible waste treatment facility with major radionuclides and Annex B-5 lists the location and capacity of this facility.

Table D.2-2 Inventory of Radioactive Waste Stored at KAERI

(As of March 31, 2020)

Facility	Inventory [200 liter drum]	Major Radionuclide
1st storehouse	8,799	^{60}Co, ^{238}U, ^{137}Cs, etc.
2nd storehouse	895	^{60}Co, ^{238}U, ^{137}Cs, etc.
Storehouse of combustible waste treatment facility	11,491	^{60}Co, ^{137}Cs, Natural Uranium, etc.

D.2.3 Nuclear Fuel Fabrication Facilities

Two nuclear fuel fabrication plants are operated by KEPCO NF. The 1st plant started its commercial operation in 1989 and the 2nd plant started in

1998. Based on the business permit granted in 2018, the 3rd plant is under construction with a completion target by 2022. The solid waste treatment and storage concept of the two fabrication plants are almost identical, and details of the storage facilities 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 March 2020, the amount of solid waste generated from the nuclear fuel fabrication facilities is 9,016 drums as shown in Table D.2-3.

Table D.2-3 Inventory of Radioactive Waste Stored at Nuclear Fuel Fabrication Facility

(As of March 31, 2020)

Facility	Inventory [200 liter drum]	Major Radionuclide
Nuclear fuel fabrication storehouse	9,016	^{234}U, ^{235}U, ^{238}U

D.2.4 RI Waste Management Facility

The RI waste generated from RI utilization facilities is delivered and stored at the RI waste management facility operated by KORAD in Daejeon. As of late March 2020, about 561 drums (200 liter drum) of RI waste are safely stored and managed in the facility. Annex B-8 lists the location and main characteristics of the RI waste management facility.

Table D.2-4 shows the inventory and major radionuclides of the RI waste stored in the RI waste management facility as of late March 2020,

Table D.2-4 Inventory of RI Waste at KORAD

(As of March 31, 2020)

Facility	Inventory [200 liter drum]	Major Radionuclides
RI waste management facility	372 (unsealed sources)	^{125}I, ^{99}Tc, etc.
	189 (sealed sources)	^{60}Co, ^{137}Cs, ^{241}Am, etc.

D.2.5 LILW Disposal Facility

Construction of the 1st phase LILW disposal facility with a capacity of 100,000 drums was completed and it is currently in operation. The application for a CP and OL of the 2nd phase disposal facility (engineered vault type, with a completion target by the end of 2022) is currently under regulatory review. The location and characteristics of these disposal facilities are listed in Annex B-9.

As of late March 2020, 3,283 drums (200 liter drum) of LILW are stored and managed in the receipt/storage building and 19,050 drums have been disposed of in silos. Among which, 314 drums generated by RI utilization facilities, etc. were delivered to the disposal facility of KORAD: 45 drums (200 liter drum) of the RI waste is stored in the receipt/storage building and 269 drums (200 liter drum), in the radioactive waste building. The inventory of the receipt/storage building, the radioactive waste building and the silos is listed in Table D.2-5.

Table D.2-5 Inventory of Radioactive Waste at LILW Disposal Facility

(As of March 31, 2020)

Facility	Storage/Disposal Inventory[1)] [200 liter drum]	Major Radionuclides
Receipt/storage building	2,969	^{60}Co, ^{137}Cs, etc.
	45 (sealed source)	^{60}Co, ^{137}Cs, ^{241}Am, etc.
Radioactive waste building	209 (unsealed source)	^{3}H, ^{14}C, ^{125}I, ^{99}Tc, etc.
	60 (sealed source)	^{60}Co, ^{137}Cs, ^{241}Am, etc.
Silo	19,050	^{14}C, ^{137}Cs, ^{59}Ni, etc.

Note 1) It means storage inventory for the receipt/storage building and the radioactive waste building, and disposal inventory for silos.

Note 2) Other radioactive waste (1,496 drums (200 liter drum) of waste asphalt concrete) is additionally stored in the radioactive waste building.

D.2.6 Other Facilities

Taekwang Industrial Co. Ltd. in Ulsan generated radiologically contaminated byproducts in the process of producing synthetic fiber using licensed depleted uranium, as a catalyst. Nuclear materials have not been used since the depleted uranium was replaced with a non-radioactive chemical catalyst in 2004. Currently, decontamination and decommissioning of the facility is underway and radiologically contaminated byproducts are additionally generated due to decontamination of the facility to be converted into a general area. The total inventory of radioactive waste currently stored in this facility is 8,635 drums.

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 currently stored in this facility is 52 drums.

D.3 Decommissioning

The research reactors, KRR-1 and 2, are under decommissioning and the generated radioactive waste is temporarily stored at the KRR-2 reactor building. The major radionuclides and the inventory of radioactive waste generated in the decommissioning process as of late March 2020 are listed in Table D.3-1. 516 drums of decommissioning waste were transported to the disposal facility in 2015 and 248 drums were transported to the radioactive waste storage facility at KAERI in Daejeon in 2016. Annex C shows the list of nuclear facilities under decommissioning.

Table D.3-1 Inventory of Decommissioning Radioactive Waste from KRR-1 and 2

(As of March 31, 2020)

Facility	Inventory [200 liter drum]	Major Radionuclides
KRR-2	641	^{137}Cs, ^{152}Eu, etc.

D.4 Record Keeping and Reporting

The nuclear enterpriser maintains records on radioactive waste in accordance with Article 145 (Preparation and Maintenance of Records) and Attached Table 7 of the Enforcement Rule of the NSA. They also report radiation safety-related data (e.g. quarterly amount of radioactive waste and spent fuel generated and cumulatively stored) to KINS within one month after the end of every quarter pursuant to the reporting requirements of Article 98 (Report/Inspection, etc.) of the NSA and Article 127 (Report) of the Enforcement Rule of the NSA. KINS reviews and manages the reported data submitted by each licensee, and verifies them through periodic inspections, etc.

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 Joint 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 Safety Related Act and Subordinate Statutes

National laws on the management and the safety of spent fuel and radioactive waste are the NSA, the RWMA, Environmental Impact Assessment Act and others, as shown in Table E.2-1. Matters regarding the management and the safety of spent fuel and radioactive waste are stipulated in the NSA. Thus, the NSA is a main law governing safety regulation for spent fuel and radioactive waste management.

The legal framework of nuclear regulation, as shown in Figure E.2-1, consists of the NSA, its Enforcement Decree (a Presidential Decree), its Enforcement Rule (an Ordinance of Prime Minister), the NSSC Regulation (Regulations on Technical Standards for Nuclear Reactor Facilities, etc. and Regulations on Technical Standards for Radiation Safety Control, etc.), and the NSSC Notices.

The NSA, as shown in Table E.2-2, is composed of a total of 11 chapters including General Provision, Establishment and Execution of Comprehensive Nuclear Safety Plan, Construction Permit (CP) and Operation License (OL) of the radioactive waste management facilities, etc. (e.g. facilities for storage, treatment and disposal of radioactive waste and associated facilities). The Enforcement Decree of the NSA provides the articles entrusted in the NSA and stipulates other administrative details including the procedures and methods necessary for enforcement of the NSA. The Enforcement Rule of the NSA provides the articles, including detailed procedures, format of documents and technical standards, as entrusted by the same Act and the same Decree. The Regulations and Notices of the NSSC prescribe the regulatory requirements, technical standards and guidelines, as entrusted by the NSA, its Enforcement Decree and Rule.

Table E.2-1 Laws concerning Nuclear Safety Regulation

Title	Major Contents	Competent Authorities	Remark
Nuclear Safety Act	Basic law on the nuclear safety regulations	NSSC	-
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	NSSC	-
Nuclear Liability Act	Provides the procedures and the extent of compensation for any damages which an individual has suffered from a nuclear accident	NSSC	-
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	NSSC	-
Act on Establishment and Operation of the NSSC	Provides the particulars on establishment and operation of the NSSC	NSSC	-
Radiation and Radioisotope Use Promotion Act	Provides the particulars on research, development, and promotion of utilization of radiation and radioisotope	MSIT	-
Atomic Energy Promotion Act	Provides the particulars on research, development, production, and utilization of nuclear energy	MSIT	Basic provisions for promotion of nuclear energy
Electricity Business Act	Provides the basic system of electricity business	MOTIE	The NSA is entrusted with the particulars on safety regulations on construction, maintenance, repair, operation, and security of nuclear reactor facilities.
Electric Source Development Promotion Act	Provides special cases relevant to the development of electric sources	MOTIE	Prior designation notice of nuclear site
Radioactive Waste Management Act	Provides the framework for radioactive waste management and basic elements therefor	MOTIE	-
Basic Act of Environmental Policy	Mother law of the environmental preservation policy	ME	The NSA is entrusted with the particulars on measures to prevent radiological contamination
Environmental Impact Assessment Act	Provides the extent and procedures to assess environmental impact according to the Basic Act of Environmental Policy	ME	Assessment of environmental impacts excluding radiological impacts

Title	Major Contents	Competent Authorities	Remark
Framework Act on Fire-Fighting Services	Provides for general matters on the prevention, precaution and the suppression of fires	NFA	The requirements for safety management of inflammables
Building Act	Provides for general matters on construction	MOLIT	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
Occupational Safety and Health Act	Provides for general matters on the preservation and enhancement of the safety and health of employees	MOEL	The NSA is entrusted with the particulars on radiological safety
Industrial Accident Compensation Insurance Act	Provides for general matters to compensate employees for any occupational accident through the industrial accident compensation insurance business	MOEL	Nuclear workers are to be compensated in accordance with the compensation standards in the NSA
Framework Act on Civil Defense	Provides for general matters on the civil defense system	MOIS	Preparedness against disasters due to nuclear accidents is included in the basic civil defense plan
Framework Act on the Management of Disasters and Safety	Provides for general matters on disaster and safety management systems of the State and local governments.	MOIS	The management system under the APPRE shall be applied preferentially regarding radiological disaster management

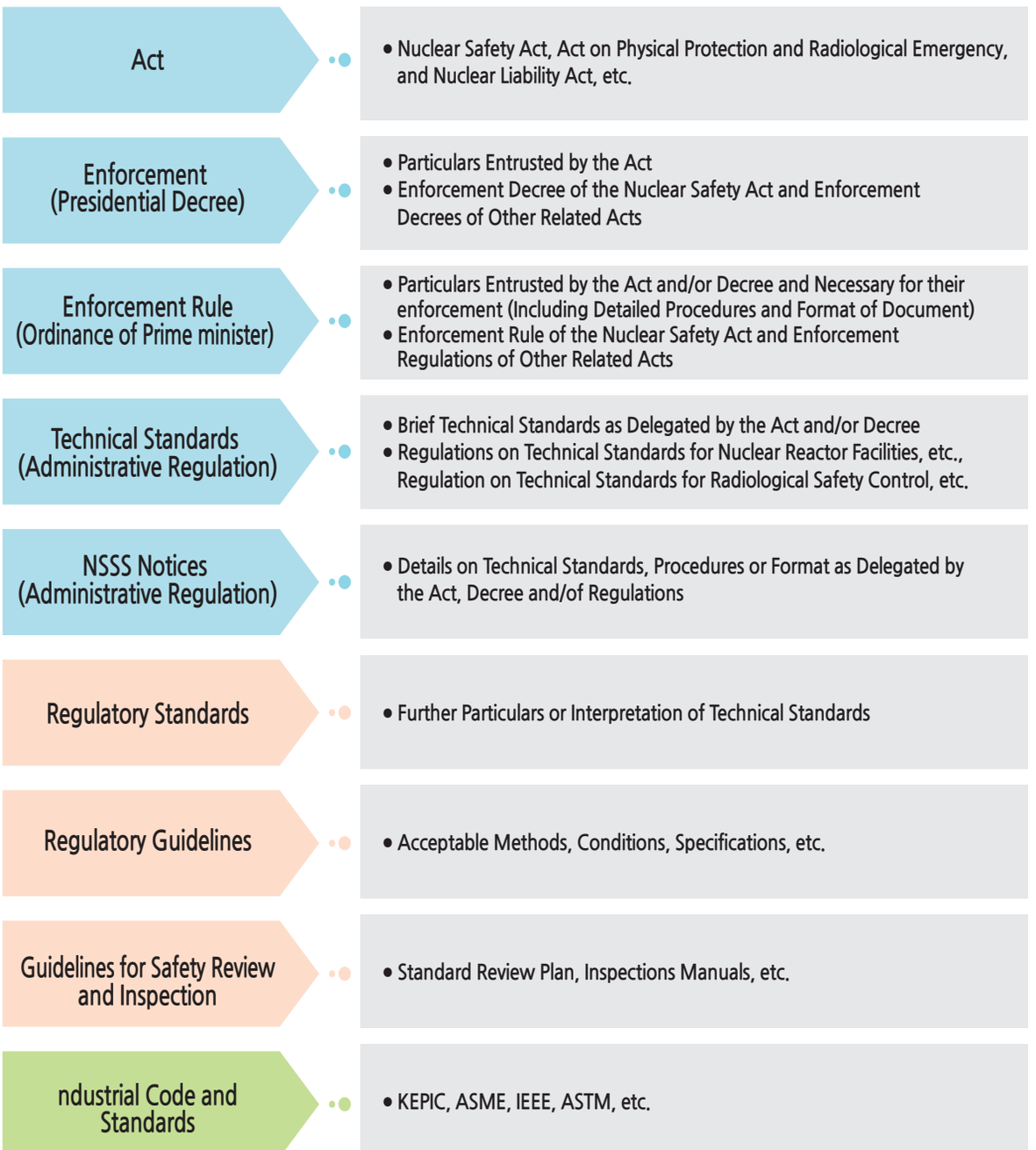

Figure E.2-1 Legal Framework for Nuclear Safety Regulation

Table E.2-2 Contents of Nuclear Safety Act

Contents		Main Description
Chapter 1	General Provisions	Purpose of Nuclear Safety Act and Definitions of Terms
	Article 1 (purpose)	Purpose of Nuclear Safety Act
	Article 2 (definitions)	Definition of radioactive waste
Chapter 2	Establishment and Execution of Comprehensive Nuclear Safety Plan	Establishment and enforcement of Comprehensive Nuclear Safety Plan and the implementation of nuclear safety research and development projects
Chapter 3	Construction and Operation of Nuclear 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 the contents that must be included in the decommissioning plan
Section 3	Construction and Operation of Nuclear Research Reactor, etc.	Describes overall matters related to the construction and operation of research reactors
Chapter 4	Nuclear Fuel Cycle Business and Use of Nuclear Material, etc.	Permission procedure and criteria for nuclear fuel cycle enterprise
Section 1	Nuclear Fuel Cycle Business	
	Article 42 (Decommissioning of Nuclear Fuel Cycle Facility)	Specifies the contents that 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	Radioisotope and Radiation Generating Device	Permission procedure and standard, inspection procedure and method
	Article 54 (Registration of Business Agent)	Specifies that those who wish to collect, treat, and transport radioactive isotopes, Etc. and radioactive waste must register with the NSSC
Chapter 6	Disposal and Transport	Construction and operation permit and inspection of disposal facilities, etc.
	Article 63 (Permit for Construction and operation of waste management facilities, etc.)	Specifies that those who wish to construct and operate a radioactive waste disposal facility, Etc. must obtain the permission from the NSSC
	Article 70 (Restrictions on Disposal of Radioactive Wastes)	Describes matters related with disposal method, disposal restriction and sea dumping prohibition
Chapter 7	Dosimeter Reading, etc.	Registration and inspection of dosimeter reading service provider
Chapter 8	License and Examination	Examination of license and 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	Conditions for permit or designation, approval of topical report, 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 gather 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
Addenda		Enforcement date, relationship to other acts, etc.

Nuclear Safety Act (NSA)

The NSA stipulates matters related to safety regulation applied to a radioactive waste management facility, etc. as follows:

- CP and OL of a radioactive waste management facility, etc.;
- safety inspection with respect to installation and operation of a radioactive waste management facility, etc.;
- limitations on disposal of radioactive waste including prohibition of dumping into the sea; and
- transport and packaging of radioactive material, etc.

Enforcement Decree and Rule of the NSA

The Enforcement Decree of the NSA (Presidential Decree) specifies detailed requirements necessary for implementing articles in the NSA, and the Enforcement Rule of the NSA (Ordinance of the Prime Minister) specifies requirements entrusted in the NSA and its Enforcement Decree, and others necessary for implementing the Act and the Decree as follows:

- requirements concerning application for CP and OL of a radioactive waste management facility, etc. and application for change permit of permitted matters;
- requirements concerning nuclear material accounting and security in a disposal facility, etc.;
- requirements concerning implementation of regulatory inspections such as pre-operational inspection, periodic inspection, disposal inspection, quality assurance inspection applicable to a radioactive waste management facility, etc.;
- requirements concerning procedures and methods for clearance of radioactive waste; and
- requirements concerning transport and packaging of radioactive materials, etc.

Regulations and Notices of the NSSC

The Regulations of the NSSC (Regulations on Technical Standards for Nuclear Reactor Facilities, etc. and Regulations on Technical Standards for Radiation Safety Control, etc.) specify below contents:

- requirements concerning structure, equipment and performance of radioactive waste treatment and storage facilities for nuclear reactors and related facilities, and nuclear fuel cycle facilities (Regulations on Technical Standards for Nuclear Reactor Facilities, etc.);
- requirements concerning radioactive waste management during operation of reactors and related facilities, and nuclear fuel cycle facilities (Regulations on Technical Standards for Nuclear Reactor Facilities, etc.);
- requirements concerning siting, structure, equipment and performance of near surface disposal facility, deep geological repository, spent fuel interim storage facilities (Regulations on Technical Standards for Radiation Safety Control, etc.); and
- requirements concerning storage, treatment or disposal of radioactive waste (Regulations on Technical Standards for Radiation Safety Control, etc.).

The Notices of the NSSC present detailed technical standards for radioactive waste management specified in the NSA and its Enforcement Decree, its Enforcement Rule and NSSC Regulations. Annex E lists the Notices applicable to the management of radioactive waste.

- Siting Criteria and Standards for Structure and Equipment of Low- and Intermediate-Level Radioactive Waste Disposal Facility and Interim Storage Facility of Spent Nuclear Fuel
- General Acceptance Criteria for Low- and Intermediate-Level Radioactive Waste and Spent Fuel
- Radiological Protection Criteria for the Long-term Safety on Low- and Intermediate-Level Radioactive Waste Disposal
- Regulations on the Criteria for the Classification and Clearance of Radioactive Waste
- Standard Format and Contents of the Site Characterization Report for Low- and Intermediate-Level Radioactive Waste Disposal Facilities
- Standard Format and Content of the Safety Analysis Report for Low- and Intermediate-Level Radioactive Waste Disposal Facilities and Interim Storage Facilities of Spent Nuclear Fuel

- General Criteria for Deep Geological Disposal Facilities for High-Level Radioactive Waste
- Standard Format and Content of the Decommissioning for Nuclear Facilities
- Regulation on the Methods of Verifying and Inspection the Decommissioning Status of Nuclear Facilities

E.2.1.2 Radioactive Waste Management Related Act

Articles concerning radioactive waste management are defined in the Radioactive Waste Management Act (RWMA). As shown in Figure E.2-2, the RWMA is composed of four levels: RWMA, its Enforcement Decree, its Enforcement Rule and Notices of the MOTIE, and provides particulars regarding management of LILW and spent fuel, establishment of KORAD, and establishment of radioactive waste management fund. The Notices of the MOTIE prescribe standards and procedures necessary for implementation and requirements entrusted by the higher legislation and regulations. Major Notices of the MOTIE regarding radioactive waste management are listed in Annex E.

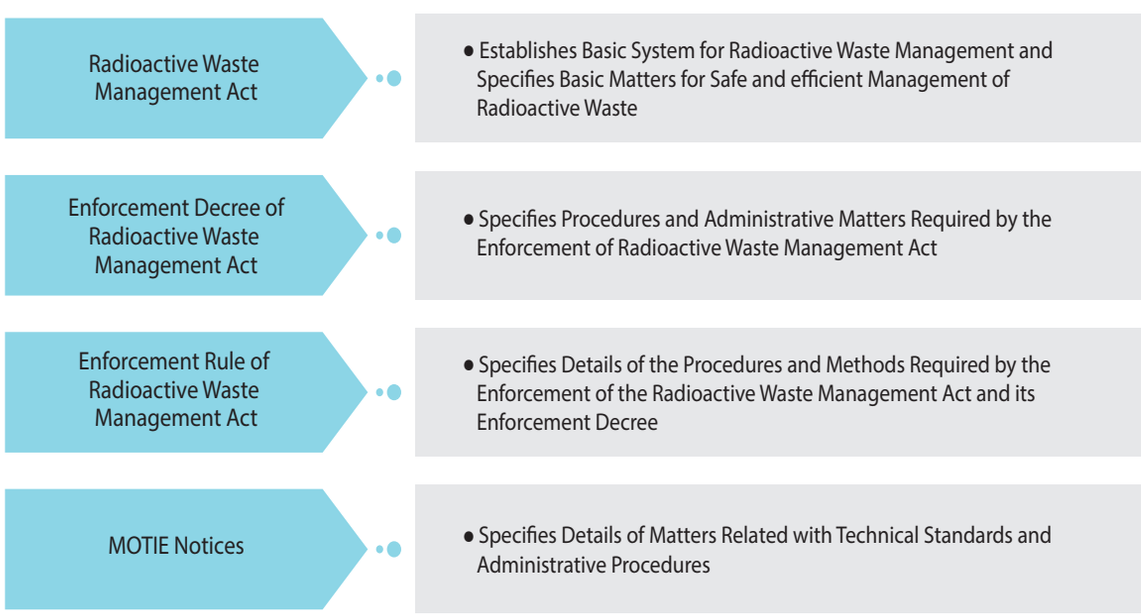

Figure E.2-2 Legal Framework of the Radioactive Waste Management Act

E.2.1.3 Laws related to Physical Protection and Radiological Emergency of Nuclear Facilities, etc.

The Act on Physical Protection and Radiological Emergency (APPRE) was enacted in May 2003 to strengthen the physical protection system for nuclear materials and facilities and the radiological emergency preparedness and response system. This Act inherits the articles related to physical protection and radiological disaster prevention as previously specified in the NSA as well as specifies various requirements to strengthen measures for physical protection and radiological disaster prevention. Also, the emergency planning zone (EPZ) was further classified into the precautionary action zone (PAZ) up to 3~5 km from a nuclear power reactor and related facilities, and the urgent protective action planning zone (UPZ) within 20~30 km radius of a nuclear power reactor and related facilities to ensure efficient emergency response in case of radiological emergency in accordance with the IAEA Safety Standards in May 2014.

E.2.1.4 Laws related to Nuclear Damage Compensation

For the civil liabilities of the license or permit holder due to a nuclear accident, the Nuclear Liability Act (1969) and the Act on Indemnification Agreement for Nuclear Liability (1975) were enacted to prescribe internationally accepted general principles for civil liabilities concerning nuclear damage. The Nuclear Liability Act was amended in January 2001 to reflect in domestic laws the contents of the Vienna Convention revised in 1997. The amendment of the Act concretized the concept of nuclear damage, set the limit of liability of the business operator to a calculation unit of 300 million. Here the “Calculation Unit” means amount equivalent to the special drawing right (SDR) of the International Monetary Fund (IMF). The upper limit of the compensation amount is prescribed in the Enforcement Decree of the Nuclear Liability Act, which was revised in January 2015 to raise the upper limit of the compensation amount from KRW 50 billion to a calculation unit of 300 million, consistent with the limit of liability.

E.2.2 Nuclear Regulatory Framework

In the Korean framework for nuclear safety regulation, the NSSC has authority over overall nuclear safety regulation. The government gives the

NSSC the authority in relation to nuclear safety regulation such as establishment of a nuclear safety policy and licensing under the provision of nuclear safety related laws such as the NSA. Likewise, Ministries of the government deal with nuclear safety management related tasks in fulfilling their own duties according to the Government Organization Act by forming an organic system with the NSSC. For example, the Ministry of Security and Public Administration, which implements national disaster prevention and management measures is in charge of the safety management of combustible materials in nuclear facilities. Figure E.2-3 shows the government organizations that are related with the safety management concerning nuclear facilities and activities.

The government separately operates the Ministry of Government Legislation which has authority over government legislation to ensure neither overlapping nor omission of safety regulations when laws related to the operations of these government sectors are established or amended. The Regulations on Legislative Operation Management (Presidential Decree) also stipulates that related agencies must consult with each other through overall legislative activities. Article 89 of the Constitution of the Republic 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 of safety regulation requirements.

For nuclear safety regulation requiring professional expertise, the Korean government is operating KINS as a professional regulatory agency under the provision of the NSA and Korea Institute of Nuclear Safety Act, in order to strengthen expertise in nuclear safety regulation. Based on the expertise and accumulated experience in nuclear safety regulation, KINS is in charge of regulatory services concerning nuclear safety entrusted by the NSSC such as safety review, safety inspection, verification and examination, R&D for standards (including technical standards), and management of records and reporting.

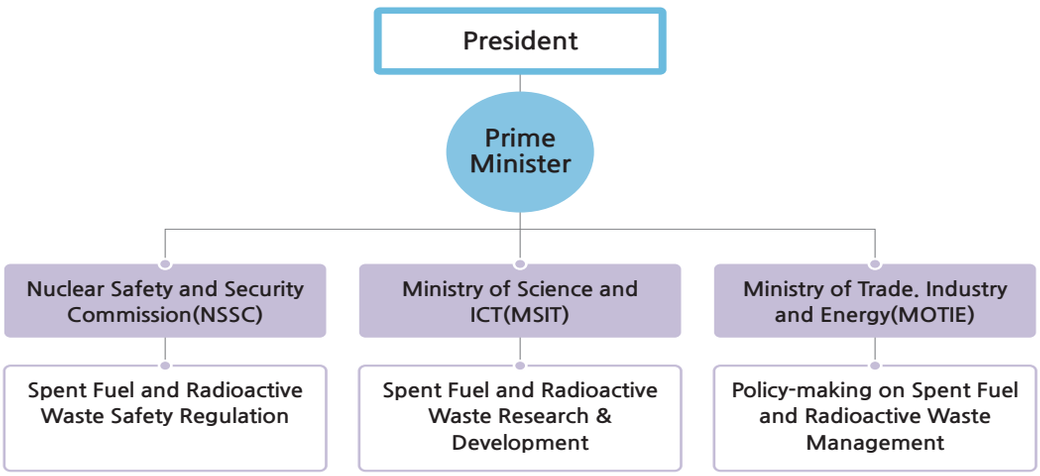

Figure E.2-3 Government Organizations Related to Radioactive Waste Management

E.2.3 Licensing Procedure

Early Site Approval

It is to start a limited construction work on a proposed site before a CP is issued and an applicant may apply for an Early Site Approval. The applicant shall submit an application together with a site investigation report (SIR) and a radiation environmental report (RER) to the NSSC. The NSSC delegates the safety review of application for early site approval to the KINS. The KINS conducts a safety review with respect to the adequacy of the proposed site for a radioactive waste management facility, etc., and the radiological impacts on the surrounding environment. Based on the results of the safety review by KINS for Early Site Approval, the NSSC will grant an approval.

CP and OL of Radioactive Waste Management Facility, etc.

An applicant who wishes to obtain a CP and OL of a radioactive waste management facility, etc., should submit to the NSSC an application which is attached with the RER, the safety analysis report (SAR), regulations on safety control, descriptions of design and construction method, and quality assurance program with respect to construction and operation. KINS conducts a safety review of application for the CP and OL. After deliberating on the results of the safety review, the NSSC may grant the CP and OL to the applicant.

The safety review of application documents for the CP and OL of a radioactive waste management facility, etc. is conducted to confirm that the site and the design of a radioactive waste management facility, etc. are in conformity with the relevant regulatory requirements and technical standards. The safety review is conducted to check the safety and implementation of regulatory requirements including principle and concept of the design of the radioactive waste management facility, ect., and assess the radiological impact to the environment and ways to minimize those impact. The RER, to be submitted at the time of application for CP and OL of a radioactive waste disposal facility or an interim storage facility for spent fuel, shall contain opinions collected from local residents living in the proposed site.

Amendment to CP and OL

For an amendment to CP and OL, such as a change in the design that affects or may affect the safety of radioactive waste management facility, etc., it is necessary to obtain approval from the NSSC. However, the alteration of any insignificant matter prescribed by the Ordinance of the Prime Minister shall be reported to the NSSC.

E.2.4 Regulatory Inspection

Regulatory inspections for a radioactive waste management facility, etc. under construction or in operation include pre-operational inspection for construction and performance of a radioactive waste management facility, etc., disposal inspection, periodic inspection, quality insurance inspection, inspection of control and accountancy for special nuclear material (internationally controlled nuclear material), daily inspection by Regional Offices and special inspection.

Pre-operational Inspection

The pre-operational inspection is conducted to verify whether the radioactive waste management facility is properly constructed in conformity with the conditions of the CP, and whether the constructed facility may be operated safely throughout its lifetime. The pre-operational inspection is divided into facility inspection and performance inspection.

Disposal Inspection

The disposal inspection is conducted to verify whether radioactive waste is properly disposed of in conformity to all the related technical standards provided in the NSA and subordinate statutes, prior to disposal of radioactive waste.

Periodic Inspection

The periodic inspection for a radioactive waste management facility, etc. is conducted to verify whether the facility is being properly operated in conformity with the conditions of the OL; whether the structure, equipment and performance of the facility maintains license based condition.

Quality Assurance Inspection

The quality assurance inspection is conducted to verify whether all activities that may affect quality at each stage of the construction and operation of a radioactive waste management facility, etc. are being performed in conformity with the quality assurance program approved by the regulatory body.

Inspection of Control and Accountancy for Special Nuclear Material

The inspection of control and accountancy for special nuclear material is conducted to verify whether special nuclear material is managed in conformity with regulation on control and accountancy for special nuclear material approved by the regulatory body. This inspection includes initial inspection, routine inspection, ad hoc inspection and special inspection.

Daily Inspection by Regional Offices

The main purpose of daily inspection by Regional Offices is to check a radioactive waste management facility, etc. under construction or in operation on a daily basis. It includes observation of surveillance and monitoring, an investigation on the measures taken when an abnormal event occurs at a radioactive waste management facility, etc., and check-up on the licensee over the implementation of radiation safety management.

Special Inspection

The special inspection includes an examination of important safety issues, or reportable events and a field inspection for the prevention of any potential event.

E.2.5 Enforcement

When the safety review results of the license application of a radioactive waste management facility, etc., meet the relevant requirements, the NSSC will issue a license. The NSSC may impose minimum conditions therein, when judged necessary to ensure safety. If any violation is found as a result of the regulatory inspection, the NSSC may order the license holder to take corrective or complementary measures in accordance with the NSA.

If it is deemed necessary for the enforcement of the nuclear regulations, the NSSC is to order the nuclear enterpriser to submit the necessary documents on their business and to complement any submitted documents. The NSSC may also conduct a regulatory inspection on site to verify that the documents are in conformity with field conditions, and order the licensee to take corrective or complementary measures, when necessary, as a result of inspection. The NSSC may order the revocation of license or the suspension of business within a period of no more than one year, in cases where the constructor and operator of a radioactive waste management facility, etc. falls one of the followings:

- in case of obtaining a CP and OL by fraudulent or other illegal means;
- in case of not commencing the permitted/licensed business within the period set by the Presidential Decree or suspending the permitted (or licensed) business for more than one year without good reasons;

- in case of modifying any matters subject to the permit (or license) without approval;
- in case of not meeting standards for permit (or license);
- in case of violating the order of the NSSC to take corrective or complementary measures as a result of regulatory inspections for the installment and operation of a radioactive waste management facility, etc.; and,
- in case of violating any of the permit (or license) conditions or regulations on safety measures in the operation of a radioactive waste management facility, etc.

In addition, if the licensee violates obligations prescribed in the NSA, the penal clauses (criminal punishment and fine) may be applied depending on the extent of violation.

E.2.6 Allocation of Responsibilities

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

The NSSC is responsible for the inspection at the stage of CP and OL, and the one related to the safety of radioactive waste management facilities, etc. (refer to E.2.4) in accordance with the NSA. KINS performs safety-related regulatory activities as entrusted by the NSSC.

MOTIE takes the responsibility of formulating and performing a basic plan that includes basic policy, estimated amount of generation and facility-related plans regarding radioactive waste management, pursuant to the RWMA. KORAD is responsible for radioactive waste management such as transportation, storage, and disposal, etc. of radioactive waste.

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 Nuclear Safety and Security Commission (NSSC)

The government established the NSSC under the Prime Minister with a goal to protect people from radiation hazards from generation and use of nuclear energy and to contribute to public safety and environmental conservation, pursuant to the Act on the Establishment and Operation of the Nuclear Safety and Security Commission. Accordingly, the NSSC performs overall tasks related to nuclear safety management such as safety regulation on nuclear power utilization facilities including radioactive waste management facilities, R&D activities and international cooperation.

E.3.1.1 Composition of the NSSC

The NSSC consists of nine members including the chairperson, with the chairperson and one member as standing members. The members of the NSSC are nominated or appointed among those who have in-depth expertise and experience in nuclear safety but the members are to be evenly selected from various fields such as nuclear, environment, public health, science and technology, public safety, law, and social and human sciences so as to contribute to nuclear safety in an effective and balanced way.

The chairperson is appointed by the President among the nominees referred by the Prime Minister. Four members including the standing member are appointed by the President with the referral of the chairperson of the Commission, while the rest four (4) members are appointed by the President with the referral of the National Assembly. A person who is working as an executive or an employee of an organization which received a CP and OL for a nuclear power reactor, a CP and OL for a research reactor, a permit for/designation of nuclear cycle business, or a CP and OL for a radioactive waste management facility, etc. within recent three years or who retired from those organizations within recent three years; or who are performing or performed the projects including R&D projects, worth more than KRW 10 million, entrusted by the above-mentioned organizations within recent three years should not be appointed as a member of the NSSC. The term of the NSSC members should be three years, and they may be reappointed once.

The NSSC convenes meetings upon request by more than two members or the chairperson where they deliberate and decide on key issues such as CP and OL of both nuclear power plants and radioactive waste management facilities, measures and fines to be imposed on nuclear operators for violation of relevant provisions, and enactment, amendment and abolition of Acts under their jurisdiction and the commission's regulations.

E.3.1.2 Advisory Committee

The Commission has the Advisory Committee under its control for practical consultations, preview of the issues needed to be deliberated and/or decided for efficient implementation of the tasks it entrusts.

The Advisory Committee is composed of maximum 15 expert members including the chairperson. The chairperson is appointed by the chairperson of the NSSC among the Advisory Committee's members. The expert members are appointed by the chairperson of the NSSC and should have in-depth expertise and experience in nuclear engineering or be the employees of the relevant institutions. The term of office of the Advisory Committee's members should be two years, and they may be reappointed once.

The NSSC may form a separate advisory (expert) committee for investigation in case of significant accident regarding the safety system of nuclear facilities, environmental contamination accident due to radiation, and significant radiation exposure accident.

E.3.1.3 Organization

The NSSC has the Secretariat which deals with the general affairs of the commission and the standing member holds an additional position of the secretary general. The Secretariat consists of two bureaus, one office, four officers, ten divisions and four Regional Offices, as seen in Figure E.3-1.

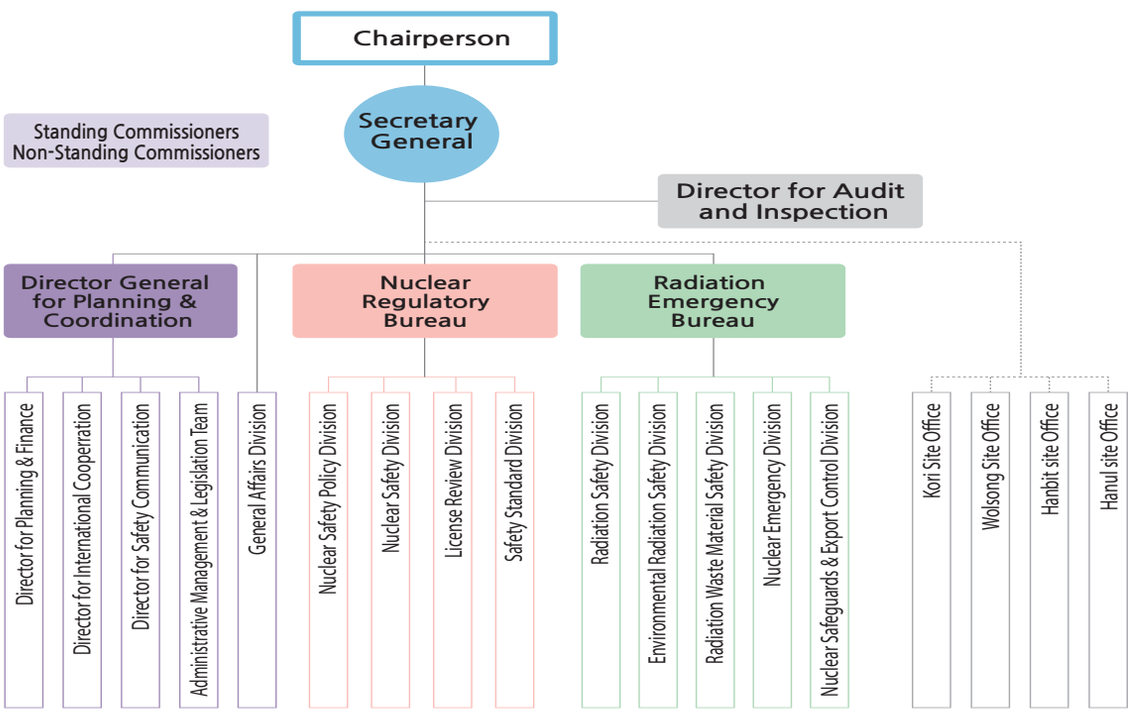

Figure E.3-1 Organization Chart of the NSSC (As of March 31, 2020)

Planning and Coordination Office is responsible for performance management, budgeting and settlement, response to the National Assembly and international cooperation. The office is also in charge of public relations, communication, response to the media and provision of information to the general public.

Nuclear Regulatory Bureau has authority over safety regulation, nuclear safety related Acts and statute, and regulatory standards on permit and license, inspection, accidents and failure investigation and decommissioning of nuclear power reactors and nuclear fuel cycle facilities.

Radiation Emergency Bureau is in charge of safety regulation on the use of nuclear materials, RIs and radiation generators (RGs) as well as spent fuel, radioactive waste and radioactive waste management facilities. The bureau also performs duties related with comprehensive safety management for

radiation workers, radiological disaster prevention, nuclear damage compensation, environmental radiation monitoring and evaluation, physical protection of nuclear materials and nuclear facilities, nuclear security, international nuclear non-proliferation regime, safety management of radiation in the natural environment.

Regional Offices located at the nuclear facilities are responsible for on-site safety regulation for nuclear reactors, nuclear fuel cycle facilities, radioactive waste management facilities, and communication with residents and local governments.

Radioactive Waste Safety Division has been newly established under Radiation Emergency Bureau in February 2017, with dedicated responsibilities for radioactive waste regulation which includes development of safety management policy and system for radioactive waste and spent fuel; regulation on storage, transportation, and disposal of radioactive waste and spent fuel; and safety regulation and R&D projects related to radioactive waste storage, treatment, and disposal facilities and attached facilities and spent fuel interim storage facilities and attached facilities.

Out of matters concerning radioactive waste and spent fuel, the responsibilities for regulation on decommissioning of nuclear power reactors are under Nuclear Safety Division, and standards for permit/license for radioactive waste management facilities are under Safety Standard Division, and on-site regulation of radioactive waste management facilities are under Regional Offices (Wolsong and Hanbit).

E.3.1.4 Human and Financial Resources

The NSSC employs 158 persons as of April 6, 2020, and 34 out of them work at Regional Offices.

The allocated budget for the NSSC is KRW 216.2 billions as of 2020, consisting of the general accounting budget of KRW 110.9 billions and KRW 105.3 billions from the Nuclear Power Fund. The operating cost of technical support organizations such as KINS and Korea Institute of Nuclear Nonproliferation and Control (KINAC), and R&D on nuclear safety regulation are funded from the general accounts while the regulatory activities such as review and inspection of nuclear power utilization facilities are funded from the Nuclear Power Fund Safety Regulation Account which is financed from the Dues for Nuclear Safety Management made by the nuclear enterprisers.

E.3.1.5 Independence of NSSC

The government has separated safety regulation on nuclear power from utilization and promotion of nuclear power, and legally guarantees the independence of the work of the NSSC.

Policies for nuclear power development and radioactive waste management are under the control of MOTIE in accordance with the Electricity Business Act and the RWMA while nuclear power related R&D and policies on the use and promotion of radiation are under the MSIT pursuant to the Atomic Energy Promotion Act and the Radiation and RI Utilization Promotion Act, and safety regulation policies on nuclear power and radiation, and measures against radiation hazards/disasters are under the NSSC in accordance with the NSA, the Act on Physical Protection and Radiological Emergency and the Nuclear Liability Act.

Article 2 (Principles of Operation) of the Act on Establishment and Operation of the NSSC provides that independence and fairness are the principles of operation of the NSSC while Article 3 (Establishment of the NSSC) of the same Act secures the independence of the NSSC by specifying that safety related matters about which decisions need to be made independently such as licensing and corrective order for nuclear operators are not subject to the authority or supervision of the Prime Minister.

E.3.1.6 Transparency of NSSC

The NSSC makes its meetings and annual reports public, and operates the Nuclear Safety Information Center (NSIC) in order to promote transparency.

The NSSC makes it a rule to open its meetings to the public and disclose meeting minutes. Those who want to sit in on the meetings are required to sign up at least 24 hours prior to opening of a meeting with the approval of the chairperson. The meeting minutes taken down are open to the public on the NSSC's website, etc. by the date of the next meeting.

The NSSC shall submit a report on its performance of duties of the relevant year to the National Assembly within three months after the last day of each fiscal year and make it public. In addition, it provides information about the safety of nuclear reactors, radiation, nuclear fuel and radioactive waste to all the people promptly and transparently with operation of the NSIC which is also used as a communication channel to collect suggestions on important matters.

E.3.2 Korea Institute of Nuclear Safety (KINS)

KINS was established in February 1990 as a nuclear safety regulation expert organization, under the Act on the Establishment of KINS. KINS performs tasks on nuclear safety regulation as entrusted by the NSSC in accordance with Article 111 of the NSA which include safety review in relation to licensing and approval of nuclear power utilization facilities; safety inspection in relation to manufacturing, construction and operation of nuclear power utilization facilities; and R&D on technical standards in relation to safety regulation of nuclear power utilization facilities. the independence and accountability of KINS has been further strengthened when the Korea Institute of Nuclear Safety Act was revised in June 2020 to stipulate that KINS performs activities regarding nuclear safety regulation in an independent and neutral position. Major activities regarding safety regulation on nuclear facilities are as follows:

- Safety regulation on nuclear facilities
  - Review and inspection of safety of nuclear power plants
  - Review and inspection of safety of nuclear fuel cycle facilities and research reactors, etc.
- Safety regulation on radiation and radioactive waste
  - Verification of safety on the use of radioactive isotopes, etc.
  - Review and inspection of safety of radioactive waste management facilities, etc.
- Radiation preparedness and emergency response
  - Emergency response and preparedness for radiological accident and terrorism
  - Monitoring of environmental radioactivity throughout the territory and the areas in the vicinity of nuclear power plants
  - detection of nuclear tests and nuclear accidents in neighboring countries
- R&D and specialization of nuclear safety regulation
  - Development of safety regulation standards and technologies
  - Development of policies and systems for safety regulation
  - Cultivation of experts
- Enhancement of global leadership and public trust
  - Enhancement of contribution and support of regulatory technologies to the international community
  - Programs to spread safety culture as well as enhance public trust

KINS employees 623 persons as of March 2020 and Figure E.3-2 shows the organization chart of KINS. KINS received a budget of KRW 134 billions from the government as of 2020. To share its safety regulatory technologies and experience with the international community, KINS opened the International Nuclear Safety School (INSS) in January 2008, which has also functioned as the IAEA's Asian training center since conclusion of Nuclear Safety Cooperation Agreement with the IAEA.

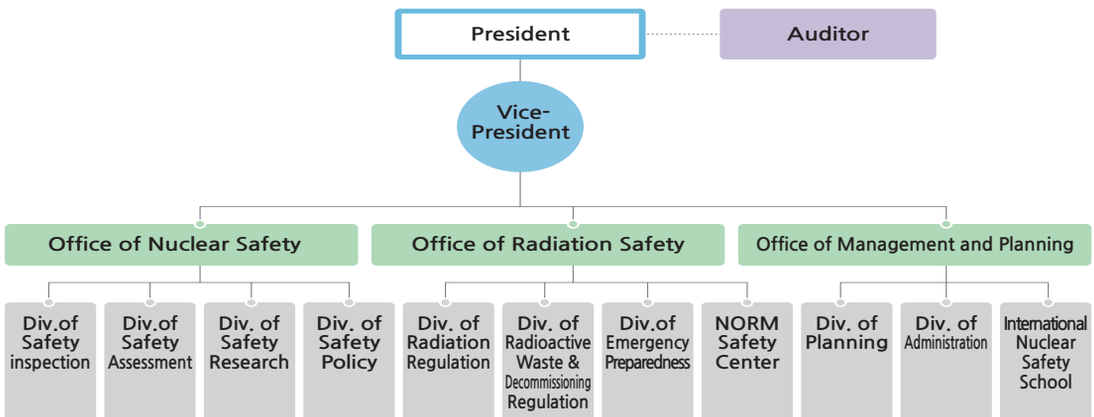

Figure E.3-2 Organization Chart of KINS (As of March 31, 2020)

E.3.3 Korea Institute of Nuclear Nonproliferation And Control (KINAC)

KINAC founded in June 2006 performs activities regarding safeguards on nuclear energy related facilities and nuclear materials, import & export control, physical protection and R&D, pursuant to Article 6 (Establishment of the Korea Institute of Nuclear Nonproliferation and Control) and Article 7 (Duties of KINAC) of the NSA. As of April 2020, KINAC is composed of two offices, one department, six divisions and two centers and hires 116 employees in total, as shown in Figure E.3-3.

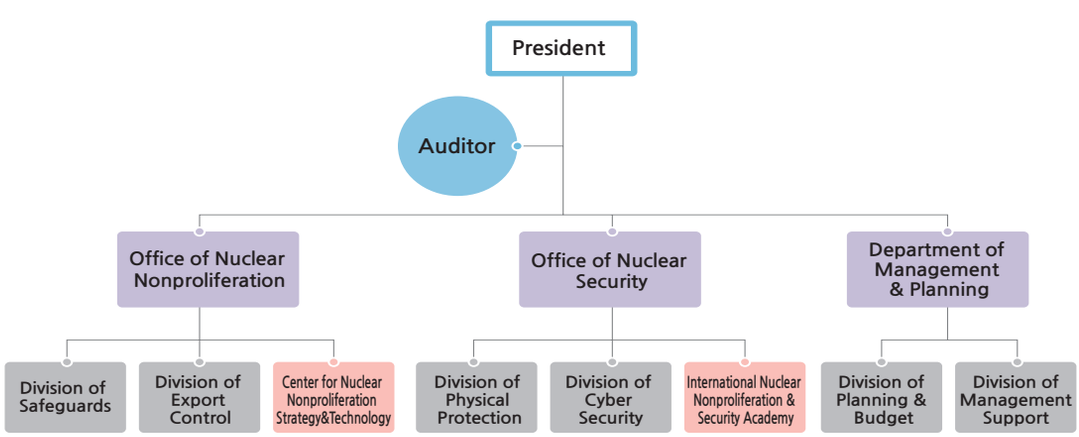

Figure E.3-3 Organization Chart of KINAC (As of April 2020)

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 Meets its Primary Responsibility for Safety

In accordance with Article 5 of the RWMA, a radioactive waste management operator should cooperate with the regulatory body to manage radioactive waste in a safe and efficient manner. In accordance with the NSA, the NSSC assumes the responsibility to verify by means of regulatory inspections described in Section E.2.4, that the installer or the operator of the nuclear power utilization facility comply with the permit or license conditions during construction or throughout the lifetime of the nuclear power utilization facility. If a violation takes place, the NSSC immediately orders the installer and the operator to take corrective or complementary measures so as to secure the safety of the nuclear power utilization facility. In case the operator of the nuclear power utilization facility has failed to meet the permit or license conditions, the NSSC may order revocation of the permit or license or the suspension of the business for a given period. In addition, if the performance of the nuclear power utilization facility does not meet the technical standards, the NSSC may order the operator to strengthen the safety measures.

The license holder of a nuclear power utilization facility has the responsibility for safe management of spent fuel and radioactive waste generated during operation in accordance with related regulations until they are transported to a storage, treatment or disposal facility. The operator of a radioactive waste management facility has the responsibility to accept the radioactive waste from the generators and then to treat (except for spent fuel), store, and dispose of it in a safe manner.

F.1.2 Ultimate Responsibility

According to the resolution of the AEPC, the Korean government adopted the State's responsibility for radioactive waste management in light of the fact that radioactive waste needs to be safely managed in the long-term. MOTIE should establish the basic plan for radioactive waste management to manage radioactive waste safely and efficiently which are deliberated and decided on at the meeting of the AEPC.

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 Korea Radioactive Waste Agency (KORAD)

Organization and Human Resources

KORAD is composed of the head office (Quality Assurance & Safety Division, Administration Division, Project Division), LILW Disposal & Facility Operation Division, R&D Institute of Radioactive Wastes, and Fund Management Center which is responsible for the Radioactive Waste Management Fund, as shown in Figure F.2-1. KORAD has a total of 316 employees; 178 in the head office, 99 in LILW Disposal & Facility Operation Division, 29 in R&D Institute and 10 in Fund Management Center. In Project Division of the head office, 17 personnel are in charge of development and implementation of spent fuel management plan, and 47 personnel are responsible for overseeing and supporting construction and operation of the LILW disposal facility. Under LILW Disposal & Facility Operation Center, Facility Operation Department is staffed with 68 personnel who operate and manage the disposal facility and RI Waste Management Team is staffed with seven personnel who operate and manage RI waste management facilities.

The main duty of LILW Disposal & Facility Operation Center is to operate the LILW disposal facility. Facility Operation Department manages the overall processes of the LILW disposal facility from transportation, receipt, inspection to disposal. The department is also in charge of radiation safety management, environmental assessment, emergency preparedness drills, etc.

The head office performs activities in relation to management, administrative support, public relations, community cooperation, quality assurance, etc.

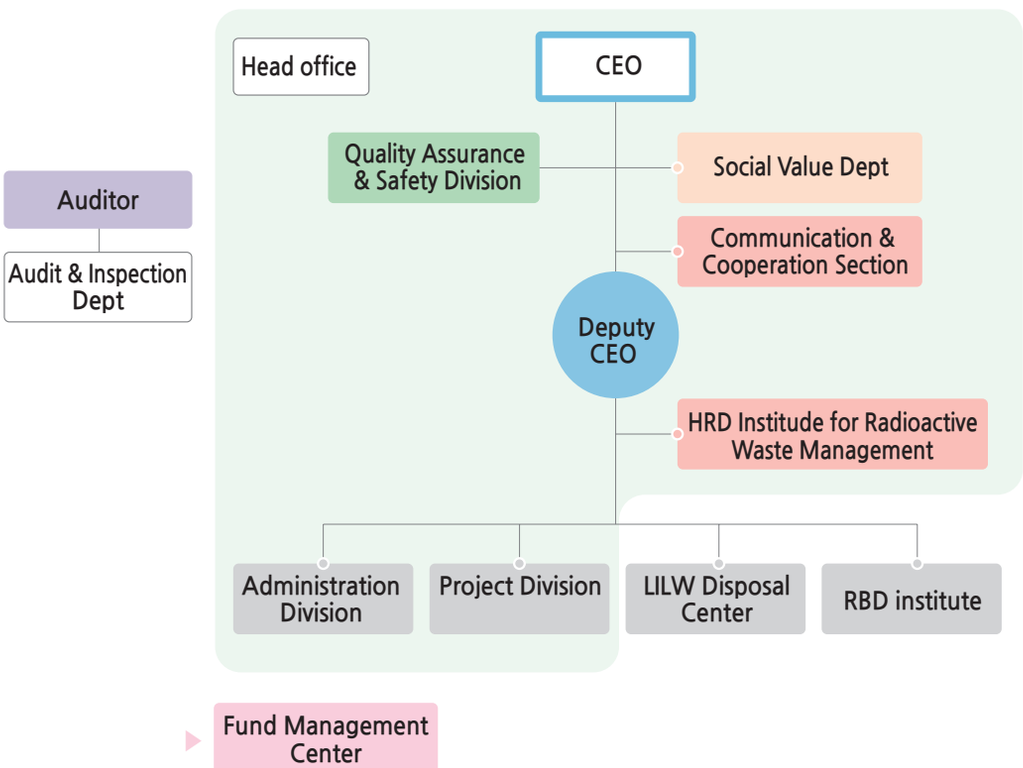

Figure F.2-1 Organization Chart of KORAD (As of March 31, 2020)

Financial Resources

As per the RWMA, the radioactive waste generators including RI waste generators pay the expenses incurred in radioactive waste management to KORAD at the point of delivery of radioactive waste. The expenses are paid into the government fund and KORAD secures the budget necessary for radioactive waste management from the government fund. KRW 160.79 billions for LILW management, KRW 1.93 billions for spent fuel management and KRW 1.32 billions for technology development have been earmarked as of 2020.

F.2.2 Korea Hydro & Nuclear Power Co. Ltd. (KHNP)

Organization and Human Resources

The KHNP is a nuclear power plant operator, consisting of the head office (7 divisions), 5 nuclear power sites and special institutes such as Central Research Institute, Human Resources Development Institute and Radiation Health Institute, as shown in Figure F.2-2. There are Radwaste Management Section, Radiation Safety Section and Emergency Preparedness & Environment Section under Radiation Safety Office of Quality & Safety Division in the head office. Spent Fuel Section is under Backend Management & Decommissioning Department of Technology Innovation Division.

Radiation Safety Office in the head office is composed of Radwaste Management Section staffed with six personnel responsible for storage, treatment and disposal of LILW generated during plant operation; Radiation Safety Section with six personnel tasked with radiation safety management such as occupational health and protection and transportation of radioactive material; and Emergency Preparedness & Environment Section with 11 personnel in charge of radiological emergency preparedness for nuclear power plants and environmental radiation management. In addition, Spent Fuel Section in Backend Management & Decommissioning Department is responsible for temporary on-site storage of spent fuel until it is transported to the repository or the interim storage facility, with nine personnel.

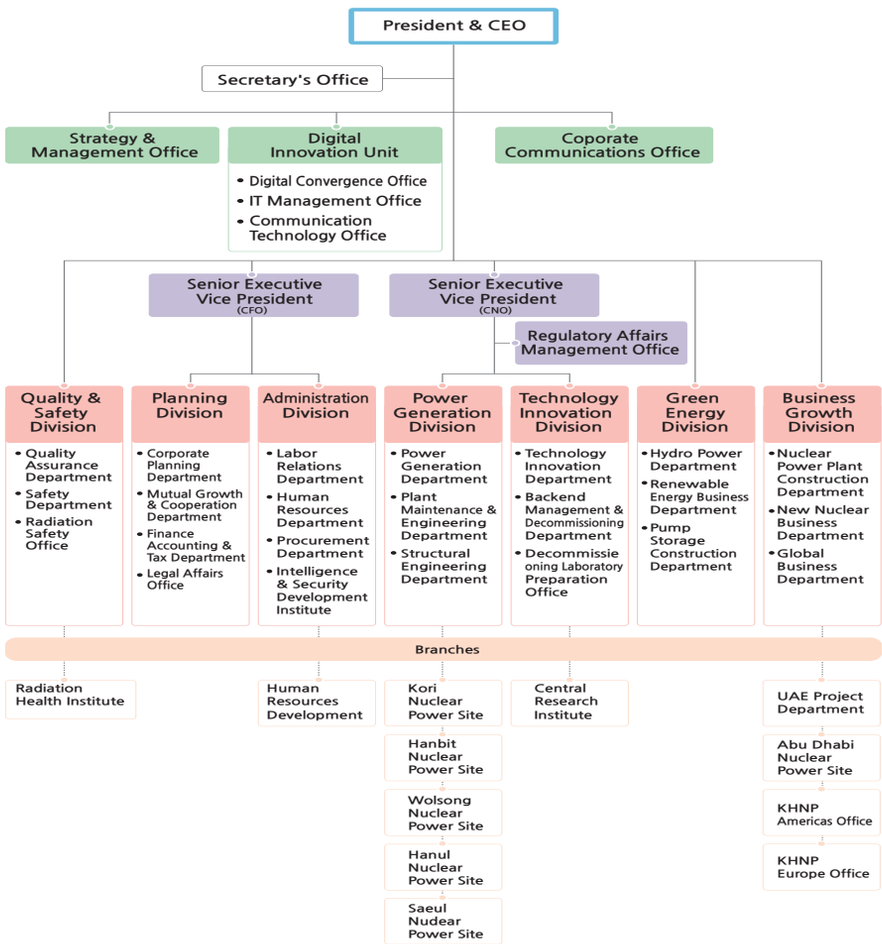

Figure F.2-2 Organization Chart of KHNP (As of March 31, 2020)

Radiation Safety Section at each nuclear power plant has approximately 30 personnel who perform duties related with health physics, radiation protection, radioactive waste management, etc., and five of them are responsible for radioactive waste management such as treatment and temporary storage of radioactive waste. Besides, a team to take charge of delivery of LILW to the disposal facility is in place at each nuclear power site.

Each nuclear power site also has Emergency Preparedness Section responsible for radiological emergency preparedness and environmental radiation management such as emergency preparedness drills and training of emergency response personnel. The organization chart of a nuclear power site is shown in Figure F.2-3.

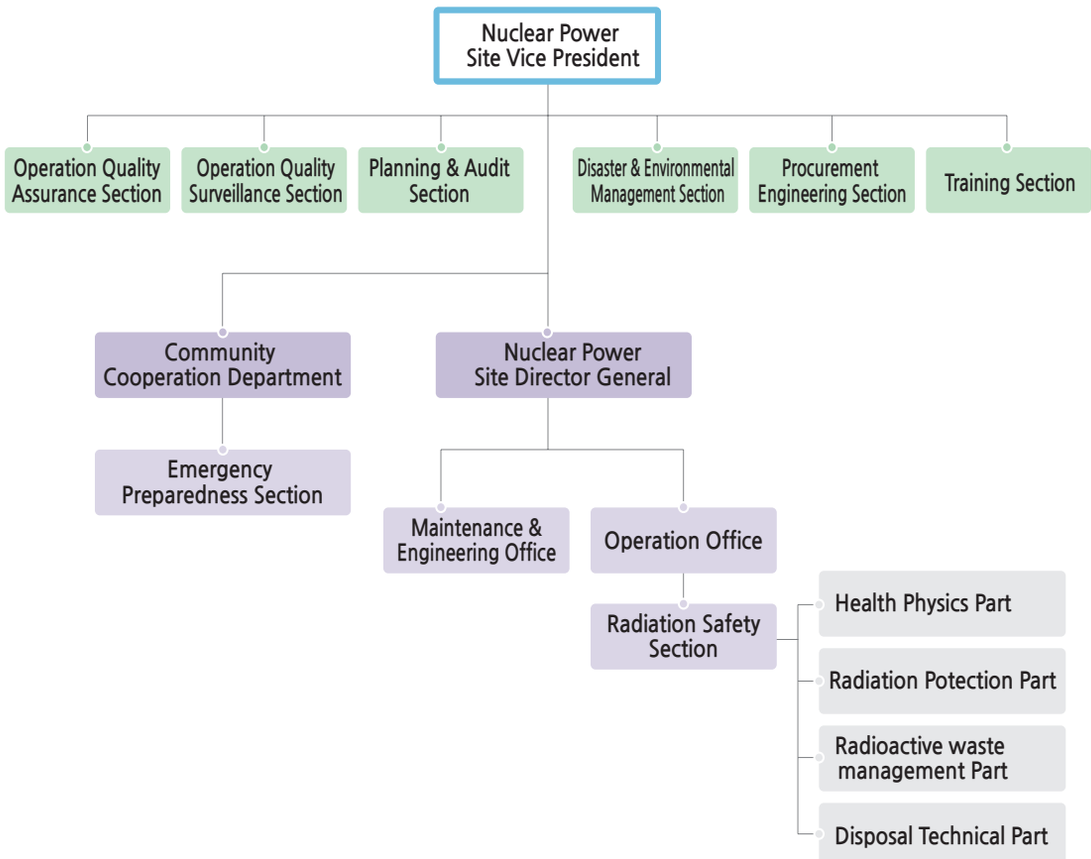

Figure F.2-3 Organization Chart of Nuclear Power Plant Site (As of March 31, 2020)

Financial Resources

In accordance with the Electric Utility Act, the operator of nuclear power plants has paid the costs for disposal of LILW and spent fuel generated during decommissioning and operation of nuclear power plants in installments on a yearly basis to prepare the reserve fund for backend management of nuclear power plants since 1983.

Cost estimates are reviewed by the minister of MOTIE every two years pursuant to the Enforcement Decree of the RWMA. According to the provision on the standards for calculation of expenses for radioactive waste management and charges for management of spent fuel, the estimate for LILW is KRW 15.19 million per drum while that for spent fuel from PWR is KRW 320 millions per bundle and spent fuel from PHWR is KRW 13.20 millions per bundle. The management expenses for LILW is accumulated payable whenever radioactive waste is generated and paid to KORAD

whenever radioactive waste is delivered pursuant to Article 14 (Expenses for Radioactive Waste Management) of the RWMA. The charges for management of spent fuel is accumulated payable when a nuclear reactor is loaded with nuclear fuel and paid to the Radioactive Waste Management Fund when nuclear fuel is unloaded from the nuclear reactor in accordance with Article 15 (Charges for Management of Spent Nuclear Fuel) of the RWMA. Meanwhile, the nuclear power plant operator should accumulate a reserve separately every year for decommissioning of the relevant nuclear power plant pursuant to Article 17 (Reserve for Cost of Decommissioning Nuclear Power Plants, etc.) of the RWMA.

F.2.3 KEPCO Nuclear Fuel Co. Ltd. (KEPCO NF)

Organization and Human Resources

KEPCO NF is a designer and manufacturer of nuclear fuel that is used in nuclear power plants. KEPCO NF consists of three divisions, Quality & Safety Center and Innovation & Growth Business Center as of late March 2020, as shown in Figure F.2-4. KEPCO NF has Nuclear Power Safety Office and Safety Management Office under Quality & Safety Center to be in charge of radiation safety, and management of radioactive waste and nuclear materials, and disaster safety. Nuclear Safety Office is composed of Nuclear Engineering Team, Nuclear Safety Team, Nuclear Environment Team, and Safety Management Office consists of Safety Management Team, Safety Inspection Team, and Regulatory Cooperation Team.

Under Nuclear Safety Office are Nuclear Engineering Team staffed with 10 personnel responsible for instrumentation, environmental radiation /radioactivity management, decontamination & dismantlement technology development; Nuclear Safety Team with eight personnel tasked with health physics, exposure control and transportation of radioactive materials; and Nuclear Environment Team with 11 personnel in charge of safety management and storage of radioactive waste, development of radioactive waste treatment technology and delivery of radioactive waste to disposal facilities. Safety Management Office has Safety Management Team with 11 personnel responsible for disaster safety and management such as radiological preparedness, fire protection and public health; Safety Inspection Team with 10 personnel, tasked with general environment and industrial safety management; and Regulatory Cooperation Team with five personnel in charge of safety guards of nuclear material and licensing of nuclear material processing business.

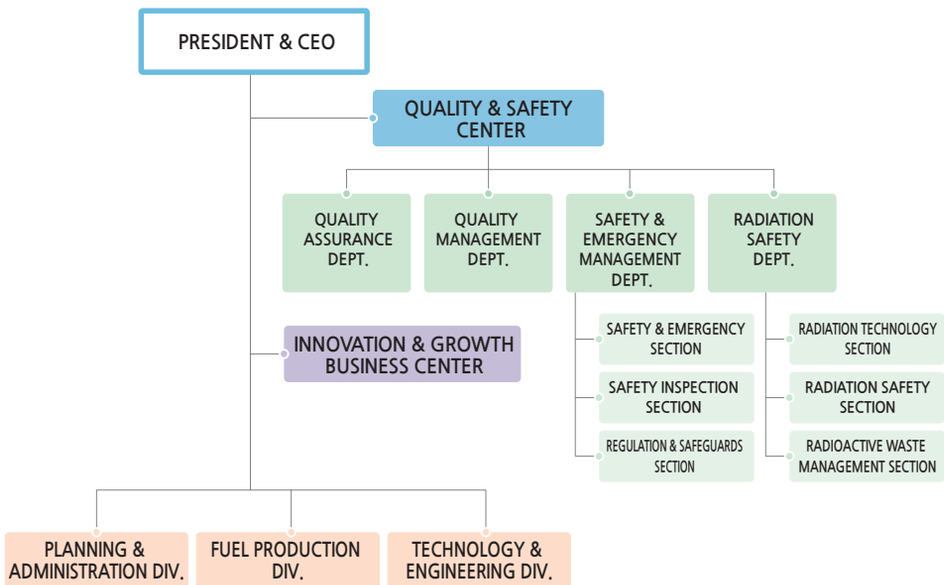

Figure F.2-4 Organization Chart of KEPCO NF (As of March 31, 2020)

Financial Resources

The management expenses for LILW is reserved pursuant to Article 14 (Expenses for Radioactive Waste Management) of the RWMA. A generator of radioactive waste should pay the management expenses at the point of delivery of radioactive waste to KORAD. KEPCO NF has reserved the management expenses based on the quantity of drums of radioactive waste generated on a quarterly basis in preparation for disposal. A total of KRW 142.7 billions has been accumulated as of late March 2020.

F.2.4 Korea Atomic Energy Research Institute (KAERI)

Organization and Human Resources

KAERI has several facilities related to management of spent fuel and radioactive waste, including HANARO, PIEF, radioactive waste treatment facilities and storage facilities, and combustible waste treatment facility. Figure F.2-5 presents KAERI's operation and management organization.

- HANARO

  With 34 personnel, HANARO Management Division under HANARO Operation and Utilization is responsible for operation and maintenance of the research reactor. Radioactive waste generated from HANARO is transferred to and managed at KAERI's radioactive waste treatment facility and storage facility. Spent fuel generated from the reactor is managed by HANARO Management Division.

- PIEF

  Post Irradiation Examination Division under Nuclear Fuel Cycle Technology of KAERI operates the PIEF. This facility is operated and maintained by 19 operating and test/maintenance personnel whose work scope is assigned according to their expertise and backgrounds. Operating staff members are responsible for operation of supporting equipment such as electricity and water quality management, and ventilating equipment as well as internal and external inspections including nuclear material accounting and licensing, whereas test/maintenance staff are in charge of post-irradiation examination for spent fuels and management of the relevant examination facilities. Radiation safety management, environmental radiation monitoring, water supply control, and nuclear material accounting, physical protection, radiological emergency preparedness with regard to the PIEF are performed in cooperation with related departments of KAERI.

- Radioactive Waste Treatment Facility and Storage Facility

  36 personnel in Radwaste Management Center under Nuclear Fuel Cycle Technology of KAERI operate radioactive waste treatment and storage facilities and 15 personnel is responsible for nuclide analysis for radioactive waste disposal. KAERI operates facilities related to evaporation, bituminization, solar evaporation, LILW storage facilities, and a radionuclide analysis facility to conduct a non-destructive radionuclide analysis of radioactive waste drums to be transported to the disposal facility. Environmental radiation monitoring, and QA are performed in cooperation with related departments of KAERI.

- Combustible Waste Treatment Facility

  Beginning in 2011, Radwaste Management Center under Nuclear Fuel Cycle Technology of KAERI operates a combustible waste treatment facility with three personnel to reduce the volume of combustible waste generated from decommissioning of KRR-1 and 2, and the UCF. Because of equipment obsolescence, the incineration process of the facility has not been operated since November 2015. Management, maintenance and repair activities are performed for the facility.

Radiation safety management, environmental radioactivity management, and QA are provided through the support and cooperation of the related KAERI departments.

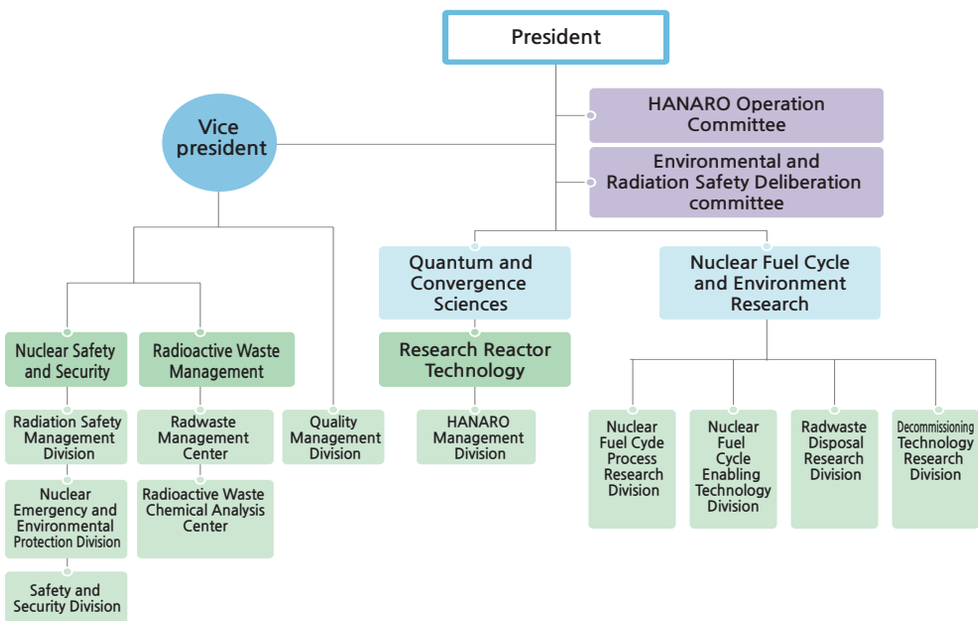

Figure F.2-5 Radioactive Waste related Organization Chart of KAERI
(As of March 31, 2020)

Financial Resources

The management expenses of spent fuel related facilities and radioactive waste treatment facilities and storage facilities of KAERI is financed by the government budget. In accordance with the RWMA, KRW 36.92 billions has been accumulated for disposal of radioactive waste as of 2020 and KRW 3.58 billions has been earmarked for preparation for treatment and analysis of radioactive waste to be disposed of so as to meet the acceptance criteria at the disposal facility.

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 Policy

The NSA stipulates that the constructor and operator of the radioactive waste management facility etc. should establish and implement a quality assurance program (QAP), so as to ensure planned and systematic QA activities at the stages of site characterization, design, construction, operation, closure, and post-closure monitoring of the facility.

Details on quality assurance of construction and operation of each facility are described in the NSSC Notice Quality Assurance Standards for Radioactive Waste Management Facilities. Another Notice of the NSSC Technical Standards for the Operation, etc. of Low and Intermediate-Level Radioactive Waste Disposal Facilities also specifies technical standards to be observed by the constructor and operator for operation and management of a LILW Disposal Facility.

An applicant for a CP and OL of a LILW Disposal Facility should develop and submit a QAP for construction and operation of the radioactive waste disposal facility as an attached document to the application for the CP and OL. The applicant has the ultimate responsibility of complying with the QAP during construction and operation of the facility.

In case that the QAP plan is to be amended after grant of CP and OL, the constructor and operator should notify the amendment to the NSSC, except the constructor and operator obtain early approval from the NSSC if related with changes in QA organization.

The licensee has the responsibility to abide by the approved QAP in the design, construction and operation of a radioactive waste management facility, etc. and the regulatory body shall audit the fulfillment state and effectiveness of the QAP implemented by the licensee in accordance with the NSA and subordinate statutes.

F.3.2 Quality Assurance Program (QAP)

As for the framework of the QAP applicable to a LILW disposal facility and an interim storage facility for spent fuel, Enforcement Rule of the NSA and the NSSC Notice Quality Assurance Standards for Radioactive Waste Management Facilities stipulates 18 criteria as follows:

1) Organization, 2) QAP, 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) Audit, supervision and business management.

F.3.3 Implementation and Assessment of QAP

The constructor and the operator of a LILW disposal facility, 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 QAP, pursuant to the NSA. The licensee is responsible for establishing an integrated system such that all participants implement the QAP.

All contractors participating in the LILW disposal project have conducted QA activities in the applicable areas of site characterization, design, fabrication, construction, commissioning, management and maintenance in operation, closure and post closure monitoring in accordance with detailed procedures based on the QAP. The QAP should be established and implemented for each contractor.

Evaluation for implementation and effectiveness of this QAP are periodically conducted by the licensee itself, as well as by the contractors. The method of assessing implementation of the QAP includes quality control inspection, QA audit, QA trend analysis, and effectiveness evaluation of the QAP.

- 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 inspection points (witness point and hold point) in the inspection plan and then executes the inspection.

- QA audits for the licensee and contractors are periodically performed by an auditor independent from the tasks to be audited.
- Quality trend analysis is conducted to analyze the trends and causes of conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, defective material and equipment, non-conformances. Based on the results of trend analysis, measures to prevent recurrence and to incorporate them into the QAP are developed so as to improve QA activities.
- Assessment of QAP effectiveness is periodically conducted by the QA organization to maintain the QAP suitable for the characteristics of facilities within the scope of the QAP. Major considerations for assessment of QAP effectiveness are given to incorporate legislation and revision of related laws and regulations, corrective actions or recommendations made by the regulatory body, modifications to the QAP, and revision of applicable technical standards into QAP documents.

The responsible person of the QA organization ensures that important issues resulting from the evaluation of implementation and effectiveness of the QAP are reported to the top management so that proper actions are taken in a timely manner, and if needed, the QAP and related procedures are revised based on the results of assessment of QAP effectiveness to maintain the QAP in the best possible condition.

F.3.4 Regulatory Activities

Regulatory control on QA is conducted through reviews and inspections by KINS, as entrusted by the NSSC. Reviews of the QAP of the licensee of a radioactive waste management facility, etc. and inspections of the appropriateness of implementation of the QAP are performed. The purpose of regulatory activities for radioactive waste disposal is to ensure that the licensee performs quality related activities in accordance with the approved QAP and each contractor participating in design, construction and/or operation of a radioactive waste disposal facility establishes and implements a QAP properly suitable for the NSA. These regulatory activities are conducted as per provisions of the NSA and subordinate statute, Safety Review Guidelines for Radioactive Waste Disposal Facilities, and the NSSC Notice on Quality Assurance Standards for Radioactive Waste Management Facilities.

The regulatory review is conducted to verify whether the QAP of the licensee complies with the NSA and subordinate statute as well as the safety

review guidelines. It also verifies whether the QA procedures for implementation of the QAP are properly established and are practicable.

The regulatory body performs a periodic inspection to confirm the appropriateness of implementation of the QAP with regard to the radioactive waste treatment, discharge and storage facilities at NPPs and the radioactive waste management facilities at research reactor and nuclear fuel fabrication facility. In the same manner, the same regulations are applied to the LILW disposal facility.

In order to encourage the operator to conduct performance-based QA activities voluntarily, KINS has developed and utilized the Inspection Guidelines for the Operator's Quality Assurance Activities (QAA). According to the guidelines, the results of regulatory inspection of QA activities of the operator is quantified and graded, and based on which, KINS has implemented a graded approach to regulatory inspection of QA activities of the operator. Under the QA Auditor Qualification Program for regulatory personnel established by KINS, qualified auditors who have completed the specified educational and training courses, conduct the QA inspections.

Quality Management System within the Regulatory Body

As part of efforts to improve reliability and fairness as an organization entrusted with regulatory activities, KINS has developed the Quality Management Plan in December 2001 based on IAEA TECDOC-1090 Quality Assurance within Regulatory Bodies. On the Occasion of IAEA's IRRS conducted in 2011, KINS made a transition from the quality management system to the Integrated Management System and accordingly renamed the Quality Management Plan with the Management System Manual. The Management System of KINS is being implemented in accordance with IAEA General Safety Requirement Part 1 Governmental, Legal and Regulatory Framework for Safety and Part 2 Leadership and Management for Safety. The Management System Manual presents principles and standards for decision-making and implementation after reviewing comprehensively international norms, matters entrusted to KINS by national laws, and reasonable expectations and demands of the public and stakeholders. The Manual also defined all processes and document control necessary for fulfilling the duties of KINS and ensure that all activities performed by KINS are implemented based on safety culture in a planned and systematic manner.

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

Regulations and requirements related to radiation protection applicable to management of spent fuel and radioactive waste generated during operation of nuclear power utilization facilities are specified in the NSA, its Enforcement Decree and Rule, and Regulations and Notices of the NSSC. These regulations and requirements are consistent with international standards (by IAEA for example) and they are summarized as follows:

Nuclear Safety Act (NSA)

The NSA prescribes articles concerning radiation protection to be applied to nuclear power utilization facilities, as follows:

- articles concerning protective measures against radiation hazards to keep quantities of released radioactive material, etc. and exposure dose as low as reasonably achievable (ALARA);
- articles concerning safety measures necessary to protect human, materials and the public from radiation hazard that may accompany the operation of nuclear power utilization facilities;
- articles concerning establishment of exclusion area to protect human, materials, and the public from radiation hazards, when installing nuclear power utilization facilities;
- articles concerning registration of dosimetry reading service provider for a radiation worker who is employed by nuclear power utilization facilities or a person with frequent access to radiation control area; and
- articles concerning securement of safety, and training and education on prevention of radiation hazards.

Enforcement Decree of NSA

The Enforcement Decree of the NSA prescribes articles entrusted by the NSA and other details necessary to implement each item stipulated in NSA as follows:

- articles concerning dose limits in related to radiation exposure (see Table F.4-1);
- articles concerning measures necessary to protect the human body, objects and public safety from radiation hazards that may be accompanied by operation of nuclear power utilization facilities;
- articles concerning measures necessary to minimize radiation exposure to radiation workers in nuclear power utilization facilities, persons with frequent access to radiation control area and residents in adjoining areas of the facilities;
- articles concerning medical checkup and exposure control for radiation workers in nuclear power utilization facilities and persons with frequent access to radiation control areas;

- articles concerning measurement of radiation dose and contamination levels for areas with concerns of radiation hazards in nuclear power utilization facilities, and concerning about performance inspection of dosimetry service providers;
- articles concerning implementation of protective measures against radiation hazards, such as actions or report with regard to a person who are over exposed; and
- articles concerning education and training of a radiation worker and a person with access to a radiation control area.

Table F.4-1 Dose Limits

Item	Effective dose limit	Equivalent dose limit	
		Lens of the eye	hands and feet, skins
Radiation Workers	100 mSv for five consecutive years and not exceeding 50 mSv/y	150 mSv/y	500 mSv/y
Persons with frequent access[1]; persons engaging in transport[2]; and persons under 18 with the purpose of education and training, etc. as recognized by the NSSC	6 mSv/y	15 mSv/y	50 mSv/y
Public	1 mSv/y	15 mSv/y	50 mSv/y

1) "Persons with frequent access" are those who access radiation control areas for work such as cleaning and facility management other than radiation workers (excluding persons with temporary access for visit or field trip).

2) "Persons engaging in transport" are those who, other than radiation workers, transport radioactive materials, etc. outside the radiation control areas

Enforcement Rule of NSA

The Enforcement Rule of the NSA prescribes detailed matters necessary for implementing the NSA and its Enforcement Decree as follows:

- detailed provisions on assessment and control of exposure dose for radiation workers or persons with frequent access;
- detailed provisions on places and objects for measuring radiation dose and contamination levels;
- detailed provisions on technical capabilities for reading of exposure dose;

- detailed provisions on contents and time of education and training for radiation workers, or persons who have access to radiation control areas; and
- details of medical check-up for radiation workers and persons with frequent access.

Regulations of the NSSC

The NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. and Regulations on Technical Standards for Radiation Safety Control, etc. prescribes detailed matters necessary for implementing the NSA and its Enforcement Decree and Rule as follows:

- detailed provisions on radiation protection equipment for protection against radiation exposure in the reactor and related facilities, and nuclear fuel cycle facilities (Regulations on Technical Standards for Nuclear Reactor Facilities, etc.);
- detailed provisions on particulars about and actions taken for radiation control areas in nuclear power utilization facilities (Regulations on Technical Standards for Nuclear Reactor Facilities, etc.; Regulations on Technical Standards for Radiation Safety Control, etc.);
- detailed provisions on radiation protection for radiation workers, or persons with frequent access (Regulations on Technical Standards for Nuclear Reactor Facilities, etc.; Regulations on Technical Standards for Radiation Safety Control, etc.); and
- detailed provisions on measures related to radiation protection programs for reactor and related facilities, and nuclear fuel cycle facilities (Regulations on Technical Standards for Nuclear Reactor Facilities, etc.).

Notices of the NSSC

Notices of the NSSC present detailed technical standards for radiation protection specified in the NSA, its Enforcement Decree and Rule. The principal Notices related to radiation protection are as follows:

- Standards on Radiation Protection, etc.
- Standard Format and Content of Radiological Environmental Impact Assessment Report for Nuclear Facilities

- Regulations on the Radiological Environmental Survey and the Radiological Assessment for Nuclear Facilities
- Regulation on Criteria and Inspection of Registration for Dosimetry Service Provider
- Regulation on Assessment and Management of Personal Radiation Exposure Dose
- Regulation on Measurement and Calculation of Internal Radiation Dose
- Regulation on the Education and Training for Radiation Safety Management, etc.

The NSSC Notice on Standards for Radiation Protection, etc. concretely defines not only reference and limit values with regard to radiation protection such as permissible surface contamination, ECL, annual limit on intake (ALI), derived air concentration (DAC), and design standards for shielding materials, but also details of the method to apply dose limits, and dose limitation and working procedures in a radiological emergency situation. Additionally, in order to prevent any environmental hazard, standards applicable to the design and operation of the corresponding facilities are specified. The NSA was amended and went into force on October 13, 2016 to strengthen the safety management level of persons with frequent access to that of radiation workers which includes medical check-up and radiation exposure dose record-keeping.

F.4.2 Radiation Protection Framework at Each Stage of Management of Nuclear Facilities

ALARA Activities for Radiation Workers and the Public

The below radiation protection principles are incorporated into the design and construction of nuclear power utilization facilities, for assuring ALARA and maintaining operational exposure dose to radiation workers and the general public below applicable limits:

- Optimization of Radiation Protection

  Consideration should be properly made in the design of nuclear and radiation facilities, to keep radiation exposure as low as reasonably achievable (ALARA) based on assessment of the expected dose received by radiation workers and the public during operation.

- Radiation protection equipment

  Nuclear power utilization facilities should be installed with equipment

to control the access of radiation workers to radiation and contamination areas. The areas of which radiation level is required to be lowered to protect radiation workers are equipped with shielding equipment. In addition, radiation monitoring systems are installed to monitor radiation levels and release, and then provide collected information to the control room and other relevant areas. Besides, the surface of the areas with potential radiation contamination should be even and impermeable so as to facilitate decontamination if necessary. Decontamination equipment should be properly available in case that person(s) and/or equipment are radiologically contaminated. Ventilation systems with proper filtration capacity are installed to ventilate contaminated air and to limit radioactive materials in the air. The facilities are designed such that contaminated air flows from low level contaminated areas to high level areas, and radiologically contaminated areas have lower pressures than clean areas to ensure the contaminated air is not leaked or does not flow back.

- Training on Radiation Safety Management

  It is required that radiation workers and persons with frequent access to a radiation control area should take appropriate training on radiation protection necessary for radiation work and entry to a radiation control area in accordance with the NSA and subordinate statute.

- Radiation Work Management

  It is required that any person who intends to have access to a radiation control area and to perform a radiation work should obtain approval in advance in the form of a radiation work permit (RWP). The type of RWP is different depending on the type of radiation work, radiation level, and working area conditions. For issuance of the RWP, a radiation safety personnel evaluates the expected dose of an applicant after due consideration of the environment and characteristics of the workplace as well as records of exposure dose, radiation protection training and medical checkup. In addition, the radiation safety personnel may permit a radiation work under special requirements, if necessary. Mock-up training is conducted for specified radiation work in which high radiation exposures are expected.

- Exposure Dose Reduction

  As part of efforts to reduce radiation exposure, feedback of radiation safety management experience, research and introduction of exposure reduction technologies and provision of radiation protection training to workers prior to radiation work have been implemented. In addition, target doses are set for unit work, outage dose and collective dose, and managed as indicators of the optimization of radiation protection. In addition to a primary dosimeter, an electronic dosimeter is given to each worker to monitor exposure during a work to ensure effective exposure control.

Individual Dose Control

- Occupational Dose Control

  The operator of a nuclear power utilization facility sets and manages dose constraints by itself to keep exposure of a radiation worker below legal dose limits. It is prescribed in the procedure that any person whose annual exposure dose reaches the set targets should not perform any more radiation work during which said worker is expected to be additionally exposed above the operational dose constraints, unless the approval of the person responsible for the operation of the facility is given or proper measures are taken.

- Dosimetry Service Provider and Performance Inspection

  With approval of the NSSC, the dosimetry service providers perform the following tasks: monthly or quarterly distribution, collection, and reading of personal dosimeter, notification of personal dose results; quarterly reporting of dose results to the government; and semiannual calibration and performance verification of dosimeter reader. The dosimetry service provider undergoes a performance inspection from the regulatory body periodically according to the international standards in order to secure accuracy and reliability in external dose assessment. In addition, the regulatory body conducts periodic inspection on dosimetry service providers on a yearly basis to review and confirm their technical capability needed for installation and operation of radiation dosimetry systems and their activities to maintain the quality assurance of the system

- Radiation Workers Information System (RAWIS)

  The NSSC developed the RAWIS to manage exposure dose, medical checkups, training & education of radiation workers at nuclear power utilization facilities comprehensively. The system is currently run by the Korea Foundation of Nuclear Safety (KoFONS) and used for radiation dose analysis for radiation workers, etc. as follows.
  - Analysis of data of exposure dose;
  - Analysis of results of investigation and assessment of a person with peculiar reading;
  - Analysis of data on radiation exposure events;
  - Analysis and research for exposure dose reduction; and
  - Analysis of causes and related data that affect statistics on radiation exposure distribution

Preventive Measures for Unplanned/Uncontrolled Release

- Legal Requirements

  The NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. and Regulations on Technical Standards for Radiation Safety Control, etc. stipulate that direct or indirect measuring equipment that can monitor the concentration of radioactive materials should be installed in the drainage and air vents of a nuclear power reactor, a nuclear fuel cycle facility, and a radioactive waste management facility, etc. When the concentration of the radioactive materials discharged exceeds established set points, an alarm is annunciated automatically, thus making appropriate countermeasures possible. Regarding radioactive effluent control, airborne or liquid radioactivity concentration at the EAB must be less than limit values and radioactive effluents must not be released in other than air vents or drainage.

- Measures in the Design Stage

  In the design stage for 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 potentially radioactive system, and to install a process radiation monitor for checking the radioactivity levels or leakage in the systems. The effluent radiation monitor and sampling equipment should be installed in the main release path, if any, and the environmental release of effluents whose radioactivity exceeds limit values should be controlled through securing of an interlock function to prevent the release automatically in case an alarm is triggered. Additionally, in the design stage, there is a need to check every effluent release path and release point, and to create a design that enables the prevention of possible effluent release in any other path and point other than 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 control program in due consideration of the characteristics of the facility. This plan includes detailed procedures for effluent monitoring and control, sampling schemes, etc. Nuclear facilities must discharge all liquid and gaseous effluents under proper monitoring and control in accordance with the pre-established program.

According to the NSSC Notice on Regulation on the Reporting and Public Announcement of Accidents and Incidents at Nuclear Facilities, when radioactive materials are released under unplanned and uncontrolled conditions due to equipment malfunction or human error, the operator must verbally report the event to the NSSC immediately and submit a detailed report to the regulatory body within 60 days. When the one-hour average concentration of radioactivity released into the environment from the facility concerned exceeds the ECL, the operator likewise must report the event to the regulatory body immediately and submit a report to the regulatory body within 60 days. Information on such unplanned/uncontrolled release must also be included in the report periodically submitted to the regulatory body.

F.4.3 Discharge Control Scheme at Nuclear Facilities

The NSA prescribes that a CP and OL of a nuclear power reactor and related facilities, a nuclear fuel cycle facility, a facility using or possessing nuclear fuel material, a radioactive waste storage, treatment, or disposal facility and related facility should be given on the condition that the prevention of radiological hazards to the public health and the environment is ensured.

Accordingly, the Enforcement Decree of the NSA stipulates that the concentration of radioactive materials discharged from a facility should meet the limits defined by the NSSC. In the Regulation of the NSSC, it is stipulated that the amount of radioactive material discharged should be minimized with the formulation of the radioactive waste management program, and that environmental impacts should be controlled to maintain ALARA.

The Enforcement Decree of the NSA and the NSSC Notice Standards for Radiation Protection, etc. define the emission control level for each radionuclide which is the concentration limit of gaseous or liquid radioactive material to be discharged from a nuclear facility into the environment, along with annual dose limits for offsite residents.

- Annual dose limits for gaseous effluents at the EAB are as follows:
  - air absorbed dose by gamma ray: 0.1 mGy/y
  - air absorbed dose by beta ray: 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 due to particulate radioactive substances, 3H, 14C, and radioiodine: 0.15 mSv/y

- Annual dose limits for liquid effluents at the EAB are as follows:
  - effective dose: 0.03 mSv/y
  - human organ equivalent dose: 0.1 mSv/y

- Annual dose limits at the EAB of a multi-unit site as follows:
  - effective dose: 0.25 mSv/y
  - thyroid equivalent dose: 0.75 mSv/y

In practice, most of nuclear facilities operate with operational limits which are stricter than the legal limits. In addition, some facilities also apply derived release limits (DRLs) based on design values in consideration of convenience in field application[1]. In addition, The compliance with the aforementioned limits is verified with periodic inspection or review of regular reports submitted to the regulatory body. Tables F.4-2 and F.4-3 present the annual release of gaseous and liquid effluents discharged from nuclear power sites and KAERI site in Daejeon, and their off-site dose estimations for the recent five years. The radiation dose to the individual in the vicinity of nuclear facilities are assessed on a quarterly basis using the Off-site Dose Calculation Manual (ODCM). The assessments are based on the radioactivity of the released liquid and gaseous effluents, atmospheric conditions, food ingestion rate, and social data including agricultural and marine products of the local community within an 80km radius.

1) pursuant to the NSA amended in December 2015, a discharge plan for liquid and gaseous radioactive materials including total discharge load for each site and for each nuclide group was added to the list of licensing documents submitted to apply an operating license for a nuclear power reactor and related facilities (effective from December 2, 2016). Accordingly, the discharge control over liquid and gaseous effluents has been much strengthened.

Table F.4-2 Annual Radioactivity in Liquid and Gaseous Radioactive Effluents Discharged from Nuclear Power Plants Sites and Calculated Off-site Dose

[Radioactivity discharged: Bq, Dose: mSv]

Site \ Year			2017	2018	2019
Kori	Liquid	^{3}H	5.47E+13	4.97E+13	9.19E+13
		Other	1.41E+08	5.40E+08	3.34E+08
	Gaseous	^{3}H	2.00E+13	1.57E+13	2.31E+13
		Other	1.16E+12	1.29E+12	1.49E+12
	Offsite dose		8.10E-03	3.88E-02	8.51E-03
Hanbit	Liquid	^{3}H	4.18E+13	5.43E+13	1.85E+13
		Other	5.81E+08	6.80E+07	1.74E+08
	Gaseous	^{3}H	1.98E+13	1.94E+13	1.56E+13
		Other	5.32E+11	1.18E+12	2.67E+11
	Offsite dose(mSv)		1.48E-02	1.01E-02	9.63E-03
Hanul	Liquid	^{3}H	6.75E+13	7.30E+13	6.33E+13
		Other	1.31E+08	1.12E+08	9.08E+07
	Gaseous	^{3}H	1.27E+13	1.46E+13	1.27E+13
		Other	4.79E+11	5.82E+11	4.17E+11
	Offsite dose		1.67E-02	1.54E-02	7.38E-03
Wolsong	Liquid	^{3}H	2.45E+13	2.46E+13	3.11E+13
		Other	1.36E+10	9.99E+08	7.32E+10
	Gaseous	^{3}H	1.08E+14	1.10E+14	1.10E+14
		Other	5.70E+12	4.73E+12	7.15E+12
	Offsite dose		3.35E-02	4.22E-02	4.20E-02

Note) The Kori : Kori Units 1 to 4 and Shin-Kori Units 1 to 4, The Hanbit : Hanbit Unit 1 to 6, The Hanul : Hanul Unit 1 to 6, The Wolsong : Wolsong Unit 1 to 4 and Shin-Wolsong Unit 1 to 2

Table F.4-3 Annual Radioactivity in Liquid and Gaseous Radioactive Effluents Discharged from Daejeon Site and Calculated Off-site Dose

[Radioactivity discharged: Bq, Dose: mSv]

Site \ Year			2017	2018	2019
Daejeon	Liquid	^{3}H	-	-	-
		Other	7.67E+06	1.40E+07	1.26E+07
	Gaseous	^{3}H	2.57E+12	4.60E+12	1.68E+12
		Other	2.29E+11	3.79E+11	3.18E+09
	Offsite dose		7.86E-04	6.09E-04	2.39E-04

Note) The gaseous radioactivity in this table is the sum of radioactivity in the gaseous effluents discharged from research facilities (HANARO, PIEF, spent fuel processing facility, combustible waste treatment facility), nuclear fuel fabrication facilities for PWR and PHWR and RI waste management facility, all of which are located in Daejeon.

F.4.4 Implementation of Complementary Measures against Unplanned/ Uncontrolled Releases from Nuclear Facilities

Monitoring Plan

Radioactive effluents undergo monitoring to keep the release within the dose limits specified by the Enforcement Decree of the NSA (concerning the dose limit for the general public) and the Notices of the NSSC (concerning the prevention of hazards to the environment), through sampling and radioactivity analysis before and after release, and off-site dose calculation.

Action Plan

The radioactive waste treatment facility of a nuclear facility, which is furnished with a proper radiation monitoring system in the identified release path of radioactive material, is subject to formulate and implement programs to take appropriate measures in the event that an uncontrolled release of radioactive materials occurs. A report should be made under the event reporting scheme, when any unplanned/uncontrolled release occurs, and proper actions should be taken with the support of the operator and the emergency response organization. Subsequently, necessary actions should be taken after evaluation of the individuals/public dose and the amount of released radioactive materials using available radiological data from the process radiation monitoring and environment radiation monitoring system with reasonable scenarios. The existing action procedures must be complemented through analysis of the release pathways and cause of the uncontrolled/unplanned release of radioactive materials.

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 APPRE which stipulates the system of managing radiological emergency, as well as Framework Act on Civil Defense and Framework Act on the Management of Disasters and Safety, which stipulates the system of national response against disasters of various kinds. Especially, the APPRE stipulates overall radiological emergency management affairs including: prevention of, preparedness for, and response to radiological emergency; radiological emergency medical treatment; and international cooperation.

Pursuant to the APPRE, the NSSC formulates a National Radiological Emergency Plan every five years, which is interlinked with Master Plan for National Safety Management established based on the Framework Act on Management of Disasters and Safety. Each year, the NSSC prepares a National Radiation Disaster Prevention Action Plans, which is an yearly implementaton plan for five year based National Radiological Emergency Plan. Local governments with relevant jurisdiction establishes and implements a Local Radiological Emergency Plan every year in accordance with a National Radiological Emergency Plan and a National Radiation Disaster Prevention Action Plans. The nuclear licensee shall formulate a radiological emergency plan and obtain approval thereof from the NSSC prior to commencement of the use of nuclear facilities.

In order to carry out public protective measures in case of radiological emergency, the APPRE was amended in May 2014 to subdivide the emergency planning zone (EPZ) into precautionary action zone (PAZ) and the urgent protective action planning zone (UPZ). This was to incorporate the IAEA Safety Standards which recommend designating the PAZ up to 3 to 5km from a NPP and the UPZ within a 20 to 30km radius of the NPP. Accordingly, subordinate statutes have been amended to allow the NPP operator to designate the PAZ and the UPZ, taking into account characteristics of the site such as road and topography within the framework of the APPRE. Based on that, details of the zones for each site were finalized and approved by the NSSC in May 2015.

F.5.2 National Radiological Emergency Response Scheme

The radiological emergency response scheme is composed of National Emergency Management Committee (NEMC) which is chaired by the Chairman of the NSSC, Off-site Emergency Management Center (OEMC), Local Emergency Management Center (LEMC), Radiological Emergency Technical Advisory Center of KINS, Radiological Emergency Medical Service Center of Korea Institute of Radiological and Medical Sciences (KIRAMS), and Emergency Operating Facility (EOF) of the nuclear licensee as shown Figure F.5-1.

The NSSC has the responsibility to control and coordinate the countermeasures against radiological disaster. When a radiological emergency occurs, the NSSC operates the NEMC, in which 18 central government departments and two specialized institute participate as member of the committee meeting to initiate a practical pan-governmental response system. In addition, the NSSC installs and operates the OEMC, which is chaired by the Secretary General of the NSSC. The OEMC consists of experts from central government; local governments; related local institutes; nuclear safety expert organizations, radiological medical service institutes; and the personnel dispatched by the licensees. The OEMC has a responsibility to perform coordination and management of radiological emergency response.

The LEMC, established by the local governments concerned, implements the OEMC's decision on protective measures for residents. It also takes charge of coordination and control of emergency relief activities utilizing local fire stations, police stations and military units.

When an accident occurs, the licensee of nuclear installation, is responsible for organizing an EOF and for taking measures to mitigate the consequences

of the accident, to restore installations, and to protect the on-site personnel.

The government establishes the national radiation emergency medical system for coordination and control of radiological medical services under the radiological emergency situation. The system consists of the National Radiation Emergency Medical Center (NREMC) of KIRAMS, and 31 primary and secondary radiation emergency treatment center designated for each region.

KIRAMS established NREMC in case of radiological disaster to take an overall management in radiation emergency medical activities including advice on medical relief, technical support and medical treatment on those who have radiation damage or are likely have radiation damage. The NREMC dispatches a field medical support team to establish and operate a joint radiation emergency medical center and support the installation and operation of field radiation emergency medical clinics.

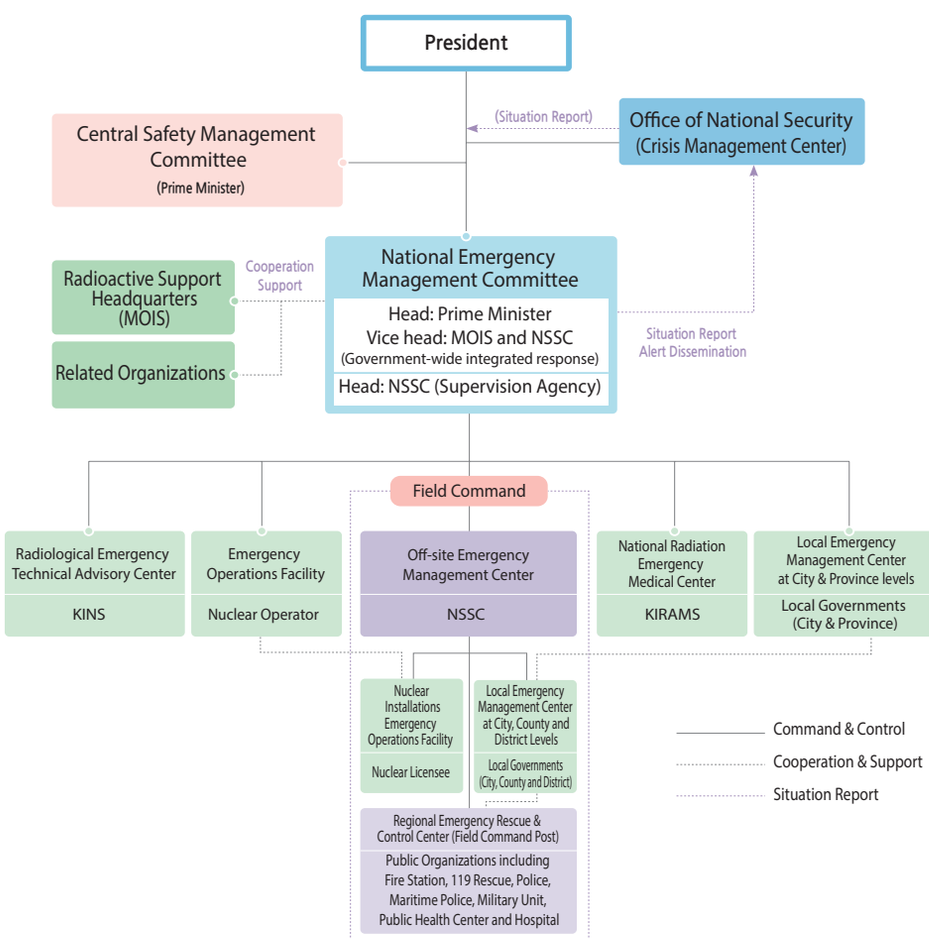

Figure F.5-1 National Radiological Emergency Response Scheme

KINS organizes Radiological Emergency Technical Advisory Center, which is in charge of providing technical advice on radiological emergency response, analysis and assessment of accident, operation of 15 regional environmental radioactivity monitoring stations and 156 environmental radiation monitoring posts across the country, assessment on environmental radiation/radioactivity and the radiological impact. KINS developed the Atomic Computerized Technical Advisory System for a Radiological Emergency (AtomCARE). Currently the system is under operation to provide various technical supports effectively for the public and environment protection in radiological emergencies. The AtomCARE enables the rapid analysis, assessment of radiological impact of emergencies and the comprehensive management of information to protect the public. Its configuraton is shown in Figure F.5-2.

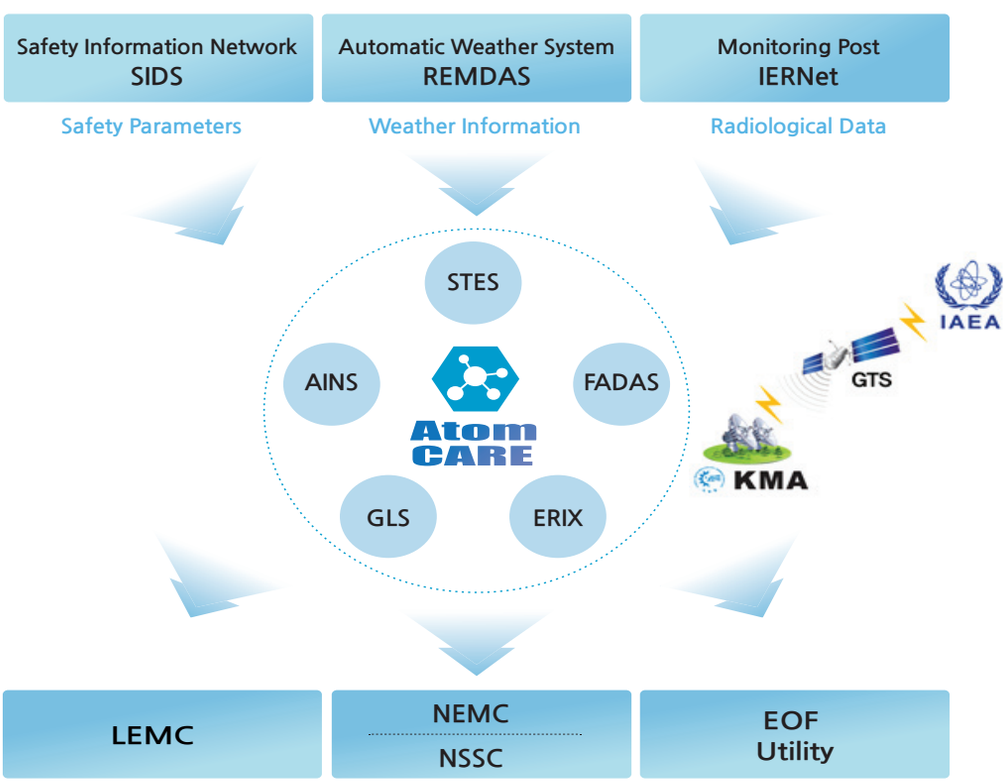

Figure F.5-2 Atomic Computerized Technical Advisory System for the Radiological Emergency (AtomCARE)

- POMS : Plant Operation Monitoring System
- SIDS : Safety Information Display System
- REMDAS : Radiological Emergency Management Data Acquisition System
- PGIS : Public protective Geographic Information System
- IERNet : Integrated Environmental Radiation Network

- STES : Source Term Evaluation System
- ADAMO : Accident Dose Assessment Model
- SIREN : System for Identifying Radiation in Environments Nationwide
- ERIX : Emergency Response Information eXchange system
- OEMC : Off-site Emergency Management Committee
- LEMC : Local Emergency Management Center
- NEMC : National Emergency Management Committee

The AtomCARE is designed to collect and analyze information about NPPs operation status, weather, social geography, environmental radiation monitoring and radioactivity analysis. In its information collection stage, the AtomCARE gathers information such as the key operation parameters of NPPs from the POMS and the SIDS, meteorological information from the REMDAS, and environmental radiation information from the IERNet. Social geography information is not provided through a network; rather it is established in a form of database on population and medical relief station of the administrative district managed by the local government in the vicinity of NPP sites.

In the analysis stage during a radiological disaster, the STES is used to evaluate the source term by calculating the core damage level, release path and release amount. The ADAMO evaluates the possible impact of radiation exposure promptly and efficiently in case of an accident in an NPP located domestically and overseas by utilizing the source term information from STES and meteorological information from the REMDAS. In case of an accident that takes place overseas, a multi-model ensemble prediction system is established in order to prepare for a worst case scenario. The PGIS displays the meteorological information, evaluation result on anticipated exposure dose, and environmental radiation information together with the residents evacuation status by administrative district and radiological protection facilities. Such information is provided to relevant emergency response agencies to support decision making on resident protection in an effective manner. In the meantime, the ERIX enables the central government, the local governments, expert organizations, and the nuclear facility operators to make prompt response and share related information immediately and effectively when an accident occurs.

F.5.3 Training

Since enactment of the APPRE, the radiological emergency training has been managed at a national level. To ensure that radiological emergency training is delivered in a comprehensive and systematic manner, details of the emergency training including designation and notification of emergency preparedness personnel, development of training programs, and training delivery methods are defined in the NSSC Notice Regulation on Education for Radiological Emergency Preparedness. Accordingly, the operators of nuclear reactor facilities have developed training programs for each position of radiological emergency preparedness and delivered training and exercise periodically to ensure emergency preparedness personnel is fully aware of their roles and to improve their skills and competencies. KIRAMS has conducted training and exercise on radiological emergency medical service for radiological emergency medical staff designated by the heads of KIRAMS and 24 primary and secondary radiological emergency medical hospitals across the country.

The NSSC has worked on revision of the APPRE to adjust the frequency of national radiological emergency preparedness drill led by the central government with participation of local governments, nuclear facility operators, and other emergency preparedness organizations from every five years to every year as part of efforts to strengthen emergency preparedness drill. From 2015 onwards, the national radiological emergency preparedness drill has been conducted every year in cooperation with related government authorities. As follow-up actions on EPZ expansion that results from amendment of the APPRE in May 2014, the NSSC revised the Enforcement Decree of the same Act in November 2014 to adjust the frequency of radiological emergency preparedness drill led by local governments from every four years to every two years per nuclear site and to create area-specific intensive drills (e.g. protective actions for residents).

Nuclear power facilities conduct radiological emergency preparedness drills that must be participated in by on-site or off-site emergency preparedness organizations as follows:

- the unified drill with participation of on-site emergency response organizations, emergency preparedness authorities, the central government and local governments is conducted under the charge of the NSSC in accordance with the schedule for radiological emergency preparedness drills.
- the integrated drill with participation of on-site emergency response organizations and off-site emergency preparedness authorities should be conducted every two years under the charge of the local government for each nuclear site.

- the on-site emergency drill with participation of all emergency organizations in nuclear reactor facilities should be conducted at least once a year for a two-unit NPPs.
- the emergency team drill is conducted every quarter for each emergency response team.
- for newly constructed reactor facilities, the on-site emergency drill is conducted to verify emergency preparedness prior to 5% of initial rated thermal power. However, the integrated drill should be conducted for a NPP constructed at a new site.

F.5.4 Environmental Radiation Monitoring

The constructor and the operator of nuclear power utilization facilities must take the primary responsibility for preserving the environment around the corresponding facilities and report to the NSSC the results of environmental radiation monitoring and radiological environmental impact assessment due to operation of the facilities. The NSSC and KINS monitor environmental radiation around the facilities as part of efforts to oversee and supervise the environmental radiation monitoring activities of the constructor and the operator of the facilities.

The legal basis for the environmental radiation monitoring of the adjoining areas of nuclear facilities is Article 104 (Preservation of Environment) of the NSA. The constructor and the operator of the corresponding facilities must establish an environmental monitoring program in accordance with the NSSC Notice Regulation on the Radiological Survey and the Radiological Environmental Impact Assessment for Nuclear Facilities and report implementation results of the plan to the NSSC. As entrusted by the NSSC, KINS conducts environmental monitoring independently from the constructor and operator of nuclear power utilization facilities and checks the adequacy of the monitoring activities through the comparison and evaluation of the monitoring data of the corresponding facilities' 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, KINS monitors in real time the variations of the environmental radioactivity and the gamma radiation dose rate in the air according to Article 105 (Monitoring of Nationwide Radioactive Environment) of the NSA, and also continuously measures the radioactive contamination of airborne dust, fallout, rainwater, agricultural products, soil, service water and milk so as to detect abnormal circumstances or signs due to radiological impact in an early stage and respond appropriately. KINS has

run a national environmental radiation monitoring network since 1997. On the occasion of the Fukushima Daiichi Accident in 2011, KINS has strived to expand the national monitoring network and install at least one environmental radiation monitor at each sector of the EPZ within a 20 to 30km radius of the nuclear power plant, as the EPZ was expanded in 2015. As a result, the Integrated Environmental Radiation Monitoring Network is established with 15 regional radioactivity analysis stations and 156 radiation monitoring posts across the country, as shown in Figure F.5-3. KINS also trains monitoring personnel from the monitoring stations every year and routinely conducts a cross analysis of domestic and foreign environmental radioactivity samples for quality control of the environmental radioactivity monitoring results.

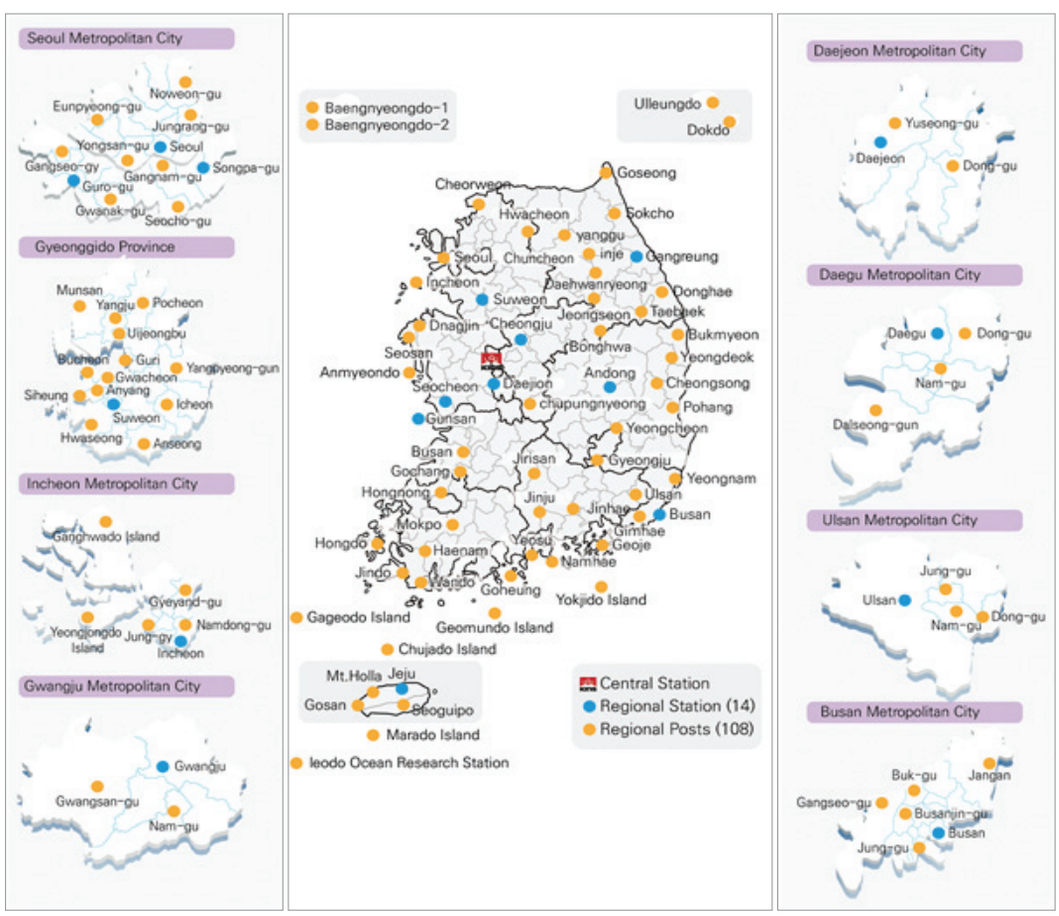

Figure F.5-3 National Environmental Radiation Monitoring Network

F.6 Decommissioning [Article 26]

ARTICLE 26. DECOMMISSIONING

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

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

The NSSC specifies the licensing procedures and related articles in the NSA and subordinate statute to ensure safety in nuclear facility decommissioning such as approval of a preliminary decommissioning plan at the construction permit and operating license stages, approval of decommissioning prior to commencement of decommissioning, verification and inspection of decommissioning status, reporting of completion of decommissioning, and verification of final site status. Based on them, KINS implements safety regulation on decommissioning such as review of a preliminary decommissioning plan for a nuclear facility under construction or in operation, review of changes in the decommissioning plan for research reactors KRR-1 & 2, and verification and inspection of decommissioning status.

In order to secure financing for the safe decommissioning of nuclear power plants, the RWMA requires a nuclear power plant operator to accumulate a reserve every year for decommissioning of the relevant nuclear power plant, and to prepare a plan for accumulating the reserve and submit it to MOTIE every year. From the aspect of safety regulation, the estimation of decommissioning cost and the plan for financing it are required to be presented in the preliminary decommissioning plan submitted at the construction and operating stages and in the final decommissioning plan at the decommissioning licensing stage, and to undergo an adequacy review from the regulatory body.

After 40-year operation including 10 years of continued operation, Kori Unit 1 and Wolsong Unit 1 were shut down permanently in June 2017 and December 2019 respectively through the permit of operating license amendment. The KHNP will submit the decommissioning plans for Kori Unit 1 and Wolsong Unit 1 for approval from the NSSC. Decommissioning activities will be initiated in earnest after approval from the NSSC, accordingly.

KRR-1 and 2 located at the site of KEPCO HRDI (former KAERI site) were permanently shut down in 1995 and have been currently under decommissioning after the government approval in 2000. The site will be returned to KEPCO after completion of decommissioning and site restoration.

The characteristics of Kori Unit 1, Wolsong Unit 1, and KRR-1 and 2 are listed in Annex C.

The UCF, which had been used for development of fuel fabrication technologies for PHWRs, was decommissioned completely in 2012 and the land and buildings have been used as a research facility.

F.6.1 Regulations and Requirements

Pursuant to the NSA, the operator of a commercial reactor, a research reactor, or a nuclear fuel cycle facility, when intending to obtain a CP, OL or business license, or to decommission thereof should submit a decommissioning plan for approval from the NSSC. The decommissioning plan should include the following;

- organization, human and financial resources for the decommissioning of nuclear facilities;
- decommissioning strategy and schedule of nuclear facilities;
- reflections in design and measures in construction and operation to facilitate decommissioning;
- radiation protection measures for preventing radioactive hazards;
- methods of removing radioactive materials and decontamination;
- radioactive waste treatment, storage and disposal methods;
- assessment of environmental impact and protective measures thereto; and others, as specified by the NSSC.

The operator should revise the preliminary decommissioning plan every 10 years based on experience and information obtained in the process of operation and management of the nuclear power utilization facility as well as the results of assessment related to decommissioning. In addition, the operator should submit the final decommissioning plan to the NSSC to apply for decommissioning after permanent shutdown. At that point, the operator should hold public hearing to reflect public opinions in the final decommissioning plan.

During the period of decommissioning, the progress of decommissioning should be reported to the NSSC every six months (Decommissioning Status Report) and the NSSC should verify and inspect the status of decommissioning. When decommissioning is completed, the operator should submit a decommissioning completion report and a final site status report to the NSSC, and the NSSC should conduct a decommissioning completion inspection to verify that decommissioning is properly performed, and then give the operator a written notice of license termination.

F.6.2 Human and Financial Resources

Nuclear Power Plants

The KHNP, the operator of nuclear power plants formed a decommissioning dedicated organization which is composed of Backend Management and Decommissioning Department in the head office, Decommissioning Technology Group in Radiation & Decommissioning Laboratory of Central Research Institute, and Safety Management Office of Kori Unit 1 in Kori Nuclear Power Plant, and takes responsibility of matters regarding decommissioning of nuclear power plants.

Training has been conducted to make a gradual staffing transition from operation to decommissioning, taking into account manpower required for each phase of decommissioning. The training program consists of six internal and domestic commissioned courses (e.g. decommissioning generals, system decontamination, decontamination & dismantlement) and eight overseas commissioned courses (e.g. characterization, radioactive waste management, residual radioactive assessment), and a total of 200 personnels took training from 2014 to 2020. Additional training programs will be developed to further improve expertise.

As per the RWMA and the MOTIE Notice Regulations on Calculation Criteria for Radioactive Waste Management Costs and Spent Fuel Management Fees, the KHNP has estimated a decommissioning cost of KRW 812.9 billions per unit as of late 2018 and reflected the reserve in the provision account.

KRR-1 and 2

KAERI, the operator of KRR-1 and 2, has developed technologies and conducted demonstration studies for nuclear decommissioning in parallel with decommissioning of KRR-1 and 2. To that end, KAERI has created KRR Decommissioning Team in its Decommissioning Technology Research Division, charged with decommissioning activities for the research reactors.

A total of KRW 23.8 billions was spent for decommissioning of KRR-1 and 2 which was broken down into KRW 19.7 billions for decommissioning of KRR-2 and KRW 4.1 billions for decommissioning of KRR-1 (including transfer of decommissioning waste therefrom). In addition, KRW 11.2 billions is being executed for the project to preserve KRR-1 as a monument as well as to release the site from regulatory control. They are all financed by the government.

F.6.3 Radiation Protection, Discharges, and Unplanned and Uncontrolled Releases

Regulations on radiation protection and safety management as described in Section F.4 (Operational Radiation Protection) are applied for the decommissioning of KRR-1 and 2. Facility status, radiological conditions, and estimated amount of radioactive waste generation, required human resources, estimated radiation dose exposure to workers under normal and abnormal conditions, and radiation protection measures were described in the decommissioning plan of KRR-1 and 2, and according to which, the radiation safety management has been conducted. Additionally, air filers are installed in the radiation control areas of KRR-1 and 2 to manage and monitor discharges, and no discharge and unplanned or uncontrolled release of radioactive materials took place from 2017 to March 2020.

Regulatory technical standards on radiation protection applied to decommissioning of nuclear facilities including Kori Unit 1 are stipulated in the NSSC Notices Standards for Radiation Protection, etc.; Regulation on the Packing and Transport of Radioactive Materials, etc.; Standard Format and

Content of the Radiological Environmental Impact Assessment Report for Nuclear Facilities; and Regulation on the Radiological Enironmental Survey and the Radiological Environmental Impact Assessment for Nuclear Facilities. Discharge and release control during decommissioning of nuclear facilities should be conducted in accordance with above technical standards, an approved discharge plan and a final decommissioning plan.

F.6.4 Emergency Preparedness

Regulations for the establishment of radiation emergency plan, in case of the decommissioning of nuclear facilities, comply with the regulations on radiological emergency preparedness of nuclear licensees. Details on the radiological emergency preparedness is described in F.5 (Emergency Preparedness).

F.6.5 Record Keeping

Under the Enforcement Rule of the NSA, records with regard to nuclear power utilization facilities including nuclear reactor facilities are to be kept until the decommissioning of the facilities. Such records include documents related to design and construction of the reactor, records on radiation safety management, accidents, and corrective actions, etc.

In accordance with the NSSC Notice Standard Format and Content of the Decommissioning Plan for Nuclear Facilities, the operators should periodically revise their preliminary decommissioning plan based on experience and information obtained during operation and management of the corresponding facilities as well as the results of assessment on matters related to decommissioning.

Information on radioactive wastes from decommissioning activities, as is the case with other radioactive wastes, is reported to the WAste Comprehensive Information Database (WACID) for accurate and prompt disclosure to the public. In addition, the KHNP plans to develop and operate a system to efficiently manage information on waste from decommissioning, especially on generation, classification, treatment and storage of solid radioactive waste.

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 Nuclear Criticality, Residual Heat Removal and Hazardous Material

Nuclear criticality, residual heat removal and other safety factors to be considered are stipulated in Article 33 (Fuel Handling and Storage Facilities) of the NSSC Regulations on Technical Standards for Nuclear Reactor

Facilities, etc. for on-site spent fuel storage facilities of the nuclear power plants, and in Article 90 (Fuel Storage Facilities) and Article 91 (Fuel, etc. Handling Equipment) of the same regulations for the PIEF.

For the independent spent fuel storage installation, nuclear criticality, residual heat removal and other safety factors to be considered are stipulated in Article 73 (Structure and Installation of Spent Nuclear Fuel Interim Storage Facilities) of the NSSC Regulations on Technical Standards for Radiation Safety Control, etc. According to the regulations, major safety factors to be considered in spent fuel management include (1) criticality prevention, (2) decay heat removal, (3) radioactive material containment, and (4) radiation shielding and protection.

G.1.2 Minimization of Radioactive Waste Generation

The amount of radioactive waste generated from nuclear power utilization facilities should be minimized in accordance with Article 66 (Radioactive Waste Management Program) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. In particular, it is stipulated in Article 24 (Facilitation of Decommissioning) of the NSSC Notice Detailed Technical Standards for the Structures and Equipment of Interim Storage Facilities of Spent Nuclear Fuel enacted in January 2016 that nuclear facilities should be designed in such ways to minimize generation of radioactive materials and contamination of equipment during operation, to facilitate dismantling and decontamination of contaminated equipment, and to minimize generation of radioactive waste during decommissioning.

G.1.3 Inter-Dependence among the Different Steps in Spent Fuel Management

Spent fuel should be managed in consideration of interdependences among different stages of spent fuel management ranging from generation to final disposal such as: on-site wet and dry storage, interim storage, and the ultimate disposal of spent fuel. Especially, the interim storage facility should be designed in such ways to make it possible to retrieve stored spent fuel safely, when it is needed, pursuant to Article 4 (General Design Requirements) of the NSSC Notice Detailed Technical Standards for the Structures and Equipment of Interim Storage Facilities of Spent Nuclear Fuel.

G.1.4 Protective Actions within the Legal Framework

Regulatory provisions to ensure the safety of spent fuel management facilities and to take necessary safety measures are stipulated in the NSA and subordinate statute. Section G.4.1 (Control of Radiological Impact) provides in detail the structure of the NSA and subordinate statute and technical standards related to control of radiological impact caused by spent fuel management facilities.

G.1.5 Impacts and Burdens on Future Generations

The potential risk of radiation exposure that spent fuel management facilities may pose to future generations should be limited to the level equivalent to the radiation protection that is applied today. In relation to this, Article 4 (Protection of Public Health and the Environment) of the NSSC Notice General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste which was enacted in 2016, stipulates that “a hazard to public health caused by a deep geological disposal facility shall be sufficiently below an acceptable level and its possible radiological impact on future generations shall not be greater than that is acceptable today”.

In addition, expenses required for spent fuel management are collected from spent fuel generators, and deposited and managed in the radioactive waste management fund in order not to impose undue burdens on future generations in managing spent fuel generated by current generations. MOTIE imposes and collects a charge for the management of spent fuel from the operator of a nuclear power plant, and the collected charge is deposited into the RWMF in order to conduct spent fuel management properly in accordance with Article 15 (Charges for Management of Spent Nuclear Fuel) of the RWMA.

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.

G.2.1 On-site Spent Fuel Storage Facilities of NPP and PIEF

On-site spent fuel storage facilities (AR-RS or AFR-RS) of nuclear power plants are within the scope of periodic inspection of nuclear power plants as well as subject to daily inspections by Regional Offices in accordance with Article 35 (Periodic Inspection) of the Enforcement Decree of the NSA. Those facilities are also within the scope of the PSR of a nuclear power plant in accordance with Article 20 (Details of Periodic Safety Review) of the Enforcement Rule of the NSA. In case that deviations from current licensing bases are identified in the process of such regulatory inspections or PSR, appropriate corrective actions should be taken. The periodic inspection is also conducted for a PIEF in accordance with Article 65 (Periodic Inspection) of the Enforcement Decree of the NSA.

Since this Joint Convention went into effect, no significant finding has been identified as a result of periodic inspections of on-site spent fuel storage facilities of the nuclear power plants and the PIEF in operation in Korea.

G.2.2 Interim Storage Facility for Spent Fuel

There have been no interim storage facility for spent fuel since this Joint Convention entered into force in Korea.

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.

G.3.1 On-site Spent Fuel Storage Facilities of NPP

The on-site spent fuel storage facilities of nuclear power plants is defined as "a nuclear power reactor and related facilities," and detailed technical standards for the location of a reactor and a nuclear fuel cycle facility are stipulated in Article 3 (Scope of Application) to Article 10 (Construction of Multiple Units) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. Major factors to be considered pursuant to the technical standards include geology, earthquake, limitations in siting, meteorological conditions, hydrology and ocean, impact of human-induced accident, feasibility of emergency plan, and construction of multiple facilities at the same site.

When a nuclear power reactor including spent fuel storage facilities is constructed, a draft RER should be open to local residents or public hearing should be held to collect public opinions in accordance with Article 103 (Gathering of Resident's Opinion) of the NSA. Furthermore, information on the safety of major nuclear facilities is released to the public through the NSIC of the NSSC.

G.3.2 Interim Storage Facility for Spent Fuel

Since effectuation of this Joint Convention, no site has been selected or permitted for interim spent fuel storage. However, technical standards for the site are stipulated in Article 67 (Location of Interim Storage Facilities for Spent Nuclear Fuel) of the NSSC Regulations on Technical Standards for Radiation Safety Control, etc., and the NSSC Notice Siting Criteria for Interim Storage Facilities of Spent Nuclear Fuel and Standard Format and Content of the Safety Analysis Report for Interim Storage Facilities for Spent Nuclear Fuel.

When an interim storage facility for spent fuel is constructed, a draft RER should be open to local residents or public hearing should be held to collect public opinions in accordance with Article 103 (Gathering of Resident's Opinion) of the NSA.

G.3.3 Consideration of Neighboring Countries

A notification of an accident and a request for assistance to international organizations and nations concerned with spent fuel management facilities are made in accordance with the procedures specified in the Convention on Early Notification of a Nuclear Accident (CENNA) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (CANARE).

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.

G.4.1 Control of Radiological Impact

The NSA and subordinate statute present as the standards for permit and license public health and the environment from the hazards of radioactive materials generated during the construction and operation of nuclear power utilization facilities. The design of nuclear power utilization facilities and the operation of multiple units at the same site are subject to quantitative criteria set in Article 16 (Prevention of Hazards to Environment) of the NSSC Notice Standards for Radiation Protection, etc.

The discharge of liquid and gaseous radioactive materials generated during normal operation of nuclear power utilization facilities should be kept below allowable limits, and planned and controlled via drainage or ventilation systems. The limits are defined in Article 6 (Effluent Control Limits) of the NSSC Notice Standards for Radiation Protection, etc.

In addition, safety measures to be taken by nuclear enterprisers when the limits are exceeded are specified in Article 136 (Protective Measure Against Radiation Injury and Report) of the Enforcement Decree of the NSA.

On-site Spent Fuel Storage Facility of NPP

Measuring equipment that can monitor the concentration of radioactive materials during ventilation or drainage at/or near the outlet of ventilation hoods should be installed in accordance with Article 20 (Instrumentation and Control System) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. In addition, ventilation monitoring equipment and drainage monitoring equipment should be installed in accordance with Article 10 (Processing and Discharge) of the NSSC Regulations on Technical Standards for Radiation Safety Control, etc., and radiation protection equipment to provide protection from radiation exposure should be installed in accordance with Article 34 (Radiation Protection Provisions) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc.

PIEF

Article 34 (Radiation Protection Provisions) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. is applicable to a PIEF.

Interim Storage Facility for Spent Fuel

Control of radiological impact caused by an interim storage facility for spent fuel is specified in the NSSC Regulations on Technical Standards for Radiation Safety Control, etc. It is stipulated in Article 4 (General Design Requirements) of the NSSC Notice Detailed Technical Standards for the Structures and Equipment of Interim Storage Facilities of Spent Nuclear Fuel that an interim storage facility for spent fuel should be designed such that the amount of radioactive materials released to the environment and radiation dose to radiation workers and the public should be kept below the reference values under conditions of normal operation, anticipated operational occurrence and design basis accident. The reference values for dose limits are presented in Article 5 (Design for Radiation Shielding and Protection) of the same Notice.

G.4.2 Decommissioning Plan

An interim storage facility for spent fuel should be designed in such ways to minimize generation of radioactive materials and contamination of equipment during operation, to facilitate dismantling and decontamination of contaminated equipment, and to minimize generation of radioactive waste during decommissioning pursuant to Article 24 (Facilitation of Decommissioning) of NSSC Notice Detailed Technical Standards for the Structures and Equipment of Interim Storage Facilities of Spent Nuclear Fuel.

G.4.3 Proven Technology

A spent fuel management facility should be designed and constructed under the basic principle that technologies incorporated into the design of a spent fuel management facility be the ones proven by domestic and oversea experience and tests.

Therefore, it is stipulated in Article 4 (General Design Requirements) of the NSSC Notice Detailed Technical Standards for the Structures and Equipment of Interim Storage Facilities of Spent Nuclear Fuel that the interim storage facility should be designed and constructed based on demonstrated engineering practice and if a new design and construction method is applied, its safety should be demonstrated with valid evidence.

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).

G.5.1 Safety Assessment and Environmental Impact Assessment

On-site Spent Fuel Storage Facility of NPP

Safety assessment of an on-site spent fuel wet storage facility is incorporated into the Preliminary Safety Analysis Report (PSAR) (Article 4 (Application for Construction Permit) of the Enforcement Rue of the NSA) and the Final Safety Analysis Report (FSAR) (Article 16 (Application for Operating License, etc.) of the Enforcement Rule of the NSA). Radiation environmental impact assessment is described in the RER in accordance with Article 4 (Application for Construction Permit) of Enforcement Rue of the NSA. The safety assessment of the an on-site spent fuel dry storage facility is described the FSAR of a relevant nuclear power plant.

PIEF

The RER should be submitted in accordance with Article 35 (Permit, etc. for Nuclear Fuel Cycle Business) of the NSA, and documents such as explanatory statement on design and construction methods including the contents of a SAR should be submitted in accordance with Article 44 (Application for Designation, etc.) of the Enforcement Rule of the NSA.

Interim Storage Facility for Spent Fuel

The contents of safety assessment of an interim storage facility for spent fuel are presented in the RER and the SAR in accordance with Article 87 (Application for permit or license for construction or operation of radioactive waste management facilities, etc.) of the Enforcement Rule of the NSA. The attached Table 2 of the NSSC Notice Standard Format and Content of Radiological Environmental Impact Assessment Report for Nuclear Facilities describes detailed information on how to prepare the RER of an interim storage facility for spent fuel. It is also required by the NSSC Standard Format and Content of Safety Analysis Report for Interim Storage Facilities of Spent Nuclear Fuel that the SAR should be written objectively and logically based on scientific facts. The survey and analysis of data and the estimation and assessment of safety should be done using objectively accepted methods and technologies so that the safety assessment is performed in a systematic manner.

G.5.2 Supplementation of Safety Assessment

Pre-operational inspection should be performed of an onsite spent fuel storage facility in accordance with Article 27 (Pre-operational Inspection) of the Enforcement Decree of the NSA, of a PIEF in accordance with Article 63 (Pre-operational Inspection) of the Enforcement Decree of the NSA, and of an interim spent fuel storage installation in accordance with Article 101 (Pre-operational Inspection) of the Enforcement Decree of the NSA. During the period of construction or pre-operational inspection, any change of matters already permitted prior to construction should be made with a change permit from the regulatory body or a notification 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 Operating License

On-site Spent Fuel Storage Facility of NPP

The construction and operation of a spent fuel pool at a nuclear power plant are approved as part of the CP and OL of a nuclear power plant (Refer to Article 10 (Construction Permit) and Article 20 (Operating License) of the NSA). The construction and operation of a spent fuel dry storage facility, additionally introduced at a nuclear power site after issuance of the OL for a nuclear power plant requires a permit change (Article 20 (Operating License) of the NSA).

Safety review and pre-operational inspection (Article 27 (Pre-operational Inspection) of Enforcement Decree of the NSA) are conducted to confirm whether the construction and operation of a spent fuel storage facility at a nuclear power site are in compliance with safety requirements.

PIEF

The PIEF, operated by KAERI is a designated facility in accordance with Article 35 (Permit, etc. for Nuclear Fuel Cycle Business) of the NSA. Safety review on the construction and operation of the PIEF is conducted in accordance with Article 61 (Application for Designation) of Enforcement Decree of the NSA, and the PIEF can be used only after completion of pre-operational inspection on construction and performance of the facility in accordance with the Article 63 (Pre-operational Inspection) of Enforcement Decree of the NSA.

Interim Storage Facility for Spent Fuel

Article 63 (Permit for construction and operation of radioactive waste management facilities, etc.) of the NSA and Article 101 (Pre-operational Inspection) of the Enforcement Decree of the NSA clearly stipulate the requirements for safety review and pre-operational inspection of an interim storage facility for spent fuel.

G.6.2 Operational Limits and Conditions

On-site Spent Fuel Storage Facility of NPP

For a nuclear power plant, operating limits and limiting conditions of operation should be established and operated in accordance with Article 48 (Establishment, Adjustment, etc. of Limiting Conditions for Operation) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. and the NSSC Notice Standard Format and Content of the Technical Specifications for Operation.

PIEF

For a PIEF, operating limits and limiting conditions of operation are prescribed in Section 3 (Manipulation of Safety Control Facilities) and Section 4 (Safe Operation of Spent Fuel Processing) of "Safety Control Regulations" in accordance with Article 44 (Application for Designation, etc.) of Enforcement Rule of the NSA.

Interim Storage Facility for Spent Fuel

For an interim storage facility for spent fuel, limiting conditions for operation (LCOs) are prescribed in Section 8 (Technical Specifications) of the SAR that is required in accordance with Article 87 (Application for permit or license for construction or operation of radioactive waste management facilities, etc.) of the Enforcement Rule of the NSA. Application of technical specifications and matters to be described for each safety limit & LCO are described in detail in the NSSC Notice Standard Format and Content of Safety Analysis Report for Interim Storage Facilities of Spent Nuclear Fuel.

G.6.3 Technical Support for Operating Procedures (operation, maintenance, monitoring, inspection and test) and Safety

On-site Spent Fuel Storage Facility of Nuclear Power Plant

Technical standards for test, monitoring, inspection and maintenance of nuclear power reactors are stipulated in Article 41 (Testability, Monitorability, Inspectability, and Maintainability) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc., and Subparagraph 4 of Article 54 of the same regulations requires the establishment of organization for engineering and technical support to review safety-related issues that may occur during operation. Article 56 (Operating Procedures) of the same regulations requires that operating procedures necessary for operation of a nuclear power plant including administration, operation, test and maintenance should be prepared in written forms and provided before the commencement of operation.

Article 72 (Instructions, Procedures and Drawings) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. stipulates that methods for implementing activities that have an impact on quality should be described in documented instructions, procedures and drawings.

PIEF

As per Subparagraph 1 of Article 36 of the NSA, securing technical capability is one of the criteria for designation as a spent fuel processing operator, and specific details are stipulated in Article 34 (Technical Capability) of the Enforcement Rule of the NSA. In addition, the same QA requirements applicable to nuclear power reactors are applied to the PIEF.

Independent Spent Fuel Storage Installation

The requirements for technical capability necessary for construction and operation of an independent spent fuel storage installation are described in Article 64 (Standards for Permit) of the NSA.

More specific description is found in Article 34 (Technical Capability) of the Enforcement Rule of the NSA which apply Article 97 (Provisions Applicable Mutatis Mutandis) of the same enforcement rule mutatis mutandis as follows: an organization and department necessary for construction and operation should be formed and the responsibility and authority required for performance of duties should be specifically assigned; there should be an engineering and technical support organization to review safety-related matters that arise in the process of refining; a person engaged in construction and operation should possess the qualifications and experience commensurate with the responsibility and authority thereof; and test and inspection programs shall be formulated pertaining to major safety-related structures and equipment.

G.6.4 Reporting of Events Significant to Safety

All nuclear power utilization facilities including a spent fuel management facility should report and disclose accidents and failures in accordance with Article 74 (Measures, etc. for Accidents), Article 92 (Measure to Prevent Radiation Damage and Report thereon), Article 97 (Report of Theft, etc.) and Article 98 (Report/Inspection, etc.) of the NSA and the NSSC Notice Regulation on the Reporting and Public Announcement of Accidents and Incidents for Nuclear Facilities.

G.6.5 Operation Experience Feedback

As for on-site spent fuel storage facilities for nuclear power plants, requirements for systematic feedback of operating experience of nuclear power plants include the following: (1) collection, analysis and management of operating experience data, and (2) incorporation of operating experience analysis results into the equipment, safety-related criteria, operating procedures, and education & training in accordance with Article 58 (Reflection of Operating Experience) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc.

For an interim storage facility for spent fuel, feedback of operating experience and lessons-learned is stipulated in accordance with Article 4 (General Design Requirements) of the NSSC Notice Detailed Technical Standards for the Structures and Equipment of Interim Storage Facilities of Spent Nuclear Fuel.

G.6.6 Decommissioning Plan

It is stipulated in the NSA that prior to permanently terminating the business, the operators of nuclear power utilization facilities including a spent fuel management facility are required to take and report to the NSSC necessary measures for protection against radiation hazards including transfer, safe-keeping, discharge, storage, treatment, disposal, and decontamination. The NSSC has an authority to order necessary measures including collection of radioactive materials and decommissioning of any and all contaminated facilities according to Article 95 (Measures following Revocation of Permit, etc. or Discontinuation, etc. of Business) of the NSA, if needed.

For on-site spent fuel storage facilities of nuclear power plants and the PIFF, a decommissioning plan should be submitted to the NSSC at the time of application for CP or designation, and afterwards updated periodically during the period of operation. The decommissioning plan should be submitted to and approved by the NSSC after the facilities are permanently shutdown for decommissioning.

Especially for interim storage facility for spent fuel, the contents of a decommissioning plan should be described in the SAR in accordance with the attached Table 2 of the NSSC Notice Standard Format and Content of Safety Analysis Report for Interim Storage Facilities of Spent Nuclear Fuel. The decommissioning plan should explain decommissioning strategies to be applied for the interim installations after termination of its operation and methods to be applied for safe decommissioning, and describe procedures to review and revise the decommissioning plan periodically.

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.

All spent fuel generated in Korea has been stored in a safe manner and the disposal of spent fuel has not been implemented yet.

Matters regarding disposal of HLW (including spent fuel declared to be disposed of) such as general safety requirements, facility design and construction, safety assessment, operation and post-closure institutional control are described in Chapter H.

On October 30, 2013, the Public Engagement Commission on Spent Nuclear Fuel Management (PECOS) was established to collect opinions of the public including various stakeholders and experts with an aim to develop measures for spent fuel management based on public consensus. After gathering public opinions for about 20 months, PECOS submitted the final recommendations on spent fuel management to the government on June 29, 2015.

Based upon the recommendations, the government established the Basic Plan on High-level Radioactive Waste Management in July 2016 which defines the method and procedure for safe management of spent fuel. The basic plan is outlined as follows: selection of the final candidate site through 12-year-long siting process; construction and operation of a site-specific underground research laboratory (URL) at the selected site; and then expansion of the URL into the permanent repository. Based on the estimated period of 24 years for the demonstration studies at the URL and the expansion work, 36 years are expected from the start of site selection process to the operation of the repository, according to the Basic Plan.

In the process of policy making after announcement of the Basic Plan on High-level Radioactive Waste Management, opinions were raised that it was necessary to hear the voices of the public, especially local residents living nearby nuclear power plants, more broadly, given the fact that spent fuel requires long-term management. In response to that, the government

launched a “Review Committee for Spent Fuel Management Policy” as an advisory committee on May 29, 2019 in order to collect public opinions regarding the policy for spent fuel management in a fair manner, pursuant to Article 6-2 of the RWMA. Currently, the review committee is collecting opinions on determined agenda from experts, the public and local residents, and based on the results of which, plans to submit policy recommendations to the government. More detailed information on the Basic Plan on High-level Radioactive Waste Management is described in K.2 (Expansion of Capacity of Storage Facilities and Review of Management Policy for Spent Fuel).

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 of Construction and Operation

The standards for permit to protect public health and the environment against radiological hazards from construction and operation of a radioactive waste management facility, etc. are specified in the Article 64 (Standards for Permit) of the NSA. It is also stipulated that the safety of a radioactive waste disposal facility should be secured even during the period of post-closure institutional control.

- technical capability necessary for construction and operation of a radioactive waste management facility, etc. defined in the Enforcement Rule of the NSA;
- the location, structure, equipment, and performance of a radioactive waste management facility, etc. should conform to the technical standards as prescribed by the NSSC Regulations in such a way that they do not present any impediment to the protection against disasters caused by the radioactive materials, etc. to human, material objects and the public;
- the construction and operation of radioactive waste management facility, etc. should conform to the standards prescribed by the Presidential Decree in order to prevent any harm to the public health and the environment caused by radioactive materials, etc.; and
- it is required to secure equipment and manpower prescribed by the Presidential Decree.
- the post-closure institutional control plan of a disposal facility after its full or partial closure should be in compliance with the standards for institutional control described in the NSSC Regulations to secure the safety of a disposal facility during the period which defined by the Presidential Decree within the maximum period of 300 years.

To ensure that the foregoing standards are satisfied, the permit applicant should perform a comprehensive and systematic safety analysis. The analysis results should then be reported to the NSSC in forms of SAR and RER. More specific technical standards are provided in the NSSC Notices.

H.1.2 Safety Analysis

The licensee of a radioactive waste management facility, etc. should prepare a SAR in accordance with the provisions of the NSA, and submit the report to the NSSC to secure safety in the overall construction and operation processes of a radioactive waste management facility.

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

H.1.3 Safety Requirements to Be Considered

Criticality Safety and Thermal Safety

A radioactive waste disposal facility should be designed to prevent nuclear criticality during operation and to withstand the heat from radioactive decay and irradiation. Therefore, it is required to secure cooling function if there is a possibility that radioactive waste is overheated due to decay heat, and to limit the concentration of fissile materials in radioactive waste so as to maintain the criticality safety in accordance with Article 87 (Storage and Processing in Disposal Facilities) of the NSSC Regulations on Technical Standards for Radiation Safety Control, etc. and Article 7 (Criticality Safety) of the NSSC Notice General Acceptance Criteria for Low- and Intermediate-Level Radioactive Waste. A deep geological repository for HLW should be designed such that, in no circumstance, disposed radioactive waste reaches nuclear criticality in the disposal environment and the safety function of disposal systems in association with engineered barriers should be maintained for a long time against decay heat and pressure in accordance with Article 18 (Characteristics of Radioactive Waste) of the NSSC Notice General Criteria for Deep Geological Disposal Facilities for High-Level Radioactive Waste.

Minimization of Generation of Radioactive Waste

The amount of radioactive waste generated during operation of nuclear power reactors and related facilities and nuclear fuel cycle facilities should be minimized in accordance with Article 66 (Radioactive Waste Management Program) of the NSSC Regulations on Technical Standards for Nuclear Reactor Facilities, etc. Accordingly, the improvement of radioactive waste treatment systems along with the introduction of a new treatment technology should be considered.

Inter-dependence among the Steps in Radioactive Waste management

Taking into account inter-dependencies among all steps in radioactive waste management ranging from generation to disposal, radioactive waste should be managed in such a way that the management method for each stage should consider those for the other stages, especially the suitability for disposal in accordance with Article 96 (Delivery of Radioactive Wastes) of the Enforcement Rule of the NSA and Article 21 (Waste Characteristics to be disposed of) of the NSSC Notice Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities.

Prevention of Hazards to Environment

One of the standards for permit of a radioactive waste management facility, etc. is that the facility should not be impediment to the prevention of hazards to public health and the environment. The standards for prevention of hazards to the environment regarding a radioactive waste management facility, etc. as determined by the NSA and subordinate statute, set forth in Article 174 (Prevention of Hazard to Environment) of the Enforcement Decree of the NSA and Article 6 (Performance Objectives) and Article 10 (Protection against Human Intrusion) of the NSSC Notice Radiological Protection Criteria for the Long-term Safety of Low- and Intermediate-Level Radioactive Waste Disposal Facilities as follows: (1) limits in the concentration of liquid and gaseous radioactive materials released from the facility; (2) annual dose limits pertaining to liquid and gaseous discharges in normal operation which are applied to the design of the facility; and (3) reference values for radiation dose and risk due to radioactive waste after the closure of the radioactive waste disposal facility. By complying with the above standards, the hazards caused by the radioactive waste management facility, etc. should be kept as low as acceptable.

The predicted future impact on the environment in the vicinity of a disposal facility resulting from the permanent disposal of radioactive waste should be negligible and the future use of natural resources should not be impeded by either radioactive or non-radioactive contaminants disposed therein.

In order to control and prevent uncontrolled release of radioactive effluents from a radioactive waste management facility, etc., radioactive waste treatment systems should be capable of controlling gaseous and liquid effluents properly during normal and abnormal operation, and ensuring that they are not released to the environment through ventilation or drainage points other than those identified when a construction permit and operating license were issued, in accordance with Article 74 (Waste Processing Installations) of the NSSC Regulations on Technical Standards for Radiation Safety Control, etc. and the NSSC Notice Technical Standards for the Structure and Equipment of Radioactive Waste Treatment Facilities. Such requirements for a radioactive waste disposal facility are specified in the NSSC Notice Standards for the Structure and Equipment of Low- and Intermediate-Level Radioactive Waste Near-Surface Disposal Facilities. In addition, sampling and monitoring systems should be properly installed to monitor the operating conditions of waste treatment systems and to monitor radioactivity discharged. Radioactive waste treatment systems should be installed separately from systems not supposed to handle radioactive materials to minimize the possibility of contamination due to backflow of radioactive materials. In case that a radiation level exceeds a set point or any abnormal condition occurs at the facility, it is required to have a function to terminate the discharge automatically along with an alarm.

Biological, Chemical, Other Hazards, etc.

In case of a LILW disposal facility, waste containing explosive, flammable, and/or pyrophoric materials to be disposed of should be adequately treated so that potential risks by them are eliminated in accordance with the NSSC Notice Genral Acceptance Criteria for Low- and Intermediate-Level Radioactive Waste. In addition, the waste should be controlled in such a way to prevent from generating gas, vapor, or liquid as a result of radiolysis, or biological or chemical reactions which may undermine the integrity of the package materials, the performance of the disposal facility or the safety of workers. With regard to the waste containing corrosive materials to be disposed of, the causticity should be mitigated and the materials should be packaged in such a way to withstand corrosion. Waste that includes toxic, perishable, or contagious materials should be processed so as to remove such hazards. Chelating agents contained in waste should be removed or their contents should be restricted according to the acceptance criteria for a disposal facility. In addition, limits for the concentration of non-radioactive contaminant in air which is potential to be released should be presented in the safety analysis report, one of licensing documents of a disposal facility in accordance with the NSSC Notice Standard Format and Content of the Safety Analysis Report for Low- and Intermediate-Level Radioactive Waste Disposal Facilities.

For a combustible, LILW treatment facility (e.g. incinerator), the incinerator should be capable of preventing fire and explosion in accordance with the NSSC Notice Criteria for the incineration of Low- and Intermediate-Level Radioactive Wastes. In addition, the exhaust gas from the incinerator should be properly treated and then released into the atmosphere and it should comply with the emission limits set forth in the environment-related laws and regulations as well as the previously mentioned NSSC Notice.

Stability of Waste Package

In accordance with the NSSC Notice Gneral Acceptance Criteria for Low- and Intermediate-Level Radioactive Waste, radioactive waste to be disposed of should be packaged in a nonflammable container, and the packaging container should pass the visual inspection. Furthermore, the package should be able to maintain its integrity under circumstances expected in disposal conditions, and withstand the internal pressure increase due to gas generation within the package.

Restriction of Effects on Future Generations

In accordance with the NSSC Notices Radiological Protection Criteria for the Long-term Safety of Low- and Intermediate-Level Radioactive Waste Disposal Facilities and General Criteria for Deep Geological Disposal Facilities for High-Level Radioactive Waste, the risk of a disposal facility shall meet post-closure performance objectives to demonstrate the risk is acceptable both for the current and future generations, thereby not imposing undue burdens on 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.

Nuclear power utilization facilities in Korea including radioactive waste management facilities are constructed and operated after adequate safety evaluation and authorization pursuant to the NSA and subordinate statute. The maintenance of these facilities according to the conditions permitted is verified through periodic and reactive inspections. In addition, when permitted conditions at a specific facility require revision, the legal procedures in pursuant to the NSA and subordinate statute, such as permit for significant change or notification of minor change, should be adhered to.

The safety of radioactive waste management facilities and nuclear facilities generating radioactive waste, existing at the time of and since this Joint Convention entered into force in Korea, has been confirmed periodically in compliance with safety regulations for operating facilities.

H.2.1 Safety Verification

Radioactive waste management facilities such as a radioactive waste disposal facility, a combustible waste treatment facility (e.g. incinerator) and a RI waste storage facility, have been constructed and operated after going through safety review which includes review of adequacy of safety and accident analysis, etc. in accordance with the NSA and subordinate statute. In accordance with Article 65 (Inspection) of the NSA, periodic and reactive inspections are performed to verify that the safety and functions of those facilities in operation are maintained under the conditions of the

construction permit and operating license. In case of any findings identified in safety or performance as a result of those inspections, proper corrective actions should be taken in due process.

H.2.2 Safety Improvement

In case of natural disaster such as earthquake and flooding, or accident which may affect the isolation function of a LILW disposal facility, the safety of the facility should be re-evaluated, and related licensing documents and procedures should be revised based on the latest available data in accordance with the NSSC Notice Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities.

In addition, the operator of a LILW disposal facility should re-evaluate and supplement, if necessary, conditions related to the safety of the disposal facility based on the experience and data obtained from operation of the disposal facility, and results of safety assessments. The above NSSC Notice also stipulates that the followings should be re-evaluated to verify the safety of the radioactive waste disposal facility prior to closure: information and data on the facility, the site and the surrounding areas for the period of performance assessment; total inventory of radioactive waste disposed of, and records of accidents during operation; and radiological and non-radiological impacts caused by waste disposal on the public and the surrounding environment for the period of performance assessment.

H.2.3 Safety Regulation on Operation of Disposal Facilities

The construction permit and operating license for the 1st phase LILW disposal facility were granted on July 31, 2008 after deliberation and resolution by the Ministry of Education, Science and Technology (its regulation function was transferred to the newly launched NSSC in November 2011). The 1st phase facility begun operation after the results of implementation of followup actions on pre-operational inspection and the CP and OL were accepted by the NSSC. In order to address shortage of capacity of radioactive waste storage facilities on the sites of nuclear power plants during the period of construction of the disposal facility, KORAD obtained a regulatory approval for and has implemented a plan for prior use (partial operation) of several surface facilities including a receipt & storage building prior to complete construction of the 1st phase disposal facility. Since the operation of the 1st phase disposal facility began in

earnest, radioactive waste stored in the receipt & storage building has been disposed of after verification of their suitability for disposal. As of March 2020, LILW stored in the receipt & storage building amounted to 3,929 drums (200 liter drum), and 19,050 drums (200 liter drum) were disposed of in the silo-type disposal facility.

Regulation on operation of the 1st phase disposal facility includes periodic inspection, disposal inspection, QA inspection and special nuclear material accounting and control inspection. Periodic inspections are performed every year of a total 28 items including integrity of structures, and disposal inspections are performed of four items including waste management environment whenever radioactive waste is disposed of. QA inspections are conducted for a total of 18 requirements including QA organization and QAP. Special nuclear material accounting and control inspections are conducted every year to verify whether special nuclear materials are managed in conformity with approved accounting and control regulations.

In addition, KORAD continues to monitor site characteristic factors (geology, meteorology. hydrology etc.) which are expected to be changed before and during operation and after closure of the disposal facility.

LILW from Hanul, Hanbit and Kori nuclear power plants are transported via a ship to the disposal facility. The LILW transportation ship is designed and built, and approved by the Ministry of Oceans and Fisheries in accordance with standards set by international organizations such as IAEA and International Maritime Organization as well as Korean standards such as the Ship Safety Act and the NSA. The safety of the ship has been verified by Korean Register of Shipping and the adequacy of radiation safety management of the ship including its operating procedure have been verified through inspections by KINS.

LILW from inland facilities including Wolsong Nuclear Power Plants, KAERI, RI management facilities inaccessible via the transportation ship is transported via a transportation vehicle to the disposal facility. For transportation of LILW in size larger than 1.6m3, the safety of transportation container and the adequacy of operating procedures are verified through transportation declaration and compliance of technical standards defined in nuclear safety-related laws and regulations. In case the LILW transportation container is subject to design approval, containers should get through design approval and container inspection before it is used for transportation of LILW.

H.3 Siting [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 Regulatory Requirements and Permit Procedure

The permit procedure for site selection of a radioactive waste management facility, etc. in accordance with the NSA is described in Section E.2.3. The standards for permit for site selection of a radioactive waste management facility, etc. are stipulated in NSSC Regulations on Technical Standards for Radiation Safety Control, etc. and NSSC Notice Siting Criteria for Low- and Intermediate-Level Radioactive Waste Disposal Facilities. The NSSC Notice Standard Format and Contents of the Site Characterization Report for Low- and Intermediate-Level Radioactive Waste Disposal Facilities stipulates that the following items should be included in site characterization report.

- 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; and

- site monitoring and investigation programs in the phases of pre-operation, operation, and post-closure.

Factors of Safety Assessment

Safety assessments for the site of a disposal facility are divided into the radiological environmental impact assessment, safety analysis and general environmental impact assessment. The general environmental impact assessment is performed for approval of the Electric Source Development Project Plan as well as the Radioactive Waste Management Project Implementation Plan which follow notification of the Designation of Prearranged Area for Electric Source Development Business. The safety assessment and radiological environmental impact assessment are conducted at the time of applying for the CP and OL of a radioactive waste disposal facility.

- Radiological Environmental Impact Assessment

  Under the NSA, a radiological environmental impact assessment should be conducted to evaluate the impact of radiation or radioactive materials caused by operation of a radioactive waste disposal facility on the surrounding environment, as one of the fundamental requisites to obtain the CP and OL of a radioactive waste disposal facility. The radiological environmental impact assessment report contains facility information, environmental status of neighboring regions, predicted radiological impact on the surroundings thereof due to operation of a facility, environmental radiation monitoring program to be implemented during the period of construction and operation, radiological impact on the environment resulting from accidents and incidents during a facility operation, and collected opinions of local residents.

- General Environmental Impact Assessment (Non-radiological)

  General environmental impact assessment should be conducted for the purpose of identifying and assessing non-radiological impact on the environment caused by construction and operation of a disposal facility, separately from the radiological environmental impact assessment in accordance with the Environmental Impact Assessment Act. The assessment addresses the areas of natural environment, living environment, and social and economic environment, and the report submitted should be approved by the Minister of MOTIE in consultation with the Minister of ME.

Disclosure of Information

In principle, the government opens to the public a site selection plan, site investigation results, a site selection process and a construction plan, etc. in a transparent manner.

To that end, the Electric Power Source Development Promotion Act prescribes to disclose the details of a project to local residents for a certain period at the time of the notice of designation of the prearranged zone for a disposal facility and approval of the Electric Source Development Project Plan. In addition, the NSA and the Environmental Impact Assessment Act also specify that the opinions of local residents should be collected through public hearings, etc. at the time of preparation of the radiological and general environmental impact assessment reports.

The Special Act on Supporting the Local Community around the Low- and Intermediate-Level Radioactive Waste Disposal Facility prescribes that the whole process for site selection should be carried out transparently and openly, and at the same time explanatory meetings or forums regarding selection of the hosting community should be held.

In addition, a private supervisory organization for environment radiation consisting of local residents and non-governmental organization (NGO) representatives are operated during the operation period of a facility as part of efforts to ensure the transparency of information disclosure.

Consultation with Neighboring Countries

The Korean peninsula is surrounded by sea on three sides and is separated from neighboring countries. The Korean government has not concluded specific international agreements with foreign countries on site selection, but on radiological emergency preparedness, follows procedures defined in Convention on Early Notification of a Nuclear Accident or Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

H.3.2 Site Selection for the Proposed Facility

A person who intends to construct and operate of a LILW disposal facility should conduct a safety assessment under the provisions of the NSA including preliminary investigation and detailed investigation on candidate sites. Based on that, a RER and a site investigation report (SIR) should be prepared and submitted to the NSSC along with an application for an early site approval. After safety review by KINS, the NSSC can issue an early site approval for the proposed site. Depending on the choice of a person who intends to construct and operate the LILW disposal facility, the early site approval process can be skipped and details on site safety can be submitted in the form of an attached document to the application for CP and OL. Currently, no site has been selected for the additionally proposed facilities, except for the LILIW disposal facility in Gyeongju.

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

Design factors to be considered for a LILW disposal facility among the radioactive waste management facilities, etc. are stipulated in the NSSC Notices Standards for the Structure and Equipment of Low- and Intermediate-Level Radioactive Waste Near-Surface Disposal Facilities and Standard Format and Content of the Safety Analysis Report for Low- and Intermediate-Level Radioactive Waste Disposal Facilities.

A LILW disposal facility should be designed such that it maintains its structural and functional integrity during normal and abnormal operations. Therefore, the design and construction of a disposal facility should be based on proven engineering practices. In case new design and construction method are applied, valid evidence should be provided and their safety should be demonstrated. In addition, equipment and components installed at a disposal facility should be designed such that they can be regularly tested and inspected to confirm that they can continue to be used safely.

Requirements for design and construction of a deep geological repository for HLW are specified in the NSSC Notice General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste. As per the technical standards, the repository should be composed of multiple barriers and multiple safety functions to ensure the radioactive waste isolation function and the disposal safety. Furthermore, it should be designed such that it

satisfies safety objectives to prevent hazard to public health and the environment and the conformity to safety objectives should be proved through safety assessment. The location, structure of a deep disposal repository as well as the performance of structures, systems and components (SSC) should be designed in such way to maintain the geological, structural and functional integrity under normal and abnormal conditions.

H.4.2 Criteria of Design and Construction

Design Objectives

The radiation exposure of local residents and radiation workers should meet the limits stipulated by Article 16 (Prevention of Hazard to the Environment) of NSSC Notice Standards for radiation protection, etc., Article 6 (Performance Objectives) and Article 10 (Protection against Human Intrusion) of the NSSC Notice Radiological Protection Criteria for the Long-term Safety of Low- and Intermediate-Level Radioactive Waste Disposal Facilities and Article 5 (Safety Objectives) of the NSSC Notice General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste. These regulations should be considered at each stage of site selection, design, operation, closure, and post-closure institutional control. The design objectives for a disposal facility to protect local residents and radiation workers from radiation effects both during operation and after the closure of the facility are as follows:

- **In-operation design objectives** (Refer to Section F.4.3.)

- **Post-closure design objectives**

  (LILW disposal facility)

  - annual dose by normal/natural phenomena: 0.1 mSv/y or less
  - annual risk by unexpected events caused by either natural or artificial factors: 10-6/y or less
  - radiological impacts due to human intrusion: 1.0 mSv/y or less

  (HLW disposal facility)

  - total risk from major exposure scenarios including natural phenomenon and human intrusion: 10-6/y or less
  - radiological impacts by each single scenario due to any unlikely natural event or human intrusion: 10 mSv/y or less

Design Standards

In accordance with the NSSC Notices, major design standards should be established to minimize the radiological effects on radiation workers and the public under conditions of operation or accident.

- **Radiological Safety**
  - The design and operation of a disposal facility should be complied with the site closure and stabilization plans; thus, the performance objectives after closure of the facility should be met.
  - A disposal facility should be designed to meet the standards for radiation safety stipulated in the NSSC Notice Standards for radiation protection, etc. during operation period. After closure, a LILW disposal facility should be designed to be complied with the performance objectives stipulated in the NSSC Notice Radiological Protection Criteria for the Long-term Safety of Low- and Intermediate-Level Radioactive Waste Disposal Facilities while the HLW disposal facility should be designed to be complied with the safety objectives presented in the NSSC Notice General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste.

- **Safety of Site and Structure**
  - A disposal facility should be designed considering site characteristics so as to supplement and improve site characteristics.
  - A disposal facility should be designed considering site characteristic factors such as geology, earthquakes, meteorology, and hydrology as well as other human-induced disasters.
  - A disposal facility should be designed to maintain its structural integrity with minimal maintenance and repair activities during the institutional control period after closure.

Considerations for Construction

The NSSC define in its Notice considerations given to construction of a LILW disposal facility. The construction of a disposal facility should be based on proven engineering practices. When new construction methods are applied, their safety should be demonstrated with valid evidence. Detailed requirements for construction of a disposal facility are specified in NSSC Notice Standards for the Structure and Equipment of Low- and Intermediate-Level Radioactive Waste Near-Surface Disposal Facilities as follows:

- The construction of a disposal facility should adhere to QA requirements.
- A disposal facility should be constructed such that damage to the functions of natural barriers is prevented as much as possible.
- Regarding the characteristics of natural barriers assumed at the design stage, their validity should be confirmed through comparisons with on-site measurements obtained during construction phase.
- When the construction and operation stages overlap, construction work should be carried out in such a way to have no adverse effect on the operational safety of a disposal facility.

It is stipulated in the NSSC Notice General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste that a deep geological repository for HLW should be constructed in such a way that the environment of the site and the safety function of natural barriers which have been verified with the safety assessment should be preserved.

Considerations for Closure

A radioactive waste disposal facility should be designed to enable its closure when the disposal capacity considered in its design or the total radioactivity of the waste disposed of reaches an allowable limit, or when maintaining its normal functions is deemed no longer possible due to unexpected accidents. Accordingly, a SAR should describe a plan for closure and stabilization of a disposal facility as well as accompanying design features to isolate radioactive waste on a long term basis. A final closure plan and a post-closure institutional control plan for the disposal facility will be finalized prior to closure of the facility in consideration of operating experience of the facility and progress made in research and development.

Considerations for Decommissioning

As part of effort to be prepared for termination of operation of a radioactive waste disposal facility, etc., revision of the NSA is in progress to establish a decommissioning procedures in consideration of characteristics of each facility. The major changes include regulatory approval for commencement of decommissioning of a radioactive waste disposal facility and establishment of the application procedures including the list of documents to be submitted (decommissioning plan and decommissioning quality assurance program, etc.). The provisions with respect to decommissioning of nuclear reactor facilities apply other matters regarding decommissioning.

H.4.3. Safety Regulation for Design and Construction of Major Nuclear Facilities

The KHNP conducted a site investigation and an environmental survey of the finally selected site and based on the results of which, submitted to the Ministry of Science and Technology (Currently, the NSSC) an application for CP and OL for the 1st phase LILW disposal facility in January 2007. At the request of the Ministry of Science and Technology, KINS conducted a safety review of the application and attached licensing documents including RER, SAR, and QAP.

As a result of the review, it was confirmed that the application was in compliance with technical standards for location, structure, equipment and performance and the radiological impact resulting from operation and closure of the disposal facility was in conformity with the standards for protection of public health and the environment, as specified in the Enforcement Decree of Atomic Act (Currently, Enforcement Decree of the NSA). As it was finally concluded that standards for CP and OL were satisfied, the Ministry of Education, Science and Technology granted the CP and OL to the KHNP on July 31, 2008. Later, the responsibilities of construction and operation of the disposal facility were transferred to the Korea Radioactive Waste Management Corporation (KRMC, later renamed as KORAD) in January 2009 in accordance with the RWMA.

The construction of the 1st phase disposal facility started in August 2008 and the construction work including excavation of construction tunnel, operation tunnel, access shaft, unloading tunnel and disposal units (e.g. silos), and concrete lining was completed in June 2014.

The 1st phase LILW disposal facility is largely divided into surface and underground facilities (see Figure H.4-1). Surface facilities consist of a receipt and storage building, radioactive waste processing building, service building and other supporting buildings. Radioactive waste from waste generators such as nuclear power plants is accepted in the surface facilities and verified to be consistent with waste acceptance criteria. On-site conditioning of the waste to be suitable for disposal may be conducted, if necessary.

Underground facilities include construction tunnel, operation tunnel, access shaft, unloading tunnel, and disposal units (e.g. silos). At first, six units of silos were constructed approximately 80-130 meters below the sea level to dispose of approximately 100,000 waste packages (Figure H.4-2). All disposal silos were reinforced with short concrete and concrete lining. Most waste packages are packed using concrete disposal containers and subsequently disposed of in the disposal units.

Figure H.4-1. Bird's Eye View of 1st Phase LILW Disposal Facility (in Operation)

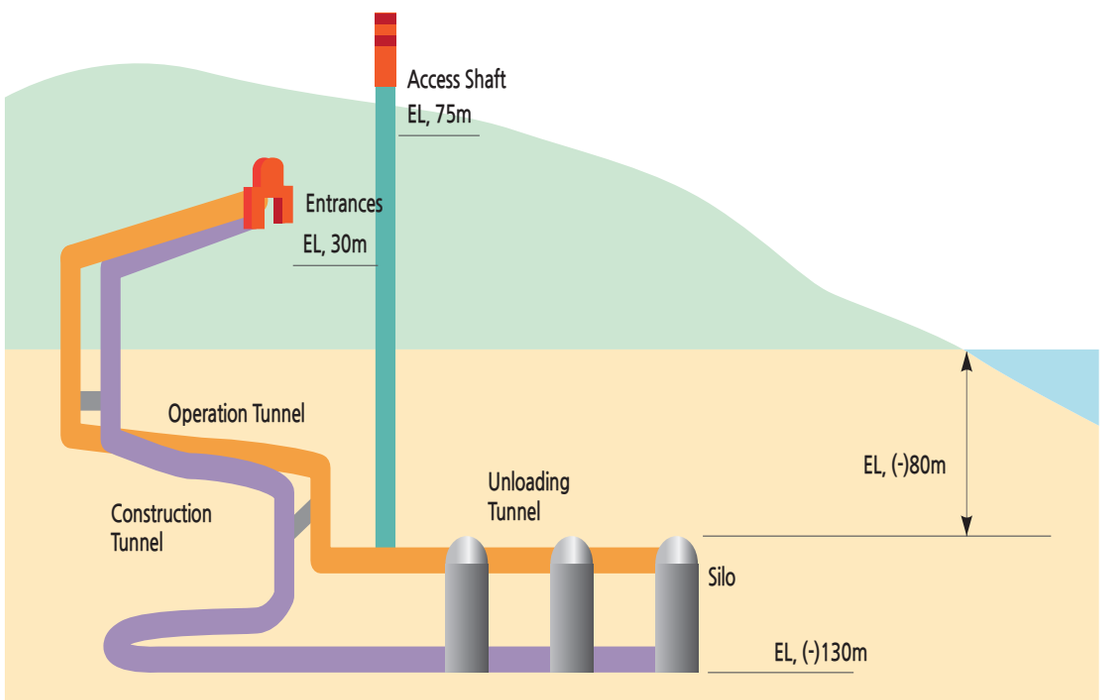

Figure H.4-2. Cross Section View of Underground 1st Phase Disposal Facility

The operator of a LILW disposal facility should undergo pre-operational inspection of the construction work and performance of the facility in the construction stage in accordance with the NSA. The purpose of the pre-operational inspection is to check prior to operation whether the construction of a disposal facility satisfies the related design and safety requirements. The disposal facility is deemed to pass the inspection when it satisfies its licensing criteria and conditions and the structure, equipment and performance of the disposal facility, etc. is in conformity with the technical standard set by the NSA.

The pre-operational inspection of the 1st phase LILW disposal facility took four steps: (1) inspection on structure, (2) inspection on system installation, (3) inspection on system performance and (4) inspection prior to operation. The pre-operational inspection was conducted from September 2008 to August 2014 and the pass of the inspection was notified to the operator on December 12, 2014 through deliberation and resolution by the NSSC. Since then, the disposal facility has been in normal operation.

In December 2015, KORAD filed an application for the CP and OL of the 2nd phase disposal facility to the NSSC and currently, KINS is reviewing the application for the CP and OL as well as 10 kinds of licensing documents such as RER, SAR, QAP. The 2nd phase disposal facility is an engineered vault type disposal facility which is planned to be capable of disposing of 125,000 drums of LILW (Figure H.4-3).

Figure H.4-3 Bird's Eye View of 2nd Phase LILW Disposal Facility (Planned for Construction)

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 Assessment and Environmental Impact Assessment

According to the NSA and subordinate statute, a person who intends to construct and operate a radioactive waste management facility, etc. should submit to the NSSC an application for a permit/license together with a SAR that includes "Safety Assessment and Accident Analysis" as well as a RER. In other words, safety assessment of a radioactive waste management facility, etc. is conducted by an applicant before construction of the facility, and after review of the safety assessment, the regulatory body may approve the application.

Assessment through SAR

The SAR of a radioactive waste disposal facility mainly includes the results of safety assessment and accident analysis of anticipated issues during the period of design, construction, operation, closure and post-closure institutional control of a disposal facility and appurtenant 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 operation and closure activities;

- infiltration water: analysis during design, safety analysis, operation, institutional control after closure, 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 criteria.

Radiological dose criteria for a radioactive waste disposal facility are presented for the period of operation and after closure respectively. During operation of a disposal facility, as with other nuclear power facilities in operation, the standards for prevention of hazards to public health and the environment as well as dose limits for the general public are to be applied. (see H.4.2.)

Radiological performance objectives after closure of a disposal facility are set in terms of the radiological impact to an individual of the critical group in the future. The annual dose due to normal natural phenomena should not exceed 0.1 mSv. In addition, the annual risk due to unpredictable phenomena caused by natural or artificial factors should be limited to 10-6 or less.

The safety assessment of a LILW disposal facility after closure should be conducted at least for 1,000 years of time frame. When the predicted risk does not reach its maximum value within this period, however, it should be duly validated that the leakage of radionuclides into the surrounding environment will not increase drastically after this period, and that individuals will not be subject to acute radiological risk.

The radiological safety objectives after closure of a deep geological repository for HLW as follows: The total annual risk for the representative person resulting from the radiation exposure in the scenario which covers both natural phenomena and human intrusion should not exceed 10-6, and the expected annual radiation dose for the representative person in a single scenario including a low probability natural phenomenon and human intrusion should not exceed 10 mSv.

The safety assessment of a HLW disposal facility after closure should be conducted at least for 10,000 years of time frame. When the predicted risk does not reach its maximum value within this period, however, it should be duly validated that the leakage of radionuclides into the surrounding environment will not increase drastically after this period, and the generation of radiation dose which will have an deterministic impact on individuals will not occur.

For major scenarios that are deemed to affect significantly the results of the safety assessment of the disposal facilities, an uncertainty assessment should 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 collection and application of input variables, modeling, detailed calculations, and comprehensive assessment should be prepared and applied.

Assessment through RER

The RER of a radioactive waste disposal facility should address the respective effects to be caused by construction, operation, and closure of the disposal facility. In particular, the impact assessment for closure should describe an analysis of the predicted migration pathways of radionuclides that can be leaked from the disposal facility, an assessment of predicted doses of local residents per exposure pathways due to potential radionuclide leakage in areas within 10 km from the relevant site, and an assessment of the predicted radionuclide concentration in groundwater release points located downstream of the site.

H.5.2 Renewal of Safety Assessment and Reassessment of Safety

Renewal of Safety Assessment

The NSSC Notices Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities and General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste stipulate that in case of an event that can affect the isolation function of a disposal facility due to natural disasters such as earthquake and flood, or accidents, the safety of the disposal facility should be re-evaluated and related licensing documents should be revised based on the latest available data. In addition, conditions related to the safety of the disposal facility should be continuously re-evaluated and supplemented, if necessary, based on the experience and data obtained from operation and management of the disposal facility and the results of safety assessment. The draft NSA which requires radioactive waste management facilities to perform a periodic safety review every 10 years has been submitted to the National Assembly.

Reassessment of Safety

The NSSC Notices as above also stipulate that the followings should be re-evaluated so as to demonstrate the safety of the radioactive waste disposal facility prior to closure:

- information and data on facility, site, and surrounding areas for the period of performance assessment.
- total amount of radioactive waste disposed of, records of accidents that have occurred during operation and with possible impact on the disposal safety, radiological and non-radiological impacts of disposal on the public and the surrounding environment, etc.

H.5.3 Implementation of Safety Assessment on Major Facility

In January 2007, the KHNP filed an application for the CP and OL of the 1st phase LILW disposal facility, attached with SAR, RER, QAP, etc., to the Ministry of Science and Technology (at present, the NSSC) in accordance with the Nuclear Safety related Act and subordinate statute. The applicant developed scenarios and conducted a safety assessment based on the safety assessment methodology recommended by the IAEA's Co-ordinated Research Project (CRP) on the Improvement of Safety Assessment Methodologies for Near Surface Disposal Facilities (ISAM).

With an authority delegated by the Ministry of Science and Technology (at present, the NSSC) in January 2007, KINS conducted the safety review of the 1st phase LILW disposal facility to verify the adequacy of safety assessment for the construction, operation and post-closure of the disposal facility so as to determine technically whether legal requirements have been met.

Based on the review results, it was recommended that the applicant implement follow-up actions after issuance of the CP and OL to address issues that require safety demonstration or further verification in order to reduce uncertainties during the period of construction and operation, and KINS has reviewed the results of implementation. The implementation and review of follow-up actions is to reduce uncertainties over the long-term safety and to secure the objectiveness and transparency of the safety of the disposal facility based on the safety review reflecting site characteristics obtained in the process of construction and operation of the disposal facility. By doing so, it is ultimately possible to develop safety cases for the

construction stage of the disposal facility, which is in line with the international safety standards including the IAEA SSR-5 (Disposal of Radioactive Waste, 2011), which stipulates establishment of safety cases for each stage in development of a disposal facility.

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 Regulatory Requirements

After obtaining a CP and OL for a radioactive waste management facility, the operator of the facility should undergo pre-operational inspection regarding construction and performance of the facility during the period of construction in accordance with the NSA. The inspection is to verify whether the constructed management facility satisfies the design and safety requirements prior to its operation. When the facility meets the standards

for and contents of the CP and OL and the structures, equipment and performance of the facility satisfy the technical standards defined by the NSA and subordinate statute, the facility will pass the inspection and start its operation.

The operator of a radioactive waste management facility should undergo periodic inspection every year during the period of operation in accordance with the NSA. The facility will pass periodic inspection when the structures, equipment and performance of the facility satisfy technical standards defined by the NSA and subordinate statute, and storage, treatment and disposal of radioactive waste depending on the characteristics of each facility meet technical standards defined by the NSA. In addition to the periodic inspection, a LILW disposal facility should undergo disposal inspection whenever it is to dispose of radioactive waste. The disposal facility will pass disposal inspection when the disposal of radioactive waste satisfies the technical standards defined by the NSA.

The NSSC Notices Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities and General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste stipulate the regulatory requirements to secure safety during operation of a disposal facility as follows:

- Performance of structures, systems and components (SSCs)
- Periodic surveillance
- Regular surveillance
- Radioactive effluent monitoring
- Radiation protection
- Prevention and measures against contamination
- Repair and modification
- Site monitoring and environmental monitoring
- Emergency preparedness

H.6.2 Safety Management of Operation of a Disposal Facility

Safety management standards necessary for operation of a disposal facility should be established to prevent radiological hazards to human bodies, material objects, and the public. To this end, such standards should include technical and administrative matters on radiation safety management necessary to receive, handle, store, transport, treat, and dispose of

radioactive waste during operation of a disposal facility and to manage and monitor the facility after closure. For this, the standards describe the following:

- organization, authorities and duties;
- operation and surveillance of a facility;
- radioactive waste management;
- radiation safety management;
- radiation measurement and management;
- exposure control and assessment methods;
- monitoring of radiation and radioactivity in surrounding areas;
- protection against radiation hazards;
- education and training;
- measures for emergency situation; and
- preparation and maintenance of records.

H.6.3 Limiting Conditions of Operation of a Disposal Facility

The limiting conditions of operation of a radioactive waste disposal facility should be documented in the technical specifications or safety management regulations in accordance with the nuclear safety related Act and subordinate statute. The limiting conditions of operation of a disposal facility are as follows:

- limiting conditions of disposal: type of waste, disposal capacity, total radioactivity, and concentration limit for each radionuclide;
- limiting conditions of operation: waste handling operation, waste treatment operation, waste disposal operation, ventilation system, fire and explosion prevention, power supply system, and effluent monitoring;
- radioactive waste acceptance criteria;
- radiation control and monitoring;
- administrative control;
- periodic safety review (PSR); and
- physical protection.

H.6.4 Operation Procedures

The NSSC Notices Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities and General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste stipulate the detailed technical standards regarding operation of a disposal facility as below in order to ensure safe operation of the facility, prevention of disasters due to the facility, and environmental conservation. In addition, it is required that the licensee of the facility to present the relevant contents in licensing documents such as SAR, RER, safety management regulations, and QAP:

- organization and functions;
- zoning and access control;
- in-operation disposal facility management standards;
- radioactive waste management standards;
- disposal facility closure standards; and
- post-closure institutional control standards.

For operation and management of a disposal facility, the licensee should establish operating procedures regarding acceptance inspection, handling, storage, disposal, radiation monitoring, and emergency measures for radioactive waste as documented procedures pursuant to its QAP. The adequacy of these procedures is to be confirmed through diverse regulatory inspections.

H.6.5 Engineering and Technical Support

KORAD has established a research and development institute to provide engineering and technical support for follow-up actions after licensing activities and technology developments with an aim to prevent radiological hazards to public health and the environment during the period of construction, operation, closure and post-closure institutional control, if necessary, by collaborating with external institutions.

H.6.6 Procedure for Characterization and Categorization of Radioactive Waste

To deliver radioactive waste to the disposal facility operator, the generator should submit to the operator an "Application for the Acceptance of Radioactive Waste" with information on characterization of the waste to be delivered, pursuant to the NSSC Notices General Acceptance Criteria for Low- and Intermediate-level Radioactive Waste and Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities. The information on characterization of waste needed to request receipt of radioactive waste is as follows:

- physical, chemical and biological characteristics, and applied characterization methods;
- total radioactivity and radionuclide-specific concentrations;
- maximum surface dose rate;
- safety characteristics of waste package and applied characterization methods; and
- quality assurance records regarding waste management (including establishment of QAP and adequacy of implementation of QAP), etc.

The NSSC Notice Genral Acceptance Criteria for Low- and Intermediate-Level Radioactive Waste stipulates to satisfy the requirements related to radiological features and structural integrity of waste package and to identify radioactivity concentrations in each waste disposal package for the radionuclides of ^{3}H, ^{14}C, ^{55}Fe, ^{58}Co, ^{60}Co, ^{59}Ni, ^{63}Ni, ^{90}Sr, ^{94}Nb, ^{99}Tc, ^{129}I, ^{137}Cs, ^{144}Ce and gross alpha. The above NSSC Notice also stipulates to establish and implement the methods and procedures to verify the QAP of waste management and to include criteria for characteristics and characterization method of waste.

H.6.7 Event Reporting and Record Management

The NSA prescribes that the nuclear enterpriser should immediately take all necessary safety measures and report to the NSSC for the following cases:

- if radiological hazards occur;
- if a failure occurs in a nuclear power utilization facility; and
- if there is any danger or possibility of danger to the nuclear power facility or radioactive materials due to earthquake, fire or other disasters.

The NSSC Notice Regulation on the Reporting and Public Announcement of Accidents and Incidents at Nuclear Facilities stipulates in detail the event reporting system. It includes the objects and means of and procedures for reporting, and rating of accidents and incidents. In particular, the reportable events at a radioactive waste disposal facility are as follows:

- concern over leakage of radioactive materials due to fire during transport and packaging;
- surface contamination of areas other than radiation areas of the facility exceeding limit 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; and
- release of radioactive materials exceeding ECLs.

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

Information on storage, treatment, or disposal of radioactive waste should be documented and kept in a disposal facility in accordance with Article 145 (Preparation and Maintenance of Records) of the Enforcement Rule of the NSA. The main contents are as follows:

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

H.6.8 Analysis and Feedback of Operating Experience

The operator of a radioactive waste disposal facility should re-evaluate and complement, if necessary, safety conditions of the disposal facility based on experience and data obtained from operation of the disposal facility and results of safety assessment, pursuant to the NSSC Notices Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities and General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste.

H.6.9 Establishment of a Decommissioning Plan and Regulatory Review

As part of effort to be prepared for termination of operation of a radioactive waste disposal facility, etc., revision of the NSA is in progress to establish a decommissioning procedures in consideration of characteristics of each facility. Pursuant to the revised NSA, the operator who intends to decommission the disposal facility is required to obtain an approval from the NSSC. To that end, the operator should submit an application for decommissioning with attached documents such as decommissioning plan and decommissioning QAP for the radioactive waste storage facility, etc. Matters and procedures with regard to decommissioning apply to provisions on decommissioning of nuclear power reactors mutatis mutandis.

H.6.10 Establishment of a Closure Plan and Review of the Regulatory Authority

As part of effort to be prepared for termination of operation of a radioactive waste disposal facility, revision of the NSA is in progress to clarify the regulatory procedure for closure. Pursuant to the revised NSA, the operator who intends to close the disposal facility is required to obtain an approval from the NSSC. To that end, the operator should submit an application for closure with attached documents such as closure plan, post-closure institutional control plan, RER and closure QAP, etc. In addition, the operator should undergo an inspection from the NSSC on closure of the radioactive waste disposal facility and conduct post-closure institutional control after the inspection is passed. When intending to terminate the post-closure institutional control, the NSSC should examine whether the operator perform post-closure institutional control adequately and notify the operator of the results of termination of post-closure institutional control in writing.

The NSSC Notices Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities and General Criteria for Deep Geological Disposal Facilities of High-Level Radioactive Waste stipulate the requirements regarding closure of a radioactive waste disposal facility. The closure of a radioactive waste disposal facility should be carried out according to a pre-approved closure plan and in such a manner that facilitates post-closure institutional control, minimizes the need for continued maintenance and repair, and facilitates post-closure environmental monitoring and survey.

Prior to closure of the disposal facility, various licensing documents including the safety analysis report of the facility should reflect the latest revisions. In addition, safety regarding the total amount of waste disposed of, records of abnormal events that have occurred during operation and with possible impact on the disposal safety, and the radiological and non-radiological impact of disposal on the public and the surrounding environment should be re-evaluated to demonstrate the safety of the disposal facility.

In addition, the operator should finally confirm the predicted performance throughout the period stipulated in the SAR at the time of completion of closure.

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 NSA, radiological data related to a radioactive waste disposal should be permanently preserved. Related records, particularly, the location and design documents of a disposal facility are to be preserved in accordance with the QAP.

With respect to the requirements regarding preparation and maintenance of records on a radioactive waste disposal facility, items to be recorded, time when the records should be drawn up, and duration of retention are stipulated in detail in the Enforcement Rule of the NSA and the NSSC Notice Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities. The major information to be recorded is as follows:

- radioactive waste-related records: manifest information, quantity and type of waste and disposal locations;
- radiation safety control-related records: radiation level in the facilities and radiation workers' exposure dose;
- facility inspection records: pre-operational inspection, periodic inspection, and disposal inspection records;
- operation and maintenance records: results of walkdown, surveillance and maintenance and repair of major equipment;
- facility accident records;

- environmental monitoring: sampling location and time/date, analytical method and results; and
- meteorological records: direction and velocity of wind, atmospheric stability, precipitation, and atmospheric temperature.

With regard to a radioactive waste disposal facility, the following records should be maintained on an annual basis: 1) site characterization documents; 2) facility design and construction-related data; 3) waste acceptance requirements and procedures; 4) SAR; 5) RER; 6) data on the characteristics of the waste disposed of; 7) location of disposal facility and waste; 8) other characteristic data for the disposal facility; 9) environmental monitoring records; 10) records of unintentional events during operation and after closure; 11) closure-related documents; 12) QA documents, and 13) post-closure institutional control plan and its results.

To preserve the records above, the licensee of a disposal facility should establish an organization, responsibility, and location for maintenance of records and should maintain and store records in a manner that provides a complete and objective description of activities in all stages of disposal. In addition, to ensure the proper use and maintenance of information at a post-closure stage, records should be updated up-to-date, maintained in usable form, and made easily accessible.

H.7.2 Post-closure Institutional Control

In accordance with the NSSC Notice Technical Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities, the operator of a disposal facility should establish and submit an institutional control plan to the NSSC by one year before the commencement of institutional control. When intending to revise the control plan, the operator should submit to the NSSC a statement of the reasons for revision and the revised control plan by June of the year before the year when the revision goes into effect. The post-closure institutional control plan should include the followings:

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

The post-closure institutional control period should be established by considering the characteristics of waste, engineering design, site characteristics, predicted social activities related to a disposal facility, records, and historical experience regarding maintenance. After the control period, further control activities should be unnecessary and the risk or dose calculated according to appropriate methods should satisfy the performance objectives for a disposal facility.

Institutional control methods should be able to prove that radiation protection requirements are met by reasonably verifying the closure performance of a disposal facility. Institutional control consists of radiological environmental survey, non-radiological environmental survey, maintenance & repair, site monitoring, access restriction, safety assessment, and record-keeping. However, detailed control methods may be adjusted according to the results of systematic safety evaluation of a disposal facility or the characteristics of a disposal facility and site. Site monitoring should meet the post-closure site monitoring program presented in the site characterization report or SAR for a disposal facility.

H.7.3 Intervention in Case of Unplanned Release

During the period of post-closure institutional control of a LILW disposal facility, unplanned and uncontrolled release of radioactive materials through activities such as survey of radiation environment, maintenance and repair, and site monitoring should be prevent or monitored. A specific description of the methods with regard to them should be included in the institutional control plan after closure for the disposal facility which should be submitted to the NSSC one year before the commencement of institutional control in accordance with the NSSC Notice Technical Standards for the Operation, etc. Low- and Intermediate-Level Radioactive Waste Disposal Facilities. In case where matters fall under each of the followings are detected from the result of a radiation survey on the surrounding environment of a disposal facility, causes and actions to address them should be reported in writing within on week after the detection.

- the case where average value in one hour for ambient gamma dose rate in the middle of continuous monitoring at a fixed location is in excess of an average value of data in the latest more than three years by 10μR/h;
- the case where the result of analysis of radioactivity at sampling locations of survey plan proves that it is in excess of five times of average value of data in the latest more than three years; and
- the case where an artificial radionuclide is detected in environmental samples which are measured less than minimum detectable concentration during the latest three years.

I Transboundary Movement [Article 27]

ARTICLE 27. TRANSBOUNDARY MOVEMENT

1. Each Contracting Party involved in trans-boundary 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 trans-boundary movement is authorized and takes place only with the prior notification and consent of the State of destination;

ii. trans-boundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilized;

iii. Contracting Party which is a State of destination shall consent to a trans-boundary 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 trans-boundary 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 trans-boundary 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 trans-boundary 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 Transportation Regulations

Regulations on transport of radioactive materials are described in the NSA, its Enforcement Decree, its Enforcement Rule, the NSSC Regulations on Technical Standards for Radiation Safety Control, etc., and the NSSC Notice Regulation on the Packing and Transport of Radioactive Materials, etc.

The domestic regulations on transport of radioactive materials are based on the Regulations for the safe transport of radioactive materials of the IAEA. The incorporation of the 1996 IAEA Regulations for the Safe Transport of Radioactive Materials (ST-1) into the NSA was made from 1999 to 2001 and the regulations based on this are applied to the safety management of transport of radioactive materials.

Articles related to transport of radioactive materials are reflected in the NSA, its Enforcement Decree, its Enforcement Rule and the NSSC Regulations on Technical Standards for Radiation Safety Control, etc. Especially, Article 71 (Report on Transport) through 77 (Inspection), of the NSA, Articles 108 (Report on Transport) through 114 (Exemption from Inspection of Transport Container) of its Enforcement Decree, Articles 98 (Report of Transport) through 110 (Application for Exemption from Inspection) of its Enforcement Rule, and Articles 89 (Scope of Application) through 128 (Standards for Transport by Post) of the NSSC Regulations on Technical Standards for Radiation Safety Control, etc. stipulate the notification of transport of radioactive materials, criteria of both transport and packaging for radioactive materials, radiation exposure management of transport workers, action for the accident during transport, inspection for transport, and design approval and inspecting of transport cask. The detailed technical regulations on the safe transport of radioactive materials are described in the NSSC Notices Regulation on the Packing and Transport of Radioactive Materials, etc. and Regulation on the Manufacture and Periodical Inspection of Packaging 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, and it has been observing the obligations stipulated in the treaty and protocol (e.g. 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 Safety Requirements

The general safety requirements for transport of radioactive materials defined in the NSSC Regulations on Technical Standards for Radiation Safety Control, etc. specify radiation exposure management, emergency response, QA, compliance of transport safety standards, education & training of transportation workers, etc.

I.2.2 Safety Requirements for Transportation Containers

The NSSC Notice Regulation on Packing and Transport of Radioactive Materials, etc. specify the safety requirements of each package type corresponding to type L package, type IP package, type A package, type B package and package containing fissile material that are divided into general performance requirements and safety test requirements in both normal and accident conditions. General requirements and test requirements for transport containers conform to the requirements which are, in general, same as ones specified in the IAEA Regulations (SSR-6).

I.2.3 Safety Requirements for Transportation

The safety requirements for transport stipulated in the NSSC Notice Regulation on Packing and Transport of Radioactive Materials, etc. include assigned amount of radioactive materials by package type, e.g. type L package, type IP package, type A package, type B package and package containing fissile material; restriction of mixed package with other dangerous materials; transport index (TI) and critical safety index (CSI); categorization of package; marking and labelling of package; isolation of package and fissile material; control of surface dose rate and surface contamination; responsibilities of consignors and carriers; and safety requirements by transport means such as vehicle, airplane, and ship, etc. In general, these safety requirements for transport are equivalent to the requirements specified the IAEA transport regulations (SSR-6).

I.3 Approval and Administrative Action

I.3.1 Design Approval

The matters for approval prescribed in the NSA include design approval for special radioactive material, design approval for transport packaging and special arrangements specified in the IAEA Regulations for the Safe Transport of Radioactive Material. The NSSC issues an certificate of design approval for transport package after the safety review. The transport packaging, for which a design approval is granted, should undergo a manufacturing inspection to confirm its integrity. In addition, an inspection for use is conducted for each packaging every five years from the manufacturing date to ensure the safety for continuous use.

I.3.2 Report on Transportation

The nuclear enterpriser who intends to transport following radioactive materials, etc. shall file to the Commission a report on their transport, attached with the details of transport including radioactive contents, form of a package, a written transport procedures and an emergency response plan by five working days before the date the transport is scheduled to commence. The NSSC should review reported details, and issue an order to improve deficiencies or correct factors detrimental to safety, if any, prior to transport. As for reported radioactive materials, etc., regulatory inspections are conducted to check the compliance of transport regulations.

- Type B packages, Type C packages, fissile material packages, packages requiring special arrangement, and LILW with a volume of 1.6 m^3 or more

In the meantime, any person, who intends to get any ship or any aircraft laden with following radioactive materials, etc, to enter into any port or any airport of the Republic of Korea or to sail or fly through the territorial waters or sky of the Republic of Korea, shall file a report to the NSSC by 7 days before he intends to do so. The NSSC should review reported details, and issue an order to improve deficiencies or correct factors detrimental to safety, if any, prior to transport.

- Type B(M) packages, Type B(U) and C packages containing a large amount of radioactive materials, etc.

I.3.3 Cases of Trans-boundary Movement

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 Section J.2.3 for the sealed source).

J Disused Sealed Sources [Article 28]

ARTICLE 28. DISUSED SEALED SOURCES

1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.
2. A Contracting Party shall allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.

J.1 Management System

In October 1989, the radioisotope (RI) waste management facility for the safe treatment and storage of RI waste was constructed in the site of KAERI. The RI waste was collected beginning August 1990 and the RI waste management facility was operated by KAERI until the end of 1996. The responsibility for RI waste management was transferred from the Ministry of Science and Technology (at present, the NSSS) to MOTIE in 1996 with revision of related Acts such as Atomic Energy Act (at present, the NSA) and Electric Utility Act which was made as part of change in the implementation of the national nuclear business in 1996. Currently, KORAD is in charge of management and operation of the RI waste management facility.

The RI waste management business is part of shipment, storage, treatment and disposal of radioactive waste generated from the facilities using RI, specified in Article 9 (Radioactive Waste Management Services) of the RWMA. MOTIE is responsible for the administrative supervision of RI waste management operator and the NSSC implements safety regulation.

RI waste has to be collected and delivered to the RI waste management operator by a RI user directly, or through a transport agent.

J.2 Management of Disused Sealed Sources

J.2.1 Requirements for Facilities and Handling

Disused sealed sources are temporarily managed by the RI users in the storage facility which passes a facility inspection in accordance with the NSA. The matters on safety such as radiation shielding, waste handling etc. with consideration of the storage capacity of the facility are required to be specified in the radiation safety report and the safety management regulations and to be observed. Currently, the RI waste management facility being operated by KORAD is periodically inspected by the regulatory body in accordance with the NSA.

J.2.2 Management

Procedures for Waste Management by RI User

In accordance with Article 53 (Permit, etc. for Use, etc. of Radioisotope and Radiation Generating Devices) of the NSA, the facilities who wish to import from abroad and use RI should obtain a permit for use of RI from the NSSC and meet the importation provisions of the Korea Foundation of Nuclear Safety (KoFONS). The use of domestic RI requires a permit for use of RI from the NSSC.

RI users are allowed to store temporarily disused sealed sources - 192Ir for the purpose of radiography testing for five years from the date of acquisition and other RIs for the next two years after termination of their use, pursuant to the NSSC Notice Regulation on the Security Management of Radioisotopes. The disused sealed sources are temporarily stored in the container of the RI users and then delivered to the RI waste management facility of KORAD,

As per the NSSC Notice Regulation to Be Observed by Sellers of Radioisotopes, it is also allowed to commission RI sellers to collect RI waste. Those who wish to commission the operator of the management facility to collect and dispose of RI waste should pay the management expenses defined in the RWMA.

RI Waste Management System

KORAD takes over disused sealed 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 MOTIE Notice Regulations on Radioactive Waste Receiving Method, KORAD operates its RI waste management facility where the RI waste that has been received from RI users is safely stored and managed. The national RI waste management framework is shown in Figure J.2-1.

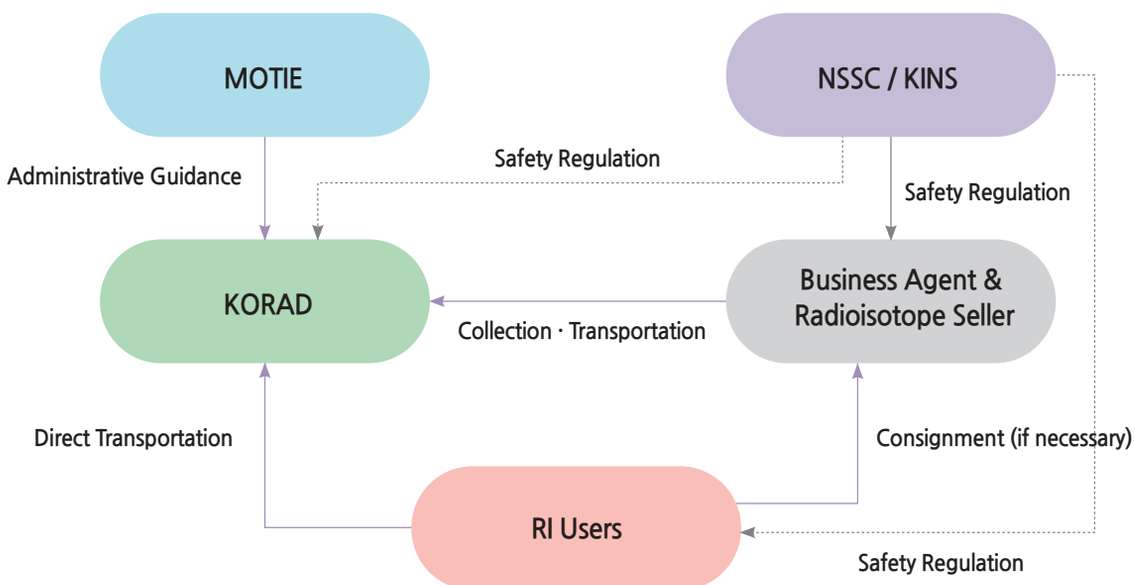

Figure J.2-1. RI Waste Management Framework

J.2.3 Return

Currently, the sealed sources used in Korea are mostly imported from foreign countries. Based on a sales contract between a domestic licensed RI seller and a foreign manufacturer, some of the disused sealed sources are returned to the foreign manufacturer. On the other hand, in case of the sealed sources manufactured in Korea such as ^{192}Ir, when they are exported to foreign countries and if a foreign RI user wishes 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 and export requirements set forth in the NSA. The disused sealed sources from abroad are then delivered to KORAD which was authorized as a RI waste management facility operator in accordance with the NSA.

K Safety Improvement Activities

K.1 Improvement of Safety Regulation System for Radioactive Waste Management

As part of effort to improve the safety regulation system for radioactive waste, the regulatory body has worked on amendment of the nuclear safety-related Act and subordinate, technical standards. As radioactive waste management facilities have gone into full operation, the regulator has been revising the NSA to introduce several practices to radioactive waste management facilities (PSR, safety measures for operation, suspension of use, etc.) to ensure that the safety regulation system related to assessment and obligation during operation is consistent with international standards.

Considering the findings of IAEA IRRS mission in 2014 and overseas precedents, the NSA is under revision to lay a legal basis for a PSR to be performed every 10 years by a radioactive waste management facility before the time comes when the first PSR needs to be performed. Major revisions to the NSA include the obligation of the operator to conduct a PSR and submit the results and the authority of the regulatory body to order corrective or supplementary measures when the results of the PSR or followup actions are not sufficient. In addition, the revised Act will include safety measures that the operator is obliged to take during operation, compliance of safety control regulations, exception of application of safety measures as well as regulatory actions (suspension of use, modification, repair, etc.) to be imposed when such obligations are violated.

Another significant revision to the NSA is to establish a regulatory procedure related to termination of operation (decommissioning of radioactive waste treatment or storage facilities, closure and post-closure institutional control of disposal facilities), with consideration of characteristics of each facility, so as to be prepared for termination of operation of a radioactive waste management facility. The NSA is to be revised in such ways to obtain a regulatory approval for decommissioning of a radioactive waste management facility and to clearly define a procedure for decommissioning approval and a list of documents (decommissioning plan, decommissioning QAP, etc.) to be submitted along with an application for decommissioning approval. Additionally, a closure procedure for a radioactive waste disposal facility,

etc. which cover approval for closure, documents to be submitted when an application is filed (closure plan, post-closure institutional control plan, closure QAP, etc.) is to be defined. When such legislative changes are completed, it is expected that a regulatory system for all stages of the life-cycle of a radioactive waste management facility will be established including decommissioning and closure procedures.

With respect to HLW including spent fuel, the revision of the NSA and the enactment of technical standards are also in progress.

A legal basis for design approval and manufacturing inspection of spent nuclear fuel cask will be included in the revised NSA with intentions to improve the regulatory review for the construction permit and operating license of a spent nuclear fuel storage facility and to respond to demands for development of spent nuclear fuel cask. The partial revision to the NSA were deliberated and decided at the 106th meeting of the NSSC in August 2019 and the pre-announcement of legislation was made from September to November 2019 (Announcement No. 2019-55). Major revisions are to allow the nuclear enterpriser to apply for a design approval for a cask to be used in the nuclear power utilization facility and to require manufacturing inspection by the regulatory body when the approved design of a cask is manufactured. By doing so, it will be possible to secure sufficient time to review the safety of spent nuclear fuel cask and improve the efficiency of the regulatory process.

K.2 Expansion of Capacity of Storage Facilities and Review of Management Policy for Spent Fuel

K.2.1 Expansion of Storage Capacity for Spent Fuel

The KHNP has pushed forward with additional construction of onsite dry storage facility (MACSTOR) at Wolsong power site to expand the storage capacity for spent fuel from PHWR plants. The operator obtained a permit for operating license amendment from the NSSC in January 2020 and commenced the construction in August 2020 with a completion target by 2022. It is also planned to install high density storage racks additionally in the open space of the spent fuel pools for Shin-Hanul Units 1 and 2 and Shin-Wolsong Units 1 and 2 to expand the storage capacity for spent fuel from PWR plants.

Spent fuel from research reactors, HANARO is currently stored in the pool inside the reactor building. In order to expand the storage capacity, high density storage racks for spent fuel are on the drawing board. In the long-term, a final management plan for spent fuel will be developed when a national policy on interim storage and disposal facilities for spent fuel is determined

K.2.2 Review of Spent Fuel Management Policy

In accordance with the resolution by the AEPC (the former AEC) on spent fuel management policy, the government launched PECOS in October 2013 to collect public opinions comprehensively including that of stakeholders and experts, and then to develop a basic plan on spent fuel management. PECOS submitted a set of recommendations on detailed procedures and plans for safe management of spent fuel to the government in June 2015.

Based on the recommendations, the government developed the Basic Plan on Management of High level Radioactive Waste which defines methods and procedures for management of spent fuel in July 2016. The basic plan is outlined as follows: to construct a site-specific underground research laboratory, an interim storage facility for spent fuel and a repository for HLW at a same site; to endeavor to secure an international joint storage and disposal facility with consideration of domestic and oversea situations; to develop core technologies timely to improve the reliability on safety; to strive to conduct spent fuel management projects transparently and objectively and secure public acceptance through communications with local

residents; and to construct additional on-site storage facilities at nuclear power sites.

With regard to the Basic Plan, opinions were raised that it was needed to hear voices of the public and residents in the vicinity of nuclear power plants more broadly. Thus, the government put "Review of Spent Fuel Management Policy" on the national agenda in July 2017.

To that end, a preparatory group for review of spent fuel management policy was launched to discuss ways for the policy review with local communities near nuclear power plants, civic groups and nuclear communities, and submitted a policy proposal to the government.

Based on the policy proposal, the government formed and currently operates a Review Committee for Spent Fuel Management Policy with participation of neutral figures to ensure that opinions are fairly collected.

After collection of opinions from the general public and residents in the vicinity of nuclear power plants is completed, the committee will submit policy recommendations to the government. Then the government will revise and complement its spent fuel management policy after taking into account the recommendations as much as possible.

K.3 Securement of Safety of Permanent Shutdown and Decommissioning of NPPs

K.3.1 Regulatory Preparation for Permanent Shutdown and Decommissioning

With regard to permanent shutdown and decommissioning of nuclear facilities, amendment of the NSA and enactment of technical standards (NSSC Notices) were completed in 2016. As the regulation system for permanent shutdown and decommissioning has been established, KINS legislated and revised a safety review guidelines and field inspection guidelines for concerned facilities and has conducted regulatory activities in accordance with them. The below is the list of safety review and inspection guidelines in relation to permanent shutdown and decommissioning which were enacted or revised from 2017 onwards.

- Safety Review Guidelines for Permanently Shutdown Nuclear Power Plants, KINS/GE-N012 (revised in January 2019)
- Safety Review Guidelines for Permanently Shutdown PHWR Plants KINS/GE-N017 (enacted in February 2019)
- Periodic Inspection Guidelines for Permanently Shutdown Nuclear Power Plants (Westinghouse type), KINS/GI-N026 (enacted in November 2017, revised in January 2019)
- Periodic Inspection Guidelines for Permanently Shutdown Nuclear Power Plants (CANDU type), KINS/GI-N027 (enacted in January 2020)
- Review Guidelines for Preliminary Decommissioning Plan for Nuclear Power Utilization Facilities, KINS/GE-N001 (enacted in July 2017)
- Review Guidelines for Final Decommissioning Plan for Nuclear Power Utilization Facilities, KINS/GE-N002 (enacted in June 2020)
- Verification and Inspection Guidelines for Decommissioning Status of Research Reactors, KINS/GE-W003 (revised in April 2018)

K.3.2 Safety Regulatory Activities for Permanent Shutdown and Decommissioning Plan of Nuclear Power Plants

As the NSSC granted a permit for operating license amendment to the KHNP on June 9, 2017, Kori Unit 1, which started commercial operation in 1978, for the first time in Korea was permanently shut down on June 19,

2017. Subsequently, a permit for operating license amendment of Wolsong Unit 1, Korea's first PHWR (CANDU type) which started commercial operation in 1984 was issued for permanent shutdown on December 24, 2019.

During the period of permanent shutdown, the regulatory body has continued to perform safety regulatory activities including safety review and periodic inspection. As above mentioned, KINS has conducted periodic inspections in accordance with "Periodic Inspection Guidelines for Permanent Shutdown Nuclear Power Plants (Westinghouse Type)" and "Periodic Inspection Guidelines for Permanent Shutdown Nuclear Power Plants (CANDU Type)" which reflect the characteristics of Permanent shutdown nuclear power plants.

After the effectuation of the revised NSA which requires a decommissioning plan to be prepared at construction and operation stages of a nuclear power utilization facility in 2015, 20 preliminary decommissioning plans for nuclear power reactors, research reactors and nuclear fuel cycle facilities were developed and submitted to the NSSC by the KHNP, KAERI, or KEPCO NF by 2018, and they are currently under review by KINS.

As per the NSA which stipulates the submission of a final decommissioning plan within five years after permanent shutdown, the KHNP should file an application for decommissioning of Kori Unit 1 by 2022. Thus, the KHNP plans to prepare a final decommissioning plan and a decommissioning QAP of Kori Unit 1, and then submit them to the NSSC along with an application for Kori Unit 1 decommissioning after gathering public opinions on them. The final decommissioning plan of Kori Unit 1 should address decommissioning strategy, decommissioning organization, decommissioning scheduling, construction of decommissioning waste treatment facilities, and results of radiological characterization of the site and environmental conditions of Kori Unit 1. To be prepared for the submission of the final decommissioning plan of Kori Unit 1 which will be the Korea's first nuclear power reactor to be decommissioned, the NSSC legislated safety review guidelines in June 2020 and plans to use the guidelines for review and approval of Kori Unit 1 decommissioning plan which will start from the second half of 2020.

K.4 Enhancement of Verification of Suitability for Disposal of LILW

As it was found in September 2018 that errors existed in the radiological characteristics (radionuclide concentration value) of some radioactive waste permanently disposed of in the 1st phase LILW disposal facility in Gyeongju, concerns over the safety of radioactive waste management grew. Consequently, a need was raised to inspect whether the operational safety and radioactive waste management of the 1st Phase LILW disposal facility was adequate such as inventory management of radionuclides, methods for preliminary inspection at waste generation sites and acceptance inspection by the disposal facility operator, verification of the adequacy of the inspections, management of storage and disposal of radioactive waste, and assessment of effects of errors on the safety of the disposal facility.

The regulatory body conducted a special inspection with intentions to evaluate the current conditions of safety management from generation, acceptance to disposal of LILW comprehensively and to define clearly responsibilities and duties of the disposal facility operator. As a result of the special inspection, it was revealed that standards that the facility operator should have developed with consideration of characteristics of the disposal facility (criteria for characteristics and characterization method of waste, method for verification of adequacy of characteristic information provided by the generators, etc.) were not sufficient, and that methods and procedures to verify the QAP of the generators and the quality of characteristics data were not established.

In order to improve findings from the special inspection, technical standards were revised in July 2020 that a facility operator should specify and provide to a generator standards for characterization methods that should be adopted and verify the radioactive waste characterization plan that a generator conducts. Another revision was made to related technical standards in July 2020 to clarify obligations for quality assurance in radioactive waste management across the board. In accordance with the technical standards to be revised, the quality assurance obligations for radioactive waste management including characterization methods that should be adopted by waste generator, and the facility operator should provide the generators quality assurance standards for radioactive waste management, which will enable the operator to inspect the quality assurance program of the generators and ensure that the generators manage records for quality assurance properly prior to acceptance of radioactive waste. Besides, the following actions based on regulatory experience in the field have been taken in May and July 2020: describe specifically methods, items

and contents for disposal inspection in the related technical standards to make disposal inspection more substantial; add inspection items to verify the effectiveness of nuclide characterization identification and extend the processing period for disposal inspection; and revise the related Act and subordinate statue to attach a document proving the adequacy of acceptance criteria and method of radioactive waste to the application for disposal inspection.

To apply such items for improvement, the operator of the LILW disposal facility has work on improving acceptance criteria such as criteria for characteristics and characterization method for each item and matters regarding quality assurance standards. The operator has formed and operated a joint working group with the generators to enhance the verification of suitability for disposal, and plans to collect opinions through presentations on the revised acceptance standards and meetings with each generator in order to advance and sophisticate acceptance criteria. The operator will define and include in its acceptance criteria a method for characterization of waste to be disposed of and a method for verification of suitability of characteristics data as mandatory items for the safety of operation and radioactive waste management of the disposal facility. In order to verify the suitability for disposal, the operator will provide quality assurance standards for characterization of radioactive waste and based on which, the generators will develop a quality assurance program with consideration of field application.

The KHNP has created a radiochemistry laboratory under Central Research Institute to strengthen internal capability to verify the characterization of radioactive waste. In addition, the KHNP has attempted to obtain a license for a polymer-concrete high integrity container in which radioactive waste such as concentrated liquid waste and spent resin can be disposed of. The generator has also developed and assessed a scale factor for radionuclide identification and radionuclide inventory assessment and has verified its adequacy periodically (every 2 years). In addition, as part of effort to enhance the verification of criteria for characteristics of radioactive waste, the company has introduced a portable X-ray equipment which is a nondestructive inspection method to measure the radionuclide concentrations of multiple 200 L drums in single 320 L waste drum. In an attempt to secure the suitability for disposal of radioactive waste, the company has continued to discuss with the disposal facility operator criteria for characteristics, methods for characterization, and matters regarding quality assurance standards. Based on the discussion, the company will improve acceptance criteria and a quality assurance program which will then be applied to the verification of suitability for disposal of radioactive waste.

K.5 Enhancement of R&D for Safety of Storage and Disposal of Spent Fuel

As spent fuel is continuously withdrawn from the nuclear reactor facilities, it is predicted that the capacity of currently available temporary storage facilities will be reached in the near future. Therefore, there is a rising need to secure technologies related to construction and operation of spent fuel management facilities quickly so as to improve the safety of operation of nuclear power plants and the safety management of radioactive waste. As most of R&D activities focus on spent fuel management technologies in the basic or concept phase, it is necessary to timely secure and demonstrate technologies for interim storage and permanent disposal which are options to manage spent fuel after onsite temporary storage.

Currently, the government has taken a close look at the necessity of the safety of storage and disposal of spent fuel. With an aim to secure key storage and disposal solutions needed for the safety management system for spent fuel, the NSSC responsible for safety regulation, MOTIE in charge of operation of nuclear power plants and radioactive waste management and the MSIT taking charge of development of nuclear science and technology work together to conduct a multi-ministry cooperation project for nine years (2021 to 2029). As the feasibility of the project has been approved by the financial authority in June 2020, the R&D project is planned to commence in 2021 with aims to develop core storage and disposal technologies, secure enabling technologies necessary for demonstration in a deep geological disposal environment and regulatory technologies prior to demonstration of the underground research laboratory.

Core technologies for safety management of spent fuel include 1) demonstration technology of the safety of spent fuel storage, 2) enabling technology to define and demonstrate the safety of spent fuel disposal, 3) platform technology for safety regulation on the deep geological disposal system for spent fuel. In order to achieve the goal of the multi-ministry cooperation R&D project, it is planned to connect and utilize core technologies which is expected to bring positive outcome applicable to a demonstration project. The government strives to establish an achievable and sustainable spent fuel management system through close cooperation and information sharing.

In order to respond to saturation of spent fuel storage facilities and to implement a mid- and long-term spent fuel management policy which will be decided in the near future, it is imperative to provide technical support

through stepwise development and securement of related technologies. Therefore, government authorities such as the NSSC, MOTIE and the MSIT work closely with aims to secure advanced technologies for demonstration of safety and performance of spent fuel storage and disposal, and to respond actively to environmental and policy changes at home and abroad. By doing so, the government will create a society where the public feel safer.

K.6 Development and Operation of Waste Tracking System

KORAD has deployed and operated a radioactive waste tracking system (WTS) to manage data on radioactive waste systematically in accordance with Article 67 (Records and Keeping) of the NSA and the SAR of the LILW disposal facility.

The WTS is designed to track and manage locations and data generated in a series of stages related to LILW that cover request for acceptance, inspection, transport, disposal, and post-closure institutional control.

The system is composed of functions such as history management, document management, location management, and provision of information related to radioactive waste.

- History management is to manage data generated at each stage of radioactive waste (inspection, transport, disposal, etc.)
- Document management is to record and store documents required by related Acts and Notices
- Location management is to track locations of transportation vehicles & ships and disposal vehicles using GPS (Global Positioning System) and RFID (Radio Frequency IDentification)

  * RFID refers to a technology whereby digital data encoded in RFID tags are captured by a reader via radio waves.
- Information Provision is to provide information on radioactive waste management transparently to disposal operators, radioactive waste generators, regulator, and key stakeholders including the general public

Currently, the WTS has been deployed in 2015 and operated for use in the 1st phase underground silo type facility with the capacity of 100,000 drums. As KORAD plans to construct the 2nd phase engineered vault type disposal facility with the capacity of 125,000 drums additionally, it is also needed to expand the WTS accordingly.

In order to be prepared for operation of the 2nd engineered vault type disposal facility, therefore, it is planned to deploy the improved WTS for use in the complex disposal facility (1st phase underground silo type and 2nd phase engineered vault type). The key design and improvements of the WTS for the complex disposal facility are as follows:

- The current WTS is deployed based on the radioactive DAW, however, the scope of the system will be extended to manage the characteristics of other radioactive waste such as spent resin, sludge, solidified waste with an intention to manage data on characteristics of various radioactive waste.
- The current WTS is a closed network system, however it will be expanded into a system with flexibility to accommodate the expansion of the disposal facility, thereby responding actively to changes in business conditions.
- With a growing demand for information disclosure from various stakeholders such as the public, the WTS will be equipped with a statistics module to efficiently manage data on characteristics of various radioactive waste, which will enable users to search and analyze data with various conditions such as classification of waste, concentration of each radionuclide, etc.
- The improved WTS will have a smart location tracking and management system using new location tracking equipment which will substitute the current RFID to strengthen the function of real-time tracking and to visualize location data in a various manner.

Since the disposal facility in Gyeongju is planned to be developed into a complex disposal facility where underground silo type, engineered-vault type, and trench-type facilities coexist with the combined capacity of 800,000 drums, in the long-term, the WTS is also planned to be developed into an integrated radioactive waste tracking system.

Annex A List of Spent Fuel Management Facilities (As of March 31, 2020)

Annex A-1. Spent Fuel Storage Facilities at Nuclear Power Plant Sites

Plant	Location	Storage Type	Inventory [MTU]	Capacitynote) [MTU]	Reactor Type
Kori Unit 1	Gijang-gun, Busan	Wet	167.2	209.0	PWR
Kori Unit 2			244.8	313.0	
Kori Unit 3			854.5	919.0	
Kori Unit 4			858.1	920.0	
Shin-Kori Unit 1			218.2	532.0	
Shin-Kori Unit 2			293.8	532.0	
Subtotal for Kori Site			**2,636.6**	**3,425.0**	
Shin-Kori Unit 3	Ulju-gun, Ulsan	Wet	81.6	326.0	PWR
Shin-Kori Unit 4			0.0	326.0	
Subtotal for Saeul Site			**81.6**	**652.0**	
Hanbit Unit 1	Yonggwang-gun Jeollanam-do	Wet	730.0	920.0	PWR
Hanbit Unit 2			579.7	918.0	
Hanbit Unit 3			370.0	470.0	
Hanbit Unit 4			364.2	470.0	
Hanbit Unit 5			319.1	535.0	
Hanbit Unit 6			319.9	535.0	
Subtotal for Hanbit Site			**2,682.9**	**3,848.0**	
Hanul Unit 1	Ulchin-gun, Gyeongsangbuk-do	Wet	380.9	418.0	PWR
Hanul Unit 2			383.2	395.0	
Hanul Unit 3			488.7	552.0	
Hanul Unit 4			463.4	552.0	
Hanul Unit 5			429.5	535.0	
Hanul Unit 6			347.6	535.0	
Subtotal for Hanul Site			**2,493.3**	**2,987.0**	
Wolsong Unit 1	Gyeongju, Gyeongsangbuk-do	Wet	617.0	844.0	PHWR
Wolsong Unit 2			709.0	801.0	
Wolsong Unit 3			660.5	801.0	
Wolsong Unit 4			725.9	801.0	
Shin-Wolsong Unit 1			136.3	219.0	PWR
Shin-Wolsong Unit 2			78.6	219.0	
Dry storage facility		Dry	6,098.9	6,234.0	-
Subtotal for Wolsong Site			**9,026.2**	**9,919.0**	
Total			**16,920.6**	**20,831.0**	

Note) Excluding emergency cores

Annex A-2. Spent Fuel Storage Facilities at 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	0.6
			HANARO 18 element fuel assembly	0.6	0.2
PIEF spent fuel storage pool	Yuseong-gu, Daejeon	Wet	PWR spent fuel assembly & fuel rod	11.3	3.3

Annex B List of Radioactive Waste Management Facilities (As of March 31, 2020)

Annex. B-1 LILW Storage facilities at nuclear power plants

Facility	Location	Purpose	Operation Year	Capacity [200 Liter Drum]	Inventory [200 Liter Drum]
Kori storage building No. 1	Gijang-gun, Busan	Temporary storage of radioactive wastes generated from Kori Units 1 to 4	1978	10,000	8,206
Kori storage building No. 2			1979	6,000	5,815
Kori storage building No. 3			1987	11,200	9,433
Kori storage building No. 4			1993	23,000	13,647
Shin-Kori storage building No. 1		Temporary storage of radioactive wastes generated from Shin-Kori Units 1 & 2	2011	10,000	4,153
RCA		-	-	-	1,408[1)]
Subtotal for Kori Site					**42,662**
RCA	Ulju-gun, Ulsan	-	-	-	247
Subtotal for Saeul Site					**247**
Hanbit storage building No. 1	Yonggwang-gun, Jeollanam-do	Temporary storage of radioactive waste drums generated from Hanbit Units 1 & 2	1986	13,300	10,772
Hanbit storage building No. 2		Temporary storage of radioactive wastes generated from Hanbit Units 1 to 6	2002	10,000	7,420
RCA		-	-		2,777
Subtotal for Habit Site					**20,969**
Hanul storage building No. 1	Ulchin-gun, Gyeongsangbuk-do	Temporary storage of radioactive wastes generated from Hanul Units 1 & 2	1989	7,400	5,791
Hanul storage building No. 2		Temporary storage of radioactive wastes generated from Hanul Units 1 to 6	1997	10,000	5,956
RCA		-	-		4,263
Subtotal for Hanul Site					**16,010**
Wolsong storage building No. 1	Gyeongju, Gyeongsangbuk-do	Temporary storage of radioactive wastes generated from Wolsong Units 1 to 4	1983	9,000	6,663
Shin-Wolsong storage building		Temporary storage of radioactive wastes generated from Shin-Wolsong Units 1 & 2	2015	10,000	686
RCA		-	-	-	3,421[2)]
Subtotal for Wolsong Site					**10,770**
Total					**90,658**

1) Combined inventory of Kori and Shin-Kori Plants
2) Combined inventory of Wolsong and Shin-Wolsong RCAs (including spent resin, etc. stored in Wolsong RCAs)

Annex B-2. Radioactive Waste Treatment Facilities at nuclear power plants

Reactor Type	Characteristics		
	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 from buildings is treated through HEPA and/or charcoal filter

Annex B-3. Radioactive Waste Storage Facilities at Research Facilities

Facility	Location	Purpose	Organization	Capacity [200 liter drum]	Inventory [200 liter drum]
Radioactive waste storage building	Yuseong-gu, Daejeon,	Temporary storage of radioactive wastes generated from research facility	KAERI	35,263	21,185
KRR-2 temporary storage	Gongneung-dong, Seoul	Temporary storage of decommissioning waste from research reactor 1 & 2	KAERI	-	641

Annex B-4. Radioactive waste Treatment Facility at Research Facilities

Facility	Location	Purpose	Organization	Operation Year	Facility Feature	
					Process	Throughput
Radioactive waste treatment facility (RWTF)	Yuseong -gu, Daejeon	Treatment of radioactive waste generated from research facilities	KAERI	1991	Bituminization	0.03 ㎥/h
					Evaporation & Enrichment	1 ㎥/h
					Compaction	60 ton
					Solar evaporation	0.6 ㎥/h

Annex B-5. Combustible Waste Treatment Facility

Facility	Location	Purpose	Organization	Operation Year	Treatment Capacity	
Combustible waste treatment facility	Yuseong-gu, Daejeon	Incineration of Combustible waste generated from the KAERI	KAERI	2011	Combustible waste	20 kg/h

Annex B-6. Radioactive Waste Storage Facilities at Nuclear Fuel Fabrication Facilities

Facility	Location	Purpose	Organization	Operation Year	Capacity [200 liter drum]	Inventory [200 liter drum]
2nd floor of storage building No. 1	Yuseong-gu, Daejeon	Storage of radioactive waste generated in nuclear fuel fabrication facilities	KEPCO NF	1993	3,000	3,601
1st floor of storage building No. 1				2004	1,900	
Storage building No. 2				1998	4,000	5,415
Storage Building ECO				2017	2,900	
Total						9,016

Annex B-7. Radioactive Waste Treatment Systems at KEPCO NF

Facility	Location	Purpose	Organization	Operation Year	Characteristics	
					Throughput	Process
PWR liquid waste treatment system in Plant 1	Yuseong-gu, Daejeon	Liquid waste treatment	KEPCO NF	2015	18 m^3/d	Reduced Pressure Evaporation & Centrifuge
PWR liquid waste treatment system in Plant 2						
PHWR liquid waste treatment system in Plant 2				2013		UltraFiltration
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 Facilities

Facility	Location	Purpose	Organization	Operation Year	Capacity [200L drum]	Inventory [200L drum]
RI waste management facility	Daejeon	RI waste temporary storage	KORAD	1993	9,750	561

Annex B-9. LILW Disposal Facilities

Facility	Location	Purpose	Organization	Operation Year	Capacity [200L Drum]	Inventory [200L Drum]
Radwaste Receipt/Storage Building of LILW Disposal Center	Gyeongju, Gyeongsangbuk-do	Radioactive waste receipt / storage	KORAD	2010	7,000	3,014
Radwaste Building of LILW Disposal Center		RI waste temporary storage		2014	-	269[3]
Silo		Radioactive waste disposal		2015	100,000	19,050

3) In addition to RI waste, other radioactive waste (waste asphalt concretes of 1,496 drums (200 liter drum) is temporarily stored.

Annex C List of Nuclear Facilities under Decommissioning (As of June 30, 2020)

Facility	Location	License	Specification	Year		Status
				Operation	Closure	
KRR-1	Gongneung-dong, Seoul	KAERI	TRIGA Mark-II (250 kWth)	1962	1995	Under decommissioning
KRR-2		KAERI	TRIGA Mark-III (2 MWth)	1972	1995	
Kori Unit 1	Gijang-gun, Busan	KHNP	PWR (587MWe)	1978	2017	Permanent shutdown
Wolsong Unit 1	Gyeongju, Gyeongsangbuk-do	KHNP	PHWR (679MWe)	1983	2019	Permanent shutdown

Annex D Notices of the NSSC Applicable to Radioactive Waste Management

Radioactive Waste

Regulations on the Packing and Transport of Radioactive Materials, etc. (No. 2019-07)

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 NSA.

Siting Criteria for Low- and Intermediate-level Radioactive Waste Disposal Facilities (No. 2019-22)

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 NSA.

Siting Criteria for Interim Storage Facilities of Spent Nuclear Fuel (No. 2017-58)

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 NSA.

Standards for the Structure and Equipment of Low- and Intermediate-level Radioactive Waste Near-Surface Disposal Facilities (No. 2017-59)

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.

General Acceptance Criteria for Low- and Intermediate-Level Radioactive Waste (No. 2020-11)

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. 2017-61)

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

Radiological Protection Criteria for the Long-term Safety on Low- and Intermediate-Level Radioactive Waste Disposal Facilities (No. 2017-62)

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 should 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.

Standard Format and Contents of the Site Characterization Report for Low- and Intermediate-Level Radioactive Waste Disposal Facilities (No. 2017-63)

The regulation defines the matters regarding site characterization 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.

Regulation on the Delivery of Spent Nuclear Fuel (No. 2017-64)

The criteria aim to provide the general requirements for delivering spent fuel as generated from the NPPs to operator of the Away From Reactor(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 Criteria for the Classification and Clearance of Radioactive Wastes (No. 2020-6)

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 NSA.

Criteria for the Incineration of Low- and Intermediate-Level Radioactive Wastes (No. 2017-66)

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 on the Manufactures and Periodic Inspection of Packaging for Radioactive Materials (No. 2017-67)

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 Treatment Facilities (No. 2017-68)

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 Standards for the Operation, etc. of Low- and Intermediate-Level Radioactive Waste Disposal Facilities (No. 2020-12)

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.

Standard Format and Content of the Safety Analysis Report for Low- and Intermediate-Level Radioactive Waste Disposal Facilities (No.2017-70)

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 Inspection of the Disposal of Low- and Intermediate-Level Radioactive Waste (No. 2020-10)

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 NSSC up to one month before in which disposal is to be implemented.

Technical Standards for the Radiation Safety Control, etc. of the Vessel that Transport Low- and Intermediate-Level Radioactive Wastes (No. 2017-72)

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

Detailed Technical Standards for the Structures and Equipment of Interim Storage Facilities of Spent Nuclear Fuel (No. 2015-19)

The regulation purposes to provide technical details for the structure and equipment of interim storage facilities of spent nuclear fuel.

Standard Format and Content of the Safety Analysis Report for Interim Storage Facilities of Spent Nuclear Fuel (No. 2017-73)

This guide purposes to define the matters related to the preparation of safety analysis report for interim storage facilities of spent nuclear fuel. This guideline describes comprehensive items in order to accommodate diverse designs and storage methods of spent nuclear fuel at the interim storage facilities.

General Standards for Deep Geological Repository for High-Level Radioactive Waste (No. 2017-74)

This general standard stipulates general technical requirements for the safety of deep geological repository for high-level radioactive waste for every phase including basic research, site survey, design, construction, operation, shutdown and post-shutdown management.

Radiation

Standards for Radiation Protection, etc. (No. 2019-10)

The purpose of the standards lies in establishing standards related to radiation protection according to the regulations for radiation protection in the NSA. 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 nuclear power utilization facilities.

Reactor facilities

Standard Format and Content of the Radiological Environmental Impact Assessment Report for Nuclear Facilities (No. 2017-16)

The regulation purposes to describe the necessary matters regarding items of report, its preparation method and others related to the composition of the radiation 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 radiation environmental report for public consultation/hearing of residents nearby. This regulation will be applied to the draft radiation environmental report for the NPPs, the LILW disposal facility and spent fuel interim storage facility, and to the radiation environmental report for research reactor with 100kW thermal, and other waste management facilities and Etc.

Regulations on the Radiological Environment Survey and the Radiological Environmental Impact Assessment for Nuclear Facilities (No. 2017-17)

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.

Regulations on Reporting and Public Announcement of Accidents and Incidents for Nuclear Facilities (No. 2020-03)

The regulation purposes to describe the necessary details regarding reporting items, their procedures and impacts assessment on events and accidents of nuclear power utilization facilities. Especially this regulation will be applied for items of events and/or accidents which should be reported to the NSSC and release the related information to the general public during operation of nuclear power utilization facilities.

Standard Format and Content of Discharge Plan for Liquid and Gaseous Radioactive Materials from Nuclear Power Plants and Realted Facilities (No. 2017-04)

This regulation purposes to describe standard format and content of discharge plan for liquid and gaseous radioactive materials from nuclear power plants.

Standard Format and Content of the Decommissioning Plan for Nuclear Facilities (No. 2020-08)

This regulation purposes to describe standard format and content of decommissioning plan for nuclear facilities. This regulation will be applied to nuclear power plants and research reactors and nuclear fuel cycle facilities.

Regulations on the Methods of Verifying and Inspection the Decommissioning Status of Nuclear Facilities (No. 2016-32)

This regulation purposes to describe the confirmation and check-up means for decommissioning status of nuclear facilities. This regulation will be applied to nuclear power plants and research reactors and nuclear fuel cycle facilities.

Standards for the Re-use of Site and Remaining Buildings after the Decommissioning of Nuclear Facilities (No. 2016-33)

This regulation purposes to describe the release criteria of site and remaining building after completion of decommissioning of nuclear facilities. This regulation will be applied to nuclear power plants and research reactors and nuclear fuel cycle facilities.

Annex E Notices of the MOTIE Applicable to Radioactive Waste Management

Regulations on the Calculation Standard for Radioactive Waste Management Expenses and Spent Fuel Management Fee (No. 2019-217)

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

Regulations on the Utilization and Management of Radioactive Waste Management Fund (No. 2018-226)

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

Regulations on Radioactive Waste Receiving Method (No. 2016-230)

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.

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