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INTEGRATED REGULATORY REVIEW SERVICE (IRRS) EXTENDED FOLLOW-UP MISSION TO THE REPUBLIC OF KOREA

Daejeon, Republic of Korea

8 – 19 December 2014

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY

Integrated Regulatory Review Service

IRRS

IAEA Integrated Regulatory Review Service IRRS

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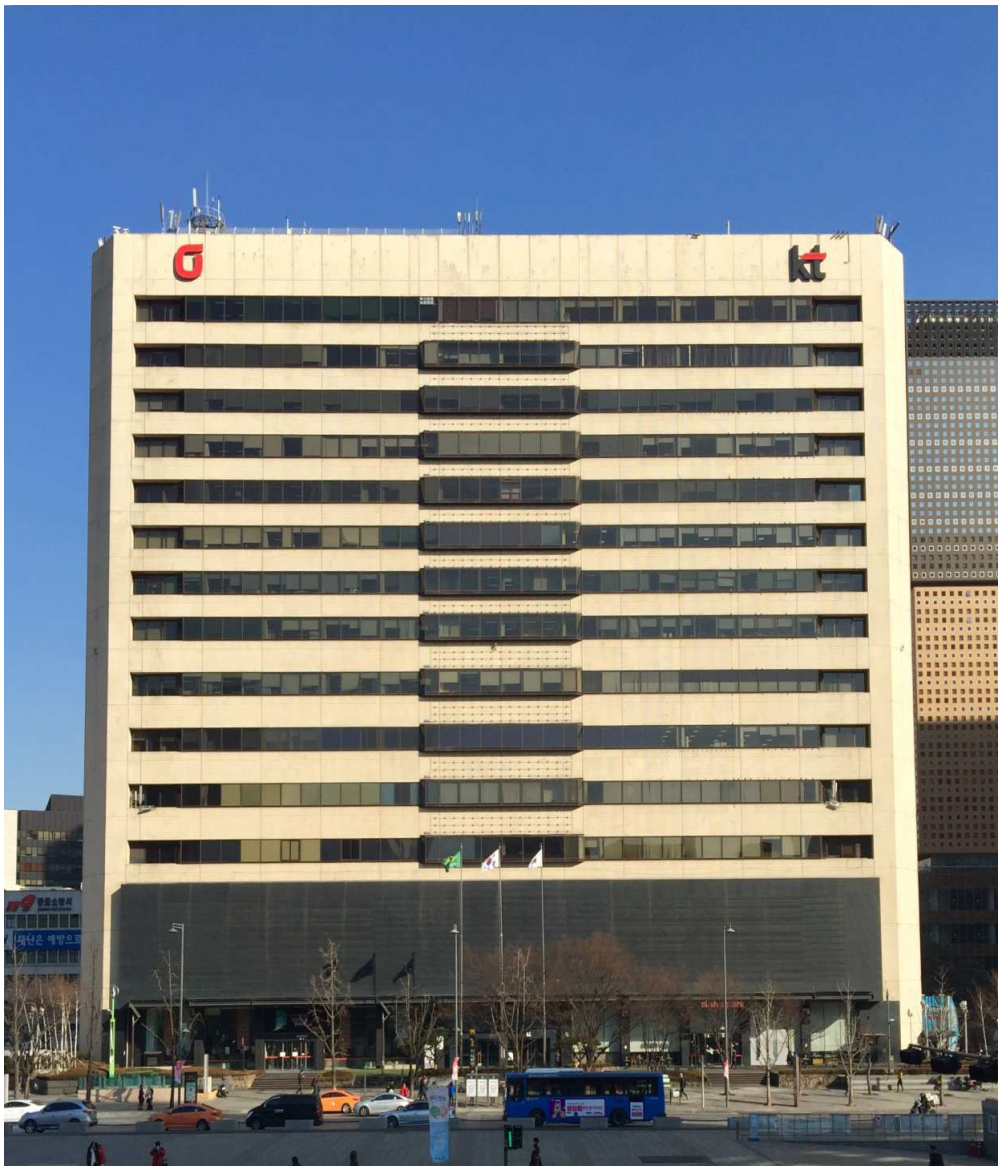
EXTENDED FOLLOW-UP REPORT TO
THE REPUBLIC OF KOREA



Integrated Regulatory Review Service
IAEA | IRRS

INTEGRATED REGULATORY REVIEW SERVICE (IRRS)

EXTENDED FOLLOW-UP REPORT TO

THE REPUBLIC OF KOREA

Mission date:	*8 – 19 December 2014*
Regulatory body:	*NSSC and relevant organizations, including KINS, KINAC, MOHW, and MOE*
Location:	*KINS HQ in Daejeon, REPUBLIC OF KOREA*
Regulated facilities and activities:	*Nuclear power plants, research reactors, fuel cycle facilities, waste management and storage facilities, radiation sources in industrial and medical facilities, emergency preparedness and response, transport, decommissioning, control of medical exposure, occupational exposure control, environmental monitoring, control of discharges and public exposure, interfaces with nuclear security*
Organized by:	*International Atomic Energy Agency (IAEA)*

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The number of recommendations, suggestions and good practices is in no way a measure of the status of the regulatory body. Comparisons of such numbers between IRRS reports from different countries should not be attempted.

Note: There is a discrepancy in the numbering of Suggestions beginning with Suggestion S7 between the initial IRRS mission report and this report, due to a mistake in the initial mission report. Readers should be aware when they compare the two reports.

CONTENTS

EXECUTIVE SUMMARY

At the request of the Government of the Republic of Korea, an international team of senior experts in nuclear and radiation safety met representatives of the Nuclear Safety and Security Commission (NSSC), Ministry of Health and Welfare (MOHW), Ministry of Environment (MOE), Korea Institute of Nuclear Safety (KINS), and Korea Institute of Nuclear Non-proliferation and Control (KINAC) from 8 to 19 December 2014 to conduct the IRRS follow-up mission to the Republic of Korea. The follow-up mission took place mainly at the headquarters of KINS in Daejeon.

The initial mission occurred in July 2011 when an international team of sixteen senior nuclear safety experts met representatives of the Nuclear Regulatory Bureau of the Ministry of Education, Science and Technology (MEST) of the Republic of Korea, together with representatives of KINS, to conduct an Integrated Regulatory Review Service (IRRS) to review the effectiveness of the Korean regulatory framework for nuclear and radiation safety.

The purpose of the follow-up mission was to review the measures undertaken following the recommendations and suggestions of the 2011 IRRS mission. In addition, the follow-up mission was extended to carry out a review of the core regulatory processes applied to fuel cycle facilities, waste management facilities, decommissioning, radiation sources and transport, as well as a review of additional areas, namely, occupational radiation protection, control of medical exposure and radioactive discharges, environmental monitoring, existing exposure situations and interfaces with security. A review of the current status of the counterfeit, fraudulent and suspect items (CFSI) initiative and progress on the post Fukushima Daiichi accident actions were also included in the scope of the follow-up mission.

The review compared the Korean regulatory framework for nuclear and radiation safety against IAEA safety standards as the international benchmark for safety. The mission was also used to exchange information and experience between the IRRS team members and the Korean counterparts in the areas covered by the IRRS.

The IRRS team consisted of sixteen senior regulatory experts from fifteen IAEA Member States, four IAEA staff members and one observer.

The IRRS team carried out a review of the measures undertaken following the recommendations and suggestions of the 2011 IRRS mission in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body related to regulation of nuclear power plants and research reactors, including authorization, review and assessment, inspection, enforcement, the development and content of regulations and guides as well as emergency preparedness and response. The additional areas referred to above were reviewed.

The mission included observations of regulatory activities, interviews and discussions with staff from the NSSC, MOHW, MOE, KINS, and KINAC, and site visits at the Advance Radiation Technology Institute (ARTI)'s irradiation facility of Korea Atomic Energy Research Institute (KAERI), the Korea Electric Power Corporation Korea Nuclear Fuel (KEPCO NF) fuel cycle facility, Korea Radioactive Waste Agency (KORAD) low and intermediate level waste disposal facility, the Konyang University Hospital and the DHI Changwon factory.

Throughout the mission, the IRRS team was extended full cooperation in regulatory, technical, and policy issues by all parties; in particular, the staff of NSSC, KINS and KINAC provided the fullest practicable assistance and demonstrated extensive openness and transparency.

The IRRS team concluded that the recommendations and suggestions from the 2011 IRRS mission have been taken into account systematically by a comprehensive action plan. Significant progress has been made in many areas and many improvements were carried out following the implementation of the action plan.

The team noted that all 2011 suggestions and recommendations referring to MEST are now applicable to NSSC, as it is the independent regulatory body established by Law in October 2011.

During this follow-up mission, the IRRS team determined that 9 out of 10 recommendations and all 12 suggestions made by the 2011 IRRS mission had been effectively addressed and therefore could be considered closed. NSSC and KINS should be commended for this accomplishment.

The IRRS team made the following general observations of progress made by Korea since the 2011 IRRS mission:

- Korea has established an independent and competent regulatory body.
- Korea has systematically and comprehensively addressed the findings of the 2011 IRRS mission and has demonstrated commendable performance in improving the regulatory system for nuclear safety. The Korean government has instituted numerous improvements to enhance public information and involvement in nuclear safety.
- Korea has made considerable progress in the application of lessons learned from the TEPCO Fukushima Daiichi accident and the counterfeit, fraudulent and suspect items event.
- Looking forward, Korea is encouraged to further strengthen its regulatory programme by applying sufficient resources, enhancing inter-governmental coordination and strengthening public involvement while accomplishing a stable, robust and consistent regulatory regime.

The IRRS team identified a number of good practices and made further recommendations and suggestions that indicate where improvements are necessary or desirable to continue enhancing the effectiveness of regulatory functions in line with the IAEA safety standards.

Among the good practices identified by the IRRS team are the following:

- The operation of a real-time Radiation Source Location Tracking System for High Activity Sealed Sources
- The establishment of a comprehensive approach for managing the interface between safety and security.

The IRRS team identified certain issues warranting attention or in need of improvement. This report includes 9 recommendations and 9 suggestions. Key areas for improvement identified during the mission include:

- Establishing the legal basis for the oversight of safety culture and integrated management system for organizations directly responsible for operating facilities and activities and providing services
- Establishing the legal basis for periodic safety reviews for fuel cycle facilities and radioactive waste management facilities
- Requiring integrated safety assessment for fuel cycle facilities, including chemical and industrial hazards
- Improving the radiation safety framework for workers in non-nuclear facilities, patients and the public by better applying the principles of justification and optimization
- Developing and implementing an action plan to address exiting exposure situation, in particular in relation to radon.
- Maintaining consistency of the regulatory framework with the current international safety standards

The findings by the IRRS team of 2011 that remain open can be found in Appendix V.

The new IRRS team findings are summarized in Appendix VI.

At the end of the mission, an IAEA and a NSSC press release were issued and a press conference was organized by the NSSC, KINS and IAEA.

I. INTRODUCTION

In July 2011, at the request of the Government of the Republic of Korea, an international team of sixteen senior nuclear safety experts met representatives of the Nuclear Regulatory Bureau of MEST of the Republic of Korea, together with representatives of KINS, to conduct an IRRS to review the effectiveness of the Korean regulatory framework for nuclear ation safety.

At the request of the Government of the Republic of Korea, an international team of senior experts in nuclear and radiation safety met representatives of NSSC, MOHW, MOE, KINS and KINAC from 8 to 19 December 2014 to conduct the IRRS follow-up mission to the Republic of Korea. The follow-up mission took place mainly at the headquarters of KINS in Daejeon. The purpose of the follow-up mission was to review the measures undertaken following the recommendations and suggestions of the 2011 IRRS mission. In addition, the scope of the follow-up mission was extended to carry out a review of the core regulatory processes applied to all facilities and activites that were not in the scope of the 2011 mission: fuel cycle facilities, waste management facilities, decommissioning, radiation sources, transport, as well as a review of additional areas, namely, occupational radiation protection, control of medical exposure, control of discharges, environmental monitoring, exisiting exposures and interface with security. A review of the current status of the counterfeit, CFSI initiative and progress on the post Fukushima Daiichi accident actions were also included in the scope of the follow-up mission.

A preparatory meeting for the follow-up mission was conducted 8 to 10 July 2014 at KINS Headquarters in Deajeon to discuss the purpose, objectives, scope and detailed preparations for the follow-up mission in conjunction with the results of the 2011 IRRS mission and the extended scope referred to above.

The IRRS team consisted of sixteen senior regulatory experts from fifteen IAEA Member States, four IAEA staff members and one observer.

The IRRS team carried out a review of the measures undertaken following the recommendations and suggestions of the 2011 IRRS mission in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body related to regulation of nuclear power plants and research reactors, including authorization, review and assessment, inspection, enforcement, and the development and content of regulations and guides. The areas included in the extended scope referred above were reviewed according to the IRRS Guidelines.

The IRRS follow-up mission also included policy discussions on stakeholder involvment and on roles and functions of regulating bodies in building nuclear safety regulation policy.

The NSSC conducted a self-assessment in preparation for the follow-up mission and prepared a preliminary action plan for the extended scope. The results of the self-assessment and supporting documentation were provided to the IRRS Team as advance reference material (ARM) for the follow-up mission. During the follow-up mission the IRRS team performed a systematic review of all topics by reviewing the ARM, conducting interviews with management and staff from NSSC, MOHW, MOE, KINS, KINAC and performed direct observation of NSSC and KINS working practices during inspection at ARTI's irradiation facility of KAERI, the KEPCO NF fuel cycle facility, the Wolsong low and intermediate level waste disposal facility, the Konyang University Hospital and the DHI Changwon factory. A meeting with Executive Vice President, Plant Engineering Division from Korea Hydro & Nuclear Power Co., LTD (KHNP) was also organized. All through the follow-up mission the IRRS team received excellent support and cooperation from NSSC, KINS and other organizations.

II. OBJECTIVE AND SCOPE

The purpose of the follow-up mission was to review the national regulatory framework for nuclear and radiation safety in the Republic of Korea, including the measures undertaken following the recommendations and suggestions of the 2011 IRRS mission. In addition, the scope of the follow-up mission was extended to include all areas not included in the scope of the 2011 IRRS mission. The scope of the IRRS follow-up mission addressed all facilities and activities regulated by the NSSC, including nuclear power plants, research reactors, fuel cycle facilities, waste management facilities, radiation sources facilities and activities, as well as transport of radioactive material. The scope of the follow-up mission also included the following additional areas: occupational radiation protection, control of medical exposure, control of discharges, environmental monitoring, existing exposures and interfaces with security. The review was carried out by comparison of existing arrangements against the IAEA safety standards.

It is expected that the IRRS follow-up mission will facilitate regulatory improvements in the Republic of Korea and other Member States from the knowledge gained and experiences shared by the NSSC, KINS and IRRS reviewers and through the evaluation of the effectiveness of the Republic of Korea regulatory framework for nuclear and radiation safety and through the identification of its good practices.

The key objectives of the follow-up mission were to enhance the regulatory framework for nuclear and radiation safety, as well as emergency preparedness and response:

- Providing the Republic of Korea, NSSC, KINS, and KINAC through completion of the IRRS questionnaire, with an opportunity for self-assessment of its activities against IAEA safety standards;
- Providing the Republic of Korea, NSSC, KINS, and KINAC with a review of its regulatory programme and policy issues relating to nuclear and radiation safety, and emergency preparedness and response;
- Providing the Republic of Korea, NSSC, KINS, and KINAC with an objective evaluation of its nuclear and radiation safety, as well as emergency preparedness and response regulatory activities with respect to IAEA safety standards;
- Contributing to the harmonization of regulatory approaches among IAEA Member States;
- Promoting the sharing of experience and exchange of lessons learned;
- Providing reviewers from IAEA Member States and the IAEA staff with opportunities to broaden their experience and knowledge of their own fields;
- Providing NSSC and KINS staff with an opportunity to discuss their practices with reviewers who have experience with different practices in the same field;
- Providing the Republic of Korea, NSSC, KINS, and KINAC with recommendations and suggestions for improvement; and
- Providing other States with information regarding good practices identified in the course of the review.

III. BASIS FOR REVIEW

A) Preparatory work and IAEA Review Team

At the request of the Government of the Republic of Korea, a preparatory meeting for the Integrated Regulatory Review Service (IRRS) follow-up mission was conducted from 8 to 10 July 2014. The preparatory meeting was carried out by the appointed Team Leader Mr Georg Schwartz, Deputy Team Leader Mr Michael Weber and the IAEA representatives, Team Coordinator Mr Tim Kobetz and Deputy Team Coordinator Mr Hilaire Mansoux.

The IRRS follow-up mission preparatory team had discussions regarding the progress made by NSSC in addressing measures undertaken following the recommendations and suggestions of the 2011 IRRS mission, the relevant regulatory programmes for additional areas for review that were not addressed in 2011 and the self-assessment work preliminary results. The NSSC and KINS teams were led by senior management, represented by Mr Baek Min, Director General of NSSC and Mr Kim Moohwan, President of KINS and included other senior management and staff of both organizations. The discussions resulted in agreement that the following areas of its regulatory programme were to be reviewed by the IRRS follow-up mission:

- Follow up of IRRS findings from the 2011 mission;
- Module 5-9 new review covering:
  - Fuel cycle facilities;
  - Waste management facilities;
  - Decommissioning;
  - Radiation sources facilities and activities (including the code of conduct on the safety and security of radioactive sources);
  - Transport or radioactive materials.
- Module 11 new review covering:
  - Occupational radiation protection;
  - Control of medical exposure;
  - Control of radioactive discharges and materials for clearance;
  - Environmental Monitoring;
  - Existing Exposure and Radon.
- Module 12 new review covering interfaces with nuclear security;
- Progress on the implementation of the post Fukushima Daiichi accident national action plan reviewed in the 2011 IRRS mission and review of progress on the 12 conclusions of the 2011 IRRS mission was discussed.
- Selected policy issues.

NSSC, KINS, and KINAC representatives made presentations on the major regulatory changes in nuclear and radiation safety since 2011, as well as progress made in implementing recommendations and suggestions of the 2011 IRRS mission and the preliminary results of the self-assessment for the additional review areas listed above.

IAEA staff presented the IRRS principles, process and methodology. This was followed by a discussion on the work plan for the implementation of the IRRS follow-up mission in the Republic of Korea in December 2014.

The proposed IRRS Team composition and size was tentatively confirmed. Logistics including meeting and work space, counterparts and liaison officer identification, proposed site visits, lodging and transportation arrangements were also addressed.

The liaison officer for the preparatory meeting and for the IRRS follow-up mission was confirmed as Mr Baek Min from NSSC and Mr Cho Kunwoo from KINS.

The liaison officers provided the IAEA (and the IRRS team) with the advance reference material (ARM) for the review in October-November 2014, including the self-assessment results. In preparation for the follow-up mission, the IAEA follow-up team members conducted a review of the ARM and provided their initial review comments to the IAEA Team Coordinator prior to the commencement of the IRRS follow-up mission.

B) Reference for the review

The most relevant IAEA safety standards and the Code of Conduct on the Safety and Security of Radioactive Sources were used as review criteria. A more complete list of IAEA publications used as the reference for the follow-up mission is given in Appendix VIII**.**

C) Conduct of the review

The initial IRRS team meeting was conducted on Sunday, 7 December 2014, in Daejeon by the IRRS team leader and the IRRS IAEA team coordinator to discuss the general overview, the focus areas and specific issues of the mission, to clarify the basis for the review and the background, context and objectives of the IRRS follow-up mission and to agree on the methodology for the review and the evaluation among all reviewers. They also presented the agenda for the mission.

The liaison officers were present at the initial IRRS Team meeting, in accordance with the IRRS guidelines, and presented logistical arrangements planned for the mission.

The reviewers also reported their first impressions of the ARM.

The IRRS entrance meeting was held on Monday, 8 December 2014, with the participation of NSSC, KINS and KINAC senior management and staff. Opening remarks were made by Mr Lee Unchul, Chairman of NSSC, Mr Kim Moohwan, President of KINS, and the IRRS Team Leader. Mr Baek Min from NSSC gave an overview of the major regulatory changes in nuclear safety since 2011, and Mr Cho Kunwoo from KINS presented a status of the progress made regarding previous IRRS findings.

During the follow-up mission, a review was conducted for all the review areas with the objective of providing the Republic of Korea, NSSC and KINS with recommendations and suggestions for improvement as well as identifying good practices. The review was conducted through meetings, interviews and discussions, visits to facilities and direct observations regarding the national practices and activities.

The IRRS Team performed its activities based on the mission programme given in Appendix III.

The IRRS exit meeting was held on Friday 19 December 2014. The opening remarks at the exit meeting were presented by Mr Kim Yonghwan, Secretary General of NSSC, and were followed by the presentation of the results of the follow-up mission by the IRRS Team Leader, Mr Georg Schwarz. Closing remarks were made by Mr Denis Flory, Deputy Director General, Head of IAEA Department of Nuclear Safety and Security.

A press conference was organized at the end of the follow-up mission by the NSSC, KINS and IAEA.

An IAEA and a NSSC press release were issued at the end of the follow-up mission.

1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT

1.1. NATIONAL POLICY AND STRATEGY

New observations from the follow-up mission

The initial IRRS mission reported that MEST in 2010 published the first comprehensive plan for nuclear safety in the Republic of Korea covering the period from 2010 to 2014. The follow-up mission was informed that the new Nuclear Safety Act (NSA) provides a stronger legal basis for this plan. Articles 3 and 4 of the NSA require the NSSC to establish a comprehensive plan for nuclear safety regulation every five years. The NSSC has published a new plan for the period from 2012 to 2016 in response to this requirement. After the inauguration of a new administration in February 2013, the government introduced a national initiative in the area of public safety entitled "Strengthening the Nuclear Safety Management System", aimed at increasing public confidence with nuclear safety. Elements of this initiative have been integrated into the annual plans that support the implementation of the 5-year comprehensive plan.

Korea is currently revisiting its policy for spent fuel management and in 2013 a Public Engagement Commission on Spent Nuclear Fuel Management (PECOS) was established. PECOS is expected to present its recommendations in mid-2015, and based on these the Government will decide on possible changes to the policy for spent fuel management.

1.2. ESTABLISHMENT OF A FRAMEWORK FOR SAFETY

New observations from the follow-up mission

Since the initial IRRS mission, the government has introduced or has planned a number of changes to the legal framework for safety. The principal changes relate to the establishment of the NSSC as the independent regulatory body; to stronger powers of oversight and enforcement over licensees and their suppliers in response to the experience with counterfeit and fraudulent parts; to improvements in emergency management; and to the introduction of requirements for decommissioning.

The Acts and Decrees issued or amended, since the initial mission, include the following:

- Act on the Establishment and Operation of the NSSC (AEON).
- Nuclear Safety Act (NSA). This new Act is derived from the former Atomic Energy Act and sets out safety management requirements for the construction and operation of nuclear and radiation facilities, and the production, sale and use of nuclear materials. The NSA was amended on 21 May 2014 to include countermeasures against corrupt actions, including a requirement for applicants and licensees to report to NSSC all contracts they make with suppliers for design, manufacture and testing of safety-related items for nuclear facilities.
- Enforcement Decree of the Nuclear Safety Act, and Enforcement Regulation of the Nuclear Safety Act. The decree was amended in 2013 and 2014 to enable the NSSC to inspect licensees' suppliers, and to provide increased monetary penalties for violations, as well as amending the scope of Periodic Safety Review in accordance with latest IAEA safety guide.
- Act on Physical Protection and Radiological Emergency. The Act prescribes physical protection system of nuclear materials and nuclear and radiological emergency management systems.
- Act on Protective Action Guidelines against Radiation in the Natural Environment. The Act, enacted on 26 July 2012, provides legal basis to protect the people from unnecessary radiation exposure in their daily life.
- Act on the Management of Disasters and Safety. The Act was amended to provide legal basis to require emergency preparedness plans for research reactors.

Draft legislation on the following topics is in the process of consideration by legislative committees prior to submittal to the National Assembly:

- Decommissioning, amendment of the NSA to include additional requirements for submitting decommissioning plans;
- Amendment of the Act on the Persons Performing the Duties of the Judicial Police Officers and the Scope of Their Duties to establish judicial police powers for the NSSC to carry out civil and criminal investigations of violations;
- Amendment of the NSA of the requirements to submit an Accident Management Plan, including Severe Accident Management Plan.

1.3. ESTABLISHMENT OF A REGULATORY BODY

New observations from the follow-up mission

The initial IRRS mission reported that the Government of Korea planned to introduce new legislation to establish an independent Nuclear Safety Commission reporting to the President of the Republic of Korea. The follow-up IRRS mission was informed that the National Assembly has passed the enabling legislation, i.e. the AEON and the NSA. The NSSC was established on October 26, 2011, taking over responsibility for regulation of nuclear safety, security and non-proliferation in the state.

The NSSC on its inception reported to the President of the Republic of Korea. This reporting relationship changed after the inauguration of the new national administration in 2013, when amendments to the relevant laws placed the NSSC under the Prime Minister. The follow-up mission was informed that these changes in reporting line had no effect on the responsibilities or functions of the NSSC.

1.4. INDEPENDENCE OF THE REGULATORY BODY

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S1	**Suggestion**: In order to ensure the effectiveness, of the new Nuclear Safety Commission the selection criteria for the members should reflect the need of independence and nuclear safety competence within the Commission.

Changes since the initial IRRS mission

Suggestion 1:

The AEON declares "independence" to be an operating principle of NSSC. Article 3 of the AEON exempts the actions of the NSSC with regard to safety from the power of the Prime Minister to suspend or cancel decisions of governmental agencies. The Chair of NSSC attends coordination meetings with the Prime Minister and representatives of other ministries but does not receive directions from the Prime Minister with regard to safety matters.

The AEON contains selection and exclusion criteria for the members of NSSC. Article 5 of the AEON requires that "*Commissioners shall be appointed or recommended from among those people with superior insight and experiences in the fields and of various fields, such as nuclear energy, environment, health and medicine, science and* technology, *public safety, law, liberal arts, and sociology, to contribute to nuclear safety*." and therefore ensures the needed nuclear safety competence. Articles 9 and 10 set out requirements that disqualify persons from acting as Commissioners who belong to a political party or who have been involved with nuclear energy users groups within the previous three years. Article 14 requires the exclusion of Commissioners from matters in which they may have a personal conflict of interest.

The above observations confirm the independence of the NSSC and the competence of the members.

Status of the findings in the initial missions

Suggestion 1 is closed based on the fact that the relevant legislation contains requirements protecting the independence of the NSSC and sets out criteria for the competence of and the selection and exclusion of members of the Commission.

1.5. PRIME RESPONSIBILITY FOR SAFETY

There were no findings in this area in the initial IRRS mission.

1.6. COMPLIANCE WITH SAFETY REGULATIONS

There were no findings in this area in the initial IRRS mission.

1.7. COORDINATION OF DIFFERENT AUTHORITIES WITH RESPONSIBILITIES FOR SAFETY WITHIN THE REGULATORY FRAMEWORK

There were no findings in this area in the initial IRRS mission.

New observations from the follow-up mission

Many government ministries and agencies in the Republic of Korea in addition to the NSSC perform functions related to nuclear and radiation safety, including the Ministry of National Defence, Ministry of Land Infrastructure and Transport, Ministry of Health and Welfare, Ministry of Environment, Korea Customs Service, Ministry of Food and Drug Safety, Ministry of Science ICT and Future Planning, Ministry of Trade Industry and Energy, and Ministry of Agriculture Food and Rural Affairs.

Several mechanisms exist for policy coordination among the involved governmental bodies. Cabinet meetings led by the President of the Republic of Korea enable policy coordination at the highest levels. In addition, the Office of Legislation oversees all legislation activities of the Korean Government and coordinates the relevant government agencies during the legislation process. For example, while the Ministry of Environment is in overall charge of environmental protection policies, the Framework Act on Environmental Policy stipulates that environmental contamination caused by radioactive material shall be covered by the relevant provisions of the NSA.

The Comprehensive Plan on Nuclear Safety required by the NSA provides a further means to align the activities of different Ministries. In addition, NSPD had been created by Prime Ministerial Order in June 2014. Presided by the Chair of NSSC, the NSPD has the aim of enhancing coordination among 22 central governmental entities with responsibilities for nuclear and radiation safety.

Roles and functions of the regulatory body in building nuclear safety regulations policy were selected by NSSC and KINS for the policy issue discussions in this mission. The discussion covered the initiatives including the NSPD taken to strengthen the coordination of different authorities with responsibilities for safety.

Nevertheless, the follow-up IRRS mission team has observed several instances where coordination between ministries and agencies in different technical areas can be further improved. The team's observations include:

- The need for exchanges of experience between NSSC, the Korean Radiation Safety Foundation and the Korean Customs Service related to the licensing of import and export of sealed sources;
- The need to control both radiation hazards and non-radiation (e.g. chemical) hazards that coexist in some nuclear facilities to prevent impacts on nuclear safety and to protect workers and the public;
- The potential for overlaps between the NSSC and the MOHW in regulation of medical exposures;
- The need for efficient coordination between the NSSC and the Ministry of Land, Infrastructure and Transport regarding transport of radioactive material in the framework of transport of dangerous goods;
- The need for coordination between NSSC and MOHW on the issue of national dose registers.

More information on the above observations is contained in the relevant chapters of this report.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	Many government ministries and agencies in Korea have responsibilities related to nuclear and radiation safety. Several mechanisms exist to coordinate the activities of these governmental bodies. Nevertheless, the team observed several areas where coordination between the involved ministries and agencies can be further improved.
(1)	**BASIS: GSR Part 1 Requirement 7 states that** *"Where several authorities have responsibilities for safety within the regulatory framework for safety, the government shall make provision for the effective coordination of their regulatory functions, to avoid any omissions or undue duplication and to avoid conflicting requirements being placed on authorized parties."*
(2)	**BASIS: NSR-R-5 (Rev.1) paragraph 3.3 states that:** *"Safety, health and environment related regulatory requirements are influenced by industrial, chemical and toxic hazards in addition to the radiological hazards. The government shall ensure cooperation with and between the relevant authorities where nuclear, environmental, industrial safety and occupational health aspects are separately regulated.*
(3)	**BASIS: CoC, paragraph 20 states that** *"Every State should ensure that the regulatory body established by it legislation has the authority to:* *[...]* *(m) liaise and co-ordinate with other governmental bodies and with relevant non-governmental bodies in all areas relating to the safety and security of radioactive sources."*
(4)	**BASIS: TS-G-1.5, paragraph 2.7 states that** *"More than one organization may be responsible for the regulatory control of the transport of radioactive material in a State ...* *Where there are several responsible authorities, they should cooperate closely and there should be legal or formal agreements between them covering the responsibilities of each authority...."*
SF1	**Suggestion: The Government and NSSC should consider further strengthening the coordination of and liaison between the various authorities involved in nuclear and radiation safety.**

1.8. COMPETENCE FOR SAFETY

There were no findings in this area in the initial IRRS mission.

1.9. PROVISION FOR THE DECOMMISSIONING OF FACILITIES AND THE MANAGEMENT OF RADIOACTIVE WASTE AND SPENT FUEL

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R1	**Recommendation**: The regulatory framework should require decommissioning plans for nuclear installations to be constructed and operated. These plans should be updated periodically

Changes since the initial IRRS mission

Recommendation 1:

The operation of the Wolsong 1 NPP has been suspended since November 2012 when its design lifetime ended.

The continued operation of Kori 1 NPP will end in 2017. No decision has been taken yet regarding the continued operation of either unit.

In order to be prepared for the decommissioning of NPPs the Korean Government decided to implement measures to improve the regulatory framework for the decommissioning of nuclear facilities. The topic is addressed in the Comprehensive Plan for Nuclear Safety for the years 2012 to 2016.

A revision of the Nuclear Safety Act reflecting Recommendation 1 is in the final stages of review by legislative committees in the national assembly and is expected to be enacted by early 2015. The draft reviewed by the team includes new requirements to:

- Submit a decommissioning plan as part of the application for construction licence for nuclear power plants, research reactors, and fuel cycle facilities;
- Submit a decommissioning plan as part of the application for operation licence for nuclear power plants;
- Periodically update the decommissioning plans of nuclear power plants, research reactors, and fuel cycle facilities.

The revision of supporting regulations and technical guidelines is said to be scheduled to start in early 2015 and to be complete by 2017. There is, however, no existing or planned legal instrument for requiring licensees to undertake decommissioning works.

Considering the facts that financing of decommissioning is guaranteed by an accumulating reserve fund stipulated in the Radioactive Waste Management Act and all operators of nuclear facilities in Korea are owned by the State, the follow-up IRRS team concluded that the current situation is acceptable and that the planned measures will provide an adequate legal framework and enforcement powers of the regulatory body with regard to decommissioning.

Status of the findings in the initial missions

Recommendation 1 is closed on the basis of progress made and confidence in effective completion. The draft revision of the Nuclear Safety Act presented to the IRRS mission adequately reflects the intent of the recommendation and will be approved in a timely manner.

1.10. PROVISION OF TECHNICAL SERVICES

There were no findings in this area in the initial IRRS mission.

2. GLOBAL NUCLEAR SAFETY REGIME

2.1. INTERNATIONAL OBLIGATIONS AND ARRANGEMENTS FOR COOPERATION

There were no findings in this area in the initial IRRS mission.

2.2. OPERATING EXPERIENCE FEEDBACK

There were no findings in this area in the initial IRRS mission.

3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY

3.1. ORGANIZATIONAL STRUCTURE OF THE REGULATORY BODY AND ALLOCATION OF RESOURCES

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R2	**Recommendation:** The Government of Korea should continue the process of clearly defining the responsibilities within the new regulatory body and avoid overlaps between the Secretariat, KINS and the Advisory Committee. Resources and staff should be allocated commensurate with those responsibilities.

Changes since the initial IRRS mission

Recommendation 2:

The responsibilities of NSSC, KINS and KINAC are set out in the relevant laws and enforcement decrees which establish these entities. NSSC is legally empowered by the provisions of the AEON and the NSA to carry out the functions and responsibilities of the regulatory body, including the issuance of regulations and guides, authorisation of facilities and activities, and inspection and enforcement. The IRRS follow-up team formed the view that the NSSC is fully assuming its roles and responsibilities. The NSSC organisation comprises the Commission which is supported by the Advisory Committee (see section 3.4 of this report) and the Secretariat. The Secretariat is led by the Secretary General and consists of four main divisions, namely the Planning and Coordination Office, the Audit and Inspection Office, the Nuclear Regulatory Bureau, the Radiation Emergency Bureau. The NSSC has also established four regional offices, one near each nuclear power plant sites.

As in the former regulatory system, NSSC delegates many technical and regulatory functions to KINS and to KINAC in their capacities as entrusted technical support organisations. The role of the latter organisations remains relatively unchanged. The IRRS team understands that KINS and KINAC are fully part of the regulatory body.

The IRRS follow-up mission was informed that both the NSSC secretariat and KINS have experienced a significant increase in workload due to growth in the number of licensed facilities and activities in Korea as well as increased efforts for public engagement to enhance trust in the regulatory system. Both organisations have recently hired additional staff. The NSSC secretariat has increased its headcount from 49 in the former organisation (MEST) to 141 staff currently. KINS has increased its staff from 424(‘11) to 443(’14).

Status of the findings in the initial missions

Recommendation 2 is closed based on the definitions of the roles and responsibilities of NSSC and KINS contained in the relevant laws and enforcement decrees which establish these entities, as well as the actions taken regarding the level of resources**.**

New observations from the follow-up mission

The growth of licensed activities is projected to continue in future, including an increase in the number of operating NPPs, the development of waste management facilities, and increased uses of radiation sources. KINS and NSSC are acting to strengthen inspection and enforcement of licensees and their suppliers in response to recent events involving CFSI. These factors, together with ongoing efforts for public engagement, will necessitate further increases in resources allocated to the regulatory body and the associated organisations commensurate with their increasing responsibilities. NSSC, KINS and KINAC have identified targets for long-term manpower levels. The continued support of the government is needed to implement these targeted resource levels in the future.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation	The projected future growth in various parts of the nuclear sector in Korea together with measures to strengthen inspection and enforcement in response to CFSI events and ongoing efforts for public engagement will necessitate future increases in the resources allocated to the regulatory organisations to enable them to fulfil their responsibilities.
(1)	**BASIS: Requirement 3 of GSR Part 1 states that** "*The government, through the legal system, shall establish and maintain a regulatory body, and shall confer on it the legal authority and provide it with the competence and the resources necessary to fulfil its statutory obligation for the regulatory control of facilities and activities".*
(2)	**BASIS: Requirement 18 of GSR Part 1 states that** "*The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities."*
SF2	**Suggestion: The Government should consider future allocation of human resources to the regulatory body commensurate with the nature and number of facilities and activities to enable the fulfilment of necessary regulatory functions and responsibilities.**

3.2. EFFECTIVE INDEPENDENCE DURING CONDUCT OF REGULATORY ACTIVITIES

There were no findings in this area in the initial IRRS mission.

3.3. STAFFING AND COMPETENCE OF THE REGULATORY BODY

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S2	**Suggestion:** The new Nuclear Safety Commission should prepare human resources plans for the Secretariat that provides appropriate staff to enable the accomplishment of its administrative function in support of the Commission without undue burden.

Changes since the initial IRRS mission

Suggestion 2:

The IRRS follow-up mission learned that the NSSC secretariat has developed a human resources plan, has received budget increases from the government and has significantly increased its staff to enable the accomplishment of its administrative functions in support of the Commission.

Status of the findings in the initial missions

Suggestion 2 is closed based on the actions taken to provide additional human resources for NSSC. The Suggestion SF2 above has been raised regarding the future resource needs of the regulatory body.

3.4. LIAISON WITH ADVISORY BODIES AND SUPPORT ORGANIZATIONS

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S3	**Suggestion:** The new Nuclear Safety Commission should establish an advisory committee, with similar capabilities as the existing Nuclear Safety Committee to support the decision-making process.

Changes since the initial IRRS mission

Suggestion 3:

The follow-up IRRS mission was informed that the NSSC has formed a Nuclear Safety Advisory Committee, in accordance with Article 15 of the AEON, consisting of 15 experts in various fields to advise on major licensing decisions, safety issues arising from licensing reviews or inspections of nuclear facilities, and the establishment of emergency measures in case of an accident. The NSSC may also form ad-hoc committees. Since the inception of the NSSC, several ad-hoc committees were formed to discuss various issues.

Status of the findings in the initial missions

Suggestion 3 is closed based on the provisions made in the relevant legislation and NSSC's establishment and operation of an expert Nuclear Safety Advisory Committee to provide advice on safety matters**.**

3.5. LIAISON BETWEEN THE REGULATORY BODY AND AUTHORIZED PARTIES

There were no findings in this area in the initial IRRS mission.

3.6. STABILITY AND CONSISTENCY OF REGULATORY CONTROL

There were no findings in this area in the initial IRRS mission.

New observations from the follow-up mission

The follow-up IRRS mission found that the new arrangements put in place in 2011 have strengthened the independence and the legal powers of the regulatory body and that the regulatory system is functioning to the satisfaction of NSSC and KINS. The IRRS mission was nevertheless informed that the new arrangements result in a slowdown of regulatory processes. In the example of Wolsong 1, the operating licence renewal has been pending since 2009.

3.7. SAFETY RELATED RECORDS

There were no findings in this area in the initial IRRS mission.

New observations from the follow-up mission

As part of the extended scope of the follow-up mission, the team reviewed KINS arrangements for tracking sealed sources. Since 2006 KINS has operated Radiation Source Location Tracking System (RADLOT)**,** a system that allows for online tracking of Cat I and Cat II sealed sources. The system is in operation for 850 mobile, high-activity sealed sources used in industrial radiography. The system allows KINS to see at each moment the precise location of each of the sources within Korea and displays the track on screen when it is transported. From 2016 a new version will become operational that will have the capability to track more sources in an optimized system. Korea remains the only country to have a real-time online tracking system.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	KINS operates a system for GPS tracking of mobile, high-activity sealed sources. This makes it possible to trace the location online and intervene quickly in case a source is lost. The GPS network registers presently 850 devices, but will be expanded to 1400 devices from 2016 on. All Cat I and Cat II mobile sources used in industrial radiography are tracked at present.
(1)	**BASIS: GSR Part 1 Requirement 35 states that** "*The regulatory body shall make*

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	provision for establishing, maintaining and retrieving adequate records relating to the safety of facilities and activities." 4.63. "*The regulatory body shall make provision for establishing and maintaining the following main registers and inventories:* *—Registers of sealed radioactive sources and radiation generators*"
(2)	**BASIS: CoC Article 11 states that** *"Every state should establish a national register of radioactive sources."*
GPF1	**Good Practice: The operation of the real-time Radiation Source Location Tracking System (RADLOT) for High Activity Sealed Sources in NDT applications contributes to a high level of safety.**

3.8. COMMUNICATION AND CONSULTATION WITH INTERESTED PARTIES

There were no findings in this area in the initial IRRS mission.

New observations from the follow-up mission

Several recent events, including the accident at Fukushima Daiichi, the CFSI events, and the cover-up of the station blackout at Kori 1, have eroded public trust in government in general, and in regulatory oversight of the nuclear industry in particular. "Stakeholder involvement" was selected as a topic by NSSC and KINS for a policy issue discussion in the follow-up mission, in order to share with the team the additional initiatives taken since 2011 to rebuilt public trust by informing and engaging the public and other stakeholders in the regulation of nuclear and radiation safety.

NSSC presented the main elements of its policy and programme for openness, transparency and stakeholder engagement. Among the major initiatives are:

- Public participation in legislation and policy development;
- Access to information through the provisions of the Official Information Disclosure Act;
- Public access to meetings of the NSSC and published meeting transcripts;
- System for reporting information on facility safety, accidents and malfunctions;
- Appointment of a nuclear safety ombudsman;
- Establishment of six regional nuclear safety councils with local civic involvement.

The most recent initiative is the involvement of civic groups comprising local residents, experts and NGOs in reviews of NPP safety issues such as steam generator welding and head penetration tube defects. NSSC's objective in these actions is to ensure its decisions are transparent and understood by the public. In response to questions from the IRRS follow-up team, NSSC explained that recent surveys of public trust show some progress.

The IRRS team members shared their views based on their own experience on the importance of facilitating through various interactions understanding by the public of the distinct roles and responsibilities of the operator and the regulator regarding nuclear and radiation safety. The IRRS follow-up team was informed that KHNP regards public acceptance as the responsibility of the operator. To this end, KHNP maintains information centres at its NPP sites. The information centres are reportedly frequented by visitors. The team also supported actions by NSSC and

KINS to directly involve stakeholders and the media and to allocate appropriate resources to continuously inform them on the activities and decisions of the regulatory body.
With regard to formal requirements for public information, the Nuclear Safety Act (Article 103) gives a requirement for applicants for nuclear facility licences to make a draft radiation environment assessment report available to the public and to hold public hearings if there is a demand from local residents. An NSSC Notice defines requirements for reporting and public announcement by licensees of accidents and incidents that occur in facilities and activities.

4. MANAGEMENT SYSTEM OF THE REGULATORY BODY

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R3	**Recommendation:** The Korean government should provide for development of a Management System, to cover all activities of the new Nuclear Safety Commission and its Secretariat. This Management System should be in place, at least the main parts of it, as soon as the new organization takes over responsibility.
R4	**Recommendation:** KINS should develop a process on Resource Management in order to achieve a fully integrated Management System.
S4	**Suggestion:** KINS should revise its Management System Manual to include an overall description of the basic processes, how they relate to each other as well as a description of all types of documentation used within the Management System.
S5	**Suggestion:** The new Nuclear Safety Commission and KINS should describe in their Management System Manuals what means they plan to use in order to ensure a common understanding of safety culture, to support individual and groups to carry out work in a safe way, to reinforce a learning and questioning attitude, and to continually develop and improve the safety culture.
S6	**Suggestion:** The new Nuclear Safety Commission and KINS should supplement their Management Systems with a process or procedure for managing organizational change in order to ensure that regulatory efficiency and effectiveness are not compromised.

Changes since the initial IRRS mission

Recommendation 3:

After NSSC was established in October 2011, the development of its Management System continued on the basis of work done by the former NRB. A draft revision 2 of the Management System Manual of NSSC was issued in December 2011. However, the incidents at NPPs in the country drew attention and resources from addressing internal development actions, and the development of the Integrated Management System (IMS) delayed. It restarted last year and a fully revised Integrated Management System manual was approved in early December 2014.

The new IMS Manual covers all activities and functions of NSSC. The recommendations of the initial IRRS mission were taken into account in the development of the IMS. IAEA GS-R-3 and related guidance were used as a reference material in the work. The new IMS of NSSC complies with GS-R-3 requirements.

NSSC personnel and managers of all levels were involved in the development of the IMS. Those who participated in this gained familiarity with the new Management System and it was considered that no additional training is needed for those people. However, the number of staff at NSSC has increased significantly during recent years. The IRRS Mission team confirmed that all newcomers get some induction training in the requirements of the IMS. In addition, NSSC has plans to address IMS in a more explicit way in the initial training of inspector officers.

Recommendation 4:

KINS started the revision of its Management System straight after the IRRS Mission in 2011 A series of self-assessments were organized in KINS. In addition, independent reviews were carried out in order to gather additional ideas for improvement. An independent team analysed gaps between the existing KINS Management System and IAEA GS-R-3. In addition to the IRRS recommendations and suggestions, 25 supplementary items were identified by the self-assessments and independent assessments. Eleven of these 25 items were identified as

recommendations and 14 as suggestions. On the basis of all these an improvement plan was developed. KINS also completed benchmarking against other regulatory bodies' practices when developing the new system.

The new Integrated Management System Manual was published in November 2014. The structure of the Manual follows the structure of GS-R-3 and all requirements have been taken into account.

The IRRS Mission 2011 gave a recommendation to develop a process for resource management to attain fully Integrated Management System. The process for resource management was included in the new Manual. Also three sub-processes for resource management were introduced: management of human resources, management of financial recourses and management of knowledge. Flowcharts and detailed guidance for most of the processes are included in the MIDAS information system.

The team acknowledges the improvement of the IMS of KINS.

Suggestion 4:

As one part of developing its improvement plan for its Management System KINS sought knowledge and experiences from regulatory bodies in other countries on how the entire processes could be described in the management system manual and how different types of illustration and process maps could be used for best effect. When the new Integrated Management System Manual was published in November 2014, it included an overall description of the processes as well as the interrelation between processes.

In the IMS Manual revision KINS also added more detailed description of the documentation related to the IMS. Appendices of IMS Manual provide lists of processes in different levels.

Suggestion 5:

Following the suggestion given in the initial IRRS mission, KINS together with NSSC set up a project on enhancing safety culture within the regulatory body. The ultimate goals of this enhancement project are to have in addition to a common understanding of safety culture also to have common safety culture within KINS and NSSC.

KINS in fact started the development and assessment of its own safety culture in 2002. The assessment has been repeated four times, the latest being in 2012. NSSC has not yet carried out such a series of assessments, but according to its plans a safety culture assessment will take place next year.

In 2013, the project defined what actions have to be taken to comply with GS-R-3 requirements on safety culture. In 2014 the implementation of safety culture related changes in the IMS were accomplished in both organizations. In 2015 training and assessments will be organized and during 2016 a plan for further actions will be produced. From 2017 all new practices should be fully implemented and safety culture improvement plans and related training plan should be then carried out on annual basis in both organizations.

In addition to what is done in the Safety Culture project, safety culture characteristics and related attributes have been discussed within KINS at all levels of the organization. KINS provides initial and advanced training on safety culture for its own staff as well as for NSSC employees.

At this stage KINS and NSSC continue to focus their efforts on improving internal safety culture.

Suggestion 6:

The initial IRRS mission suggested to KINS and NSSC that both organizations supplement their Management Systems with a description of managing organizational changes. Since then both organizations have been in continual change and a systematic approach to manage these changes was of importance.

As a part of the development of their IMS both organizations have developed a process for organizational change. NSSC has process 5.3.2.4 Change Management of Organization which describes the actions needed and the roles of different parties at all levels of the organizations. This process reflects management of organizational changes in Korean governmental organizations and the main requirements for the process are specified in the administrative legislation of Korea. KINS's IMS includes a process 5.3.2.3 Organizational Management. KINS has had more freedom than NSSC in drafting its process for organizational changes.

Both organizations collect expectations from interested parties and improvement ideas from staff as a part of the organizational change process. Both organizations have included consideration of benefits and risks to regulatory effectiveness and efficiency within processes and possible safety impacts are also considered. In addition, to enhance continuous improvement, an annual evaluation of the effectiveness and functionality of the organization has been included in the processes.

Status of the findings in the initial missions

Recommendation 3 is closed on the basis that NSSC has completed its IMS in compliance with the requirements of GS-R-3.

Recommendation 4 is closed on the basis that KINS has included a process for resources management in its IMS, in compliance with the requirements of GS-R-3.

Suggestion 4 is closed on the basis that KINS has carried out a comprehensive updating of its IMS.

Suggestion 5 is closed on the basis of progress made and confidence in effective completion of initiatives taken to enhance safety culture within the regulatory body.

Suggestion 6 is closed on the basis that NSSC and KINS have included processes for managing organisational changes within their respective management systems.

There are no new observations from the follow up mission.

5. AUTHORIZATION

5.1 AUTHORIZATION OF NUCLEAR POWER PLANTS

5.1.1 LEGAL BASIS

There were no findings in this area in the initial IRRS mission.

5.1.2. TYPES OF AUTHORIZATIONS AND REQUIREMENTS OF AUTHORIZATION

There were no findings in this area in the initial IRRS mission.

5.1.3. REGULATORY CONTROL FOR AUTHORIZATION

There were no findings in this area in the initial IRRS mission.

5.1.4. CONDITIONS AND LIMITATIONS OF AUTHORIZATION

There were no findings in this area in the initial IRRS mission.

5.1.5. LICENSE AMENDMENTS AND RENEWAL

There were no findings in this area in the initial IRRS mission.

5.1.6. TERMINATION OF LICENSE

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R5	**Recommendation:** The Regulatory body should initiate the extension of the legal basis of the licensing process in order to ensure that: 1. in case of the submittal of a report on a license amendment in minor matters, whenever the reported change has safety significance the licensee is required to submit a safety assessment on the possible consequences of the modifications, 2. in case of the submittal of a report on a license amendment in minor matters, whenever the reported change has safety significance the licensee shall not commence to realize the modification prior to the answer to its notification from the regulatory body.
R6	**Recommendation:** The Regulatory body should initiate the process to modify the Atomic Energy Act in order to eliminate the option of replacing a suspension of the licensed activity by financial penalty when the safety violation would rightly call for suspension of the activity.

Changes since the initial IRRS mission

Recommendation 5:

In a modification of the Enforcement Regulation of the Nuclear Safety Act the definition of minor matters has been modified so that changes in safety-related equipment or facility may not be classified as minor.

Any modification related to safety shall be processed according to the same authorization rules and procedures, i.e. any safety related modification shall require submission of a safety assessment and shall need an answer from the regulatory body. Thus, the issue raised by the recommendation has been resolved.

Recommendation 6:

NSSC reported in the ARM on changes in the Nuclear Safety Act resulting in the 100 times increase of the upper limit of the penalty surcharge in case of violation that could otherwise lead to suspension of license or activity.

Further, the replacement of a licensed activity suspension by penalty is no longer possible in the case of criminal acts, etc.

On the other hand, in discussions among the IRRS team and the host representatives, the latter stated that, in accordance with the NSA, the safety measures necessary to meet the standards for the permit are taken separately from penalties and are not replaced by the penalties. However, the possibility of replacing a suspension of the licensed activity by a financial penalty still exists when Article 17 is interpreted literally. An action is required to eliminate the option of replacing a suspension of the licensed activity by financial penalty when the safety violation would rightly call for suspension of the activity.

Status of the findings in the initial mission

Recommendation 5 is closed as the authorization process of minor modifications with safety implications was satisfactorily regulated.

Recommendation 6 remains open as no essential change was implemented in the relevant legislation.

5.2. AUTHORIZATION OF RESEARCH REACTORS

5.2.1. GRADED APPLICATION TO RESEARCH REACTORS

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R7	**Recommendation:** The Regulatory body should initiate a change in the regulations in order to: 1. require a Quality Assurance Plan to be submitted when licensing a research reactor of any size. The requirements on the plan shall reflect the safety importance of the facility to be constructed in line with the graded approach, 2. require emergency preparedness organization and emergency preparedness plans for research reactors of any size. The organization and plan shall follow graded approach and shall be commensurate with the threat posed by the facility.

Changes since the initial IRRS mission

Recommendation 7:

After a recent modification of the NSA, preparation of quality assurance plans for research reactors are explicitly requested.

In a recent amendment of the Framework Act on the Management of Disasters and Safety it is required that institutions having a role in nuclear and radiation emergency preparedness and response prepare Field Action Manuals on the activities to be performed in case of an emergency. The Manuals shall be prepared following a standard manual elaborated by NSSC. This regulation also concerns research reactors of any size.

Both parts of the recommendations have been complied with by recent changes in the regulations.

Status of the findings in the initial mission

Recommendation 7 is closed as the changes in the regulation requested by the Recommendation have been implemented.

5.3. AUTHORIZATION OF FUEL CYCLE FACILITIES

An applicant for a fuel cycle facility must submit an application for a permit, together with licensing basis documentation, to the NSSC for review. The Nuclear Safety Act (NSA) provides requirements for a refinery, fuel fabrication and conversion facility, and a fuel processing facility that are similar. However, differences exist that are reflective and commensurate with the radiation risk of the facility. These differences are reflected in the NSA and its supporting Enforcement Decree and Enforcement Regulation.

Fuel cycle facilities are exempted from some of the requirements for NPPs. The most important such exemption is the licensing procedure in which construction and operating licenses are granted in a single step. Renewal of a licence to construct and operate a Fuel Cycle Facility does not occur. The single step licensing procedure is supported by an inspection process that enables KINS and NSSC staff to inspect and verify facility construction and commissioning before the operator is permitted to operate the facility. This is discussed further in section 7.

Once a licence has been granted, any changes to systems, structures and components relevant to safety require prior approval from the NSSC. Licensees are required to describe the proposed changes, revise associated licence basis documentation and submit the documentation for review and assessment before the changes are permitted.

Applications for authorization of a new fuel cycle facility, or for authorization of a change, are submitted to the NSSC. The NSSC forwards the application to KINS for technical review. KINS reviews the application for completeness and prepares a review plan in accordance with their 'Procedure for Review for Nuclear Fuel Cycle Facilities". The review plan and a possible request for supplementing the application with further data and information are sent to the applicant. Upon completion of the review, a review report is sent to the NSSC for decision and posted on the KINS external website to inform both the applicant and the public of the results of the review.

An applicant for a construction permit or an operating licence for a fuel cycle facility is required to submit a quality assurance program to the NSSC with its application. However, contrary to the IAEA safety requirements, the quality assurance (QA) programme standards lack some features of management systems that are important to safety including, but not limited to, safety culture and a program of continual improvement. This is discussed in section 9.1 of this report.

An integrated assessment of safety that includes an assessment of chemical hazards and industrial hazards on nuclear safety systems is not conducted and a safety analysis report (SAR) is not required as part of a licence application for a Fuel Cycle Facility. In addition, certain elements of safety analysis are missing and other elements, such as fire hazard analysis and criticality assessment, are contained in multiple licensing basis documents.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	An integrated assessment of safety that includes an assessment of chemical hazards and industrial hazards on nuclear safety systems is not conducted and a safety analysis report (SAR) is not required as part of a licence application for a Fuel Cycle Facility.
(1)	**BASIS: NSR-R-5 (Rev.1) p 2.2 states that:** "*…In the context of fuel cycle facilities, the control of events initiated by chemical hazards can have a significant bearing on achieving the fundamental safety objective. Events initiated by chemical hazards shall be considered in the design, commissioning and operation of the facility. Activities at fuel cycle facilities may also include industrial processes that pose additional hazards to site personnel and the environment...*"
(2)	**BASIS: NS-R-5 (Rev.1) p 2.10 states that** *"The content of the licensing documentation for a facility may vary between States but at least the safety analysis report and the operational limits and conditions or equivalent shall be included."*
(3)	**BASIS: NSR-R-5 (Rev.1) p 2.11 states that:** *"The safety analysis report shall contain an analysis of the hazards associated with the operation of the facility and shall demonstrate compliance with the regulatory requirements and criteria. It shall also*

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	contain safety analyses of accident sequences and of the safety features incorporated in the design for preventing accidents or minimizing the likelihood of their occurrence and for mitigating their consequences."
RF1	**Recommendation: The Government and NSSC should develop the legal basis for the requirement of an integrated safety assessment for fuel cycle facilities, that includes chemical and industrial hazards and require a safety analysis report (SAR) as part of a licence application.**

5.4. AUTHORIZATION OF RADIOACTIVE WASTE MANAGEMENT FACILITIES

Korea has authorized several facilities for the management of low and intermediate level waste, for example an incinerator, a centralized storage for radioisotope waste and a disposal facility (Wolsong LILW Disposal Center, WLDC). The WLDC receives waste from the nuclear reactors and radioisotope use in hospitals, industry, research institutions, and from nuclear fuel cycle facilities. The construction of the disposal part of WLDC was completed in 2014, and all tests needed for taking the facility into operation have been completed. KINS has carried out the required pre-operation inspections and NSSC approved the commencement of disposal operations on December 12, 2014.

According to the Nuclear Safety Act there is only one authorization for construction, operation and closure. When the operator wishes to move from one stage to another (such as construction, operation and closure), the approval from the NSSC is required. The multi-stage approval process is largely based on the experience with WLDC, and NSSC and KINS intend that this process will also be used for other radioactive waste management facilities. The review team supports clarification of this process in the appropriate regulations. This approach is similar to the practice in many other countries and in line with IAEA Safety Standards.

Korea is currently revisiting its national policy and strategy for spent fuel management through the launch of the PECOS in 2013. The purpose of the public engagement is to define a consent-based national plan on spent fuel management. PECOS will present its recommendations in mid-2015, and based on these the Government will decide on possible changes to the policy for spent fuel management.

Korea is revisiting the spent fuel management policy and it should be noted that NSSC and KINS, as well as research institutions such as KAERI and the radioactive waste management organization KORAD, are carrying out investigations and research on spent fuel management, including geological disposal.

Currently all spent fuel is stored at the sites of the NPPs. To expand the storage capacity at the plants, re-racking and transhipment to neighbouring plants is utilized as a short-term solution until a revised spent fuel management policy is decided. The storage capacity will be sufficient for several more years but there is a need to further expand the storage capacity. Considering the time needed for siting, design, licensing and construction of storage facilities (on-site or centralized) it is necessary to start this process as soon as possible.

5.5. AUTHORIZATION OF RADIATION SOURCES, FACILITIES AND ACTIVITIES

Most authorizations concerning radiation sources are granted by the NSSC with the support of KINS. For medical imaging, authorizations are granted by MOHW. As part of a graded approach, authorization includes permits, notifications or exemptions. The number of licensees has increased significantly over the recent years and it has become more difficult for NSSC and KINS to regulate this increased number of users. Consequently KINS has increased staff of its department responsible for radiation sources in 2014. It is important that Korea continues attributing sufficient numbers of staff to NSSC and KINS. This is reflected by suggestion 2 in section 3.1.

The IRRS team has also discussed with the counterpart examples how a justification process may help to reduce unnecessary use of radiation sources and its replacement by alternative technologies. The issue of justification is further discussed in section 6.4.

The NSA establishes licensing requirements for each authorization. The Enforcement Decree of NSA and the NSSC notices prescribe detailed technical standards for licensing.

Operators have the possibility to submit a license application online. Applicants register in the Radiation Safety Information System, hereinafter referred to as "RASIS". The applicant may check the review process online and receive the notification of the result. Licensees have to report each quarter regarding nuclides, amount of radiation, and serial number of sources, name and contact of Radiation Safety Officer (RSO) by using the RASIS. The team received evidence that RASIS lists each source in its database according to the IAEA categorization. It is nevertheless noted that the categorization has not yet been put in the legislation. The respective NSSC notice is presently under review and is expected to be enforced in the first half of 2015.

Korea is among the countries that made a commitment with regard to the Code of Conduct on the Safety and Security of Radioactive Sources and the Supplementary Guidance on the Import and Export of Radioactive Sources. Each application for import or export of a sealed radioactive source is managed by NSSC through RASIS. Since the granting of the license for import and export of sealed sources is a stepwise process involving NSSC, the Korean Radiation Safety Foundation and the Korean Customs Service, the management of the application is done since 2002 electronically between the 3 administrations. Although, direct contacts may be done on a case-by-case basis, no regular platform for exchanges between the responsible personnel of 3 involved administrations has yet been established. KINS has recently taken the initiative to update RASIS. Suggestion 1 in section 1.7 refers in this context also more generally to the cooperation of authorities in case of interacting sectors.

The team also investigated whether the management of orphan sources is done by people that fulfil the necessary legal requirements for managing radiation sources. The team pointed out that radiation risks, including the risk of contamination, could be a major issue in this area. The operation of detector gates is regulated. These operators have the responsibility for notifying radiation alerts to NSSC or KINS and for managing the orphan sources. The operator also needs to secure the material, but could delegate the associated operations to licensed agencies entitled to do this work. In many cases the licensed agencies themselves hold the necessary permit. NSSC guidance on the management of radiation monitoring systems in airports, ports, and scrap metal recycling facilities give additional advice to operators.

5.6. AUTHORIZATION OF DECOMMISSIONING ACTIVITIES

Currently the Nuclear Safety Act only requires operators of NPPs, research reactors and nuclear fuel cycle facilities to submit decommissioning plans when they wish to decommission their facilities. There are no requirements for other types of facilities. The deficiency regarding decommissioning was identified as an important issue during the IRRS mission in 2011 and a recommendation in this regard was provided in recommendation 1 (see the review in section 1.9 of this report). As in many other countries, decommissioning activities are conducted under the operating license but regulatory approval is needed for commencing the activities.

5.7 AUTHORIZATION OF TRANSPORT

NSSC authorizes design of special form radioactive material, design and shipment of packages of Types B(U), B(M), C and packages for fissile material, design of packages to contain more than 0.1 kg of uranium hexafluoride, and shipment under special arrangement. Requirements, application documents and procedures for authorization are described in NSA and associated decrees and notices. No provisions for authorization of low dispersible material (LDM) have been established so far, since LDM has not been of interest in Korea. However it is planned to include authorization for LDM during revision of the regulations for taking into account SSR-6 although all relevant approvals according to the IAEA Regulations for the Safe Transport of Radioactive Material are already covered adequately.

All changes to an approved design or action other than changes to name or address of the approval holder must be approved by the authority before implementation. Validity of approvals is extended based on a review of results of periodical inspections, testing of randomly selected packages and review of defects and accidents. Multilateral approval of foreign package designs is done based on the foreign certificate without further review.

However, the transport of radioactive material, regulated by NSSC, is embedded in the more general area of transport of dangerous goods, regulated by the Ministry of Land, Infrastructure and Transport. The definition of the responsibilities of these organizations as well as effective communication between them is essential, e.g. in the areas of inspection during transport, training of drivers and contribution to international agreements. Discussion with the counterpart led to the conclusion that cooperation between the mentioned authorities is not performed in a consistent manner. To improve communication between authorities the Nuclear Safety Policy Dialogue has been established. Nevertheless it is concluded, that further improvement should be sought, see Suggestion 1 in Section 1.7.

5.8 SUMMARY

The initial IRRS mission made three recommendations on the authorization process. Due to actions taken by the regulatory body since 2011 the safety implications of minor modifications are now satisfactorily regulated, and the changes in the regulation requiring development of quality assurance plans and emergency preparedness organization and emergency plans for research reactors have been implemented. The only remaining issue is a legal possibility to replace a suspension of the licensed activity by financial penalty in the case of safety violation and therefore the corresponding recommendation is open.

In the follow-up IRRS mission, several new areas were covered, namely the authorization of fuel cycle facilities, radioactive waste management facilities, radiation source applications, decommissioning activities and transport of radioactive material. In the majority of cases, the regulatory authorization process in these new areas was found to be satisfactory. The follow-up IRRS mission made one new recommendation to require integrated safety assessment for fuel cycle facilities including the assessment of chemical and industrial hazards.

6. REVIEW AND ASSESSMENT

6.1 REVIEW AND ASSESSMENT OF NUCLEAR POWER PLANTS AND RESEARCH REACTORS

6.1.1 ORGANIZATIONAL ASPECTS OF THE REVIEW AND ASSESSMENT PROCESS

There were no findings in this area in the initial IRRS mission.

6.1.2 REFERENCE DOCUMENTS FOR REVIEW AND ASSESSMENT AND UTILIZATION OF LESSONS LEARNED

There were no findings in this area in the initial IRRS mission.

6.1.3 COMMUNICATION WITH THE LICENSEE IN THE AREA OF REVIEW AND ASSESSMENT

There were no findings in this area in the initial IRRS mission.

6.1.4 UPDATING OF REGULATIONS RELATED TO REVIEW AND ASSESSMENT

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S7	**Suggestion**: The regulatory body should initiate updating the Enforcement Regulation in order to extend the scope of the Safety Analysis report so that design extension conditions and PSA are adequately covered.

Changes since the initial IRRS mission

Suggestion 7:

Since the 2011 IRRS Mission, NSSC and KINS have taken actions to reflect design extension conditions (DEC) and PSA into the regulatory requirements so that they will be subject to nuclear safety legislation. Relevant legislative documents, namely the Nuclear Safety Act and the Enforcement Rules of the Nuclear Safety Act have been drafted so that they impose consideration of design extension conditions including severe accidents in relevant licensing steps (construction permit, operation permit, standard design approval, periodic safety review). Obligations imposed by the updated Nuclear Safety Act apply also for existing NPPs with the deadline for implementation within 3 years from the enforcement date of the Act. Updated legislative requirements include incorporation of matters of design extension conditions and probabilistic safety assessment into a new chapter 19 of the SAR, as well as development and validation of severe accident management guidelines. Further on, Regulations on Technical Standards for Nuclear Reactor Facilities require designing the NPP so that large radioactive releases are eliminated, functionality of equipment needed for coping with design extension conditions is ensured and compliance with design extension requirements is demonstrated by comprehensive assessment. Regulations on Technical Standards for Nuclear Reactor Facilities also empower the NSSC to determine details of acceptance criteria for design extension conditions. The draft regulatory requirements are in advanced stage of review so that their adoption is expected in the near future.

The efforts to revise the Enforcement regulation of the National Security Act are underway to include design extension conditions and PSA in the SAR following the IRRS Review Team's suggestion, and the draft on the revision has already been developed. NSSC and KINS aim to complete the revision work in the near future.

Status of the findings in the initial missions

Suggestion 7 is closed on the basis of progress made and confidence in effective completion. Draft updates of the legislative acts presented to the IRRS mission adequately reflect the intent of the suggestion, provided that they will be approved in the proposed scope and in a reasonable time frame. It is however important that the details of acceptance criteria to be determined by the Commission will comply with recently updated IAEA Safety Requirements for design, operation and safety assessment.

6.1.5 PROVISIONS FOR INDEPENDENT SAFETY ASSESSMENT BY THE LICENSEE

There were no findings in this area in the initial IRRS mission.

6.1.6 USE OF COMPUTER CODES AND BEST PRACTICE FOR SAFETY ANALYSIS BY THE LICENSEE

There were no findings in this area in the initial IRRS mission.

6.1.7 ENSURING CONSISTENCY OF REVIEW AND ASSESSMENT FOR VARIOUS DOCUMENTS

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S8	**Suggestion**: The regulatory body should consider harmonization of approaches used for determination of radiological consequences in Safety Analysis Report and Radiological Environmental Report.

Changes since the initial IRRS mission

Suggestion 8:

Since the 2011 IRRS Mission, ways to harmonize the different evaluation methodologies in the Safety Analysis Report (SAR) and Radiological Environmental Report (RER) were examined by the KINS. Even though the regulator is aware of the possibility of confusing the public caused by the difference in methodologies leading to different results in radiological consequences for the same accidents, the regulator prefers to maintain the current two-track approach which serves each purpose of the SAR and RER. The basis for this approach is worries about possible impact of a sudden change in regulatory practices on behaviour of the licensees and eventually on safety of nuclear installations. Apart from this position further studies will continue about SAR's evaluation of accident offsite doses in a cautious manner.

Since the 2011 IRRS Mission, there were regulatory activities aimed at enhancing the importance of the RER in the licensing process by strengthening the acceptance criteria for radiological environmental evaluation of design basis accidents (as further described in the review of Suggestion 9), which could be afterwards considered as demonstration of acceptable radiological consequences following design basis accidents in a reasonably conservative way. KINS stated that after finalization of ongoing studies and acquiring sufficient experience during a transition period with two-track assessment of radiological consequences with strengthened acceptance criteria in the RER, a change in approach can be reconsidered.

Status of the findings in the initial mission

Suggestion 8 is closed on the basis of progress made and confidence in effective completion. Provided that the criteria for radiological consequences in the Radiological Environment Report will be strengthened as intended, there is no risk of weakening of nuclear safety requirements and very conservative analysis included in the SAR can be considered as an additional confirmation of the plant safety. Nevertheless, the possibility of confusing the public due to two different methodologies leading to different results remains open and NSSC is encouraged after a certain transition period to reconsider the current two-track approach.

6.1.8 RADIOLOGICAL ACCEPTANCE CRITERIA

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S9	**Suggestion**: In connection with licensing of new reactors the regulatory body should consider harmonization of licensing acceptance criteria and off-site intervention levels for design basis accidents and establish criteria for design extension conditions.

Changes since the initial IRRS mission

Suggestion 9:

As already stated in the assessment of changes since the 2011 IRRS mission for Suggestion 7, the issue of acceptance criteria for design extension conditions is being addressed in the updated Regulations on Technical Standards for Nuclear Reactor Facilities, which empower the NSSC to determine details of acceptance criteria for design extension conditions and the final solutions for this issues is expected in the near future.

The basis for the remaining part of the suggestion is the high value of the radiological acceptance criterion (250 mSv in 2 hours) for design basis accidents used in the SAR. Such value does not correspond to the IAEA Safety Requirements for design (SSR-2/1) stating in para. 5.25. *"The design shall be such that for design basis accident conditions… they have no, or only minor, radiological impacts, on or off the site, and do not necessitate any off-site intervention measures."*

Since the 2011 IRRS Mission, NSSC decided to address the issue by a draft Notification of the NSSC, with the objective to strengthen the acceptance criteria for radiological environmental evaluation of design basis accidents in the RER. The draft Notification was presented to the follow-up mission. The Notification has been already discussed and approved by the Standard Review Committee, but still with values of the radiological acceptance criteria likely exceeding levels for off-site intervention measures. The proposed methodology in comparison with assumptions used in the SAR includes consideration of a reasonably conservative source term for design basis accidents.

Based on the discussion during the follow-up IRRS mission the counterpart agreed to reconsider the limitation of radiological consequences for design basis accidents so that to avoid doses which would necessitate emergency intervention measures beyond the exclusion area boundary. In parallel with application of the strengthened criteria for radiological consequences in the RER, the KINS prefers to continue with traditional very conservative assessment of doses in the SAR. Nevertheless, due to intended harmonization of effective doses with the emergency intervention levels in the RER, which is submitted together with the SAR in all relevant licensing submissions, the intent of the IAEA Safety Requirements for design aimed at avoiding the need of off-site intervention measures for any design basis accident will be met.

The KINS will accelerate investigating the effects of more realistic approach on determination of radiological consequences in the SAR through a five-year study which started in 2013.

Status of the findings in the initial mission

Suggestion 9 is closed on the basis of progress made and confidence in effective completion. In Korean regulatory framework, submission of the SAR is in all relevant licensing steps associated with RER, which is being strengthened in order to ensure compliance with the IAEA Safety Requirements for the design. The conclusion on closing the suggestion remains valid if the final wording of the Notification will ensure no need for emergency countermeasures for any design basis accident demonstrated in the RER in a reasonably conservative way.

6.1.9 REGULATORY APPROACH TO MANAGEMENT OF SEVERE ACCIDENTS

There were no findings in this area in the initial IRRS mission.

6.1.10 CAPABILITY FOR INDEPENDENT REGULATORY AUDIT CALCULATIONS

There were no findings in this area in the initial IRRS mission.

6.1.11 INTERRELATION BETWEEN REVIEW AND ASSESSMENT AND INSPECTIONS

There were no findings in this area in the initial IRRS mission.

6.1.12 PERIODIC SAFETY REVIEWS

There were no findings in this area in the initial IRRS mission.

6.1.13 AGEING MANAGEMENT

There were no findings in this area in the initial IRRS mission.

6.1.14 CONTINUED OPERATION

There were no findings in this area in the initial IRRS mission.

6.2 REVIEW AND ASSESSMENT OF FUEL CYCLE FACILITIES

Reviews and assessments for fuel cycle facilities are completed on licensing basis documents to support an initial authorization, revised licensing basis documents are submitted to support a request for change, and a decommissioning plan to support an application to decommission a fuel cycle facility.

Licensing basis documents are reviewed and assessed by KINS staff. Technical criteria on nuclear fuel cycle facilities are specified in the Regulation on Technical Standards for Nuclear Reactor Facilities, etc. KINS staff review the application and its licensing basis documentation against these criteria. The standard format and content of licensing basis documentation is also provided in NSSC Notices. For example, the RER would follow guidance provided in NSSC Notice 2013-3 entitled "Standard Format and Content of Radiological Environmental Report for Nuclear Power Utilization Facilities". The results of technical reviews and assessments for major projects are published on the KINS external website.

Fuel cycle facilities have the potential to release chemicals to the environment. Moreover, the chemical toxicity of uranium in its natural form may exceed its risk from a radiation perspective. The principal of ALARA is applied to releases of uranium from nuclear facilities in Korea. Therefore, the risks of uranium exposure as a chemical toxicant or as a nuclear substance are likely very low. Nevertheless, an assessment of the chemical risks posed by releases from a processing facility is important to ensure that the workers, public and environment are protected.

Fuel cycle facilities use, possess and manage chemicals, such as anhydrous hydrofluoric acid, that must be controlled in a manner to protect workers and the safety systems of the facility. In addition, industrial hazards such as high pressure and fire may also pose a risk to workers and the safety systems of the facility. Chemical hazards and industrial hazards may be reviewed and assessed by other regulatory bodies in terms of their potential to affect systems, structures and components important to nuclear safety. However, this assessment and review is not integrated with the NSSC regulatory review for nuclear safety.

The Nuclear Safety Act does not mandate NSSC to examine industrial and chemical hazards to workers and a fuel processing facility. Nor does the Nuclear Safety Act provide a mandate for the NSSC to examine the potential risks posed by chemicals, including the chemical nature of uranium, to ensure public and environmental protection. These issues are further discussed in section 1.7 of this report.

Review and assessment and inspections are interrelated activities that are important for effectiveness and consistency of the regulatory role. This is a particularly important interrelation for fuel cycle facilities because the initial licensing authorization provides a permit for construction and operation of the facility.

Integration between inspection and review/assessment functions is facilitated by the fact that KINS staff involved in review/assessment become, after adequate working experience (2 years) and passing required examination, empowered to perform regulatory inspections.

This integration would be strengthened if licensing basis documentation were updated by the licensee at periodic intervals and submitted to the NSSC for review and assessment. This would also ensure that the licensee is periodically assessing their facility and comparing the performance of their facility to modern standards. This can be achieved by the implementation of a periodic safety review within which the documents that require periodic review are selected based on a graded approach that is appropriate for fuel cycle facilities.

There is no legal basis for conducting a periodic safety review (PSR) of a fuel cycle facility. A recommendation on this topic is provided as RF2 below.

6.3 REVIEW AND ASSESSMENT OF RADIOACTIVE WASTE MANAGEMENT FACILITES

The Nuclear Safety Act requires PSR only for reactor facilities. PSR is however applied to the WLDC according to NSSC Notice No. 2013-35. PSR is not implemented for other radioactive waste management facilities (for example the incineration facility). The IAEA Safety Standards emphasize the importance of PSR for all types of facilities. KINS and NSSC are planning to develop requirements for PSR for all radioactive waste management facilities, taking the graded approach into account. It is expected that this work will be completed in 2017.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	Periodic Safety Review (PSR) is required for reactor facilities and the LILW storage and disposal facility (WLDC) but it is not required nor implemented for other radioactive waste management facilities and fuel cycle facilities. PSR would ensure that licensing basis documents for these facilities are up to date and facility performance is evaluated against modern standards.
(1)	**BASIS: NS-R-5 Safety of Nuclear Fuel Cycle Facilities, paragraph 3.10 states that:** *The regulatory body shall ensure that the operating organization has made adequate arrangements for keeping the licensing documentation up to date throughout the lifetime of the facility so as to reflect the current status of the experience and knowledge gained of the facility and in accordance with the regulatory requirements.*
(2)	**BASIS: GSR Part 1 Requirement 25 states that** *"The regulatory body shall review and assess relevant information — whether submitted by the authorized party or the vendor, compiled by the regulatory body, or obtained from elsewhere — to determine whether facilities and activities comply with regulatory requirements and the conditions specified in the authorization. This review and assessment of information shall be performed prior to authorization and again over the lifetime of the facility or the duration of the activity, as specified in regulations promulgated by the regulatory body or in the authorization."*
(3)	**BASIS: GSR Part 4 para. 5.10 states that** *"The safety assessment has to be periodically reviewed and updated at predefined intervals in accordance with regulatory requirements."*
(4)	**BASIS: GSR Part 5 Requirement 16 states that** "*The operator shall carry out periodic safety reviews and shall implement any safety upgrades required by the regulatory body following this review. The results of the periodic safety review shall be reflected in the updated version of the safety case for the facility."*
(5)	**BASIS: SSR-5 para. 6.2 states that** *"Periodic safety assessment for a disposal facility has to be aimed at providing an overall assessment of the status of protection and safety at the facility. It has to include an analysis of the operational experience acquired and possible improvements that could be made, with account taken of the existing situation*

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	and of whatever new technological developments or changes in regulatory control there might be. Periodic safety assessments cannot replace the activities for analysis, control and surveillance that are continuously carried out at disposal facilities."
RF2	**Recommendation: The Government should establish the legal basis for periodic safety review for fuel cycle facilities and all radioactive waste management facilities.**

6.4 REVIEW AND ASSESSMENT OF RADIATION SOURCES FACILITES AND ACTIVITIES

The team reviewed the notices that define the content of the two main reports that need to be submitted with an application for a permit. One of these, the safety report, contains the aspects related to radiological safety as requested by the IAEA requirements, including issues such as a utilization plan or a quality assurance plan.

The team discussed issues concerning optimization. Licensees of a large-scale business or an institution utilizing unsealed sources provide a policy on how to achieve radiation exposures that are ALARA. However, the concept of using dose constraints has not yet been included in the regulatory framework for these facilities and activities. The counterpart however recognizes the value of dose constraints as a valuable tool for optimizing radiation protection. The suggestion SF4 addresses this issue in the section 11.1.

The team also addressed the finding that the justification of practices using radiation, before they are introduced into routine use, is not included into the legislation. A justification process shall demonstrate economic, social or other benefits in relation to the health detriment they may cause. Depending on the type of practice under consideration, this justification process can be complex and may involve consideration of a wide range of societal and economic factors, in addition to the potential dose detriment. The justification may involve several stakeholders.

The same radiation protection principle is also not applied in relation to consumer products, such as smoke detectors. No mechanism is in place for the justification of the intended use of the consumer products, as well as to allow checking that this use can be exempted from regulatory control.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	The regulations in place do not provide for the justification of practices for radiation sources before they are introduced into routine use. Further, there is no requirement in place that providers of consumer products shall ensure that their products are not made available to the public unless their use by members of the public has been justified.
(1)	**BASIS: GSR part 3, Requirement 10 states that** *"Justification of practices. The government or the regulatory body shall ensure that only justified practices are authorized."*
(2)	**BASIS: GSR part 3, para 3.63 states that** *"The regulatory body, in cooperation with other relevant authorities, agencies and professional bodies, as appropriate, shall establish the requirements for regulatory control of the practice and for review of the justification."*
(3)	**BASIS: GSR part 3, Requirement 33 states that** *"Consumer products. Providers of consumer products shall ensure that consumer products are not made available to the public unless their use by members of the public has been justified, and either their use has been exempted or their provision to the public has been authorized."*
RF3	**Recommendation: The NSSC should ensure that arrangements are put in place for the justification of any type of practice involving radiation sources to be included in the review and assessment programme to ensure that only justified practices are**

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	authorized.

6.5 REVIEW AND ASSESSMENT OF DECOMMISSIONING ACTIVITIES

The Nuclear Safety Act currently does not contain comprehensive and detailed requirements on decommissioning (see section 1.9 of this report). However, there is limited detailed guidance prepared by KINS. There are for example safety review guides for research reactors and nuclear fuel cycle facilities. These guides were developed to facilitate the decommissioning of the Uranium Conversion Facility (UCF) and the research reactors KRR 1 and 2.

6.6 REVIEW AND ASSESSMENT OF TRANSPORT

Assessment of compliance with the regulations is done for design of packages and special form material, for certain shipments and shipment under special arrangement. All assessment is done by KINS. KINS has a pool of experts for all relevant fields (mechanics/materials, heat, dose rates, and criticality). The experts are selected on the basis of qualification and experience and trained according to a training plan including training classes in KINS and training abroad.

Plans for testing of packages are reviewed and approved by KINS experts, testing may be (and often is) witnessed by KINS experts. For large packages testing is done at the KAERI facility. Internal guidance for review of package design is present. There is no guidance available to designers of packages on how to show compliance with the regulations. To compensate, NSSC/KINS is considering propagating a PDSR guide currently under review by IAEA.

6.7 SUMMARY

Review and assessment related to the NPPs and research reactors was reasonably covered during the initial IRRS mission. For further improvements suggestions were made by initial IRRS mission on specific consideration of design extension conditions and PSA in the SAR, on strengthening radiological acceptance criteria for design basis accidents and on harmonization of radiological consequence analysis between the SAR and the RER.

Since the 2011 IRRS mission the suggestion on design extension conditions and PSA was addressed satisfactorily in draft legislation and was therefore closed on the basis of progress made and confidence in effective completion. Similarly, the suggestions on strengthening of radiological acceptance criteria for design basis accidents and harmonization of radiological consequence analysis are closed provided that the final wording of the Notification on strengthening of acceptance criteria will ensure that no need for emergency countermeasures for any design basis accident will be demonstrated in the RER in a reasonably conservative way. After closing the issue of acceptance criteria, the NSSC is encouraged to reconsider also harmonization of approaches for radiological consequence analysis in the SAR and the RER.

In the follow-up IRRS mission the review and assessment for fuel cycle facilities, radioactive waste management facilities, radiation source applications, decommissioning activities and transport of radioactive material were also covered as new areas. Recommendations for improvements in these areas made by the follow-up IRRS mission include

- Incorporating requirements for periodic safety review for fuel cycle facilities as well as for radioactive waste management facilities into the regulatory framework
- Requiring adequate safety justification review and assessment of any type of practice involving radiation sources.

7. INSPECTION

7.1 INSPECTION OF NUCLEAR POWER PLANTS

The NSSC was established in October 2011, via a whole suite of changes to the legislative framework from the Nuclear Safety Act, through Decrees and Regulations etc. The follow-up IRRS Mission has reviewed these changes and confirmed that they reflect similar powers of inspection to those of the predecessor organisation reported in the previous Mission report. Where there are differences they are discussed below, but they are mainly focused on strengthening the nuclear regulatory system to enable the NSSC and KINS to address corruption by regulating and inspecting the supply chain to the nuclear industry as a result of the CFSI occurrences identified in Korea during 2012.

7.1.1 ORGANIZATION OF INSPECTION

There were no findings in this area in the initial IRRS mission.

7.1.2 INSPECTION PROGRAMMES

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R8	**Recommendation**: The new Nuclear Safety Commission should recognize the current potential for conflict between technical and enforcing inspectors and ensure measures are introduced to reconcile these differences in an effective manner.

Changes since the initial IRRS mission

Recommendation 8:

To address the shortfall identified by Recommendation 8, the Commission established Regional Offices that combine previous resident and disaster prevention offices, from which the regulation of the local NPP is led. Regional Offices are staffed by residential staff from both NSSC and KINS, who work closely together under the leadership of a senior resident NSSC official or Director. Since the 2011 mission, the NSSC has established formal operating rules in NSSC Instruction 69 that sets out how the Regional Offices should be run, which also define the general role and responsibilities of the NSSC's Head of the Regional Office (the Director). The rules do state that the Director is responsible for the day to day operation of the office and consistently checking and overseeing the work performance of members, but they do not explicitly state that the Director should be the final arbiter on disputes between NSSC and KINS staff. The team subsequently confirmed that Presidential Decree No. 25335 for the NSSC states the Regional Office is responsible for on-site reactor safety regulation and radiation safety, and that the Director is in charge and directs and supervises activities.

The Team recognises the benefits of setting up the Regional Offices and under the leadership of the resident NSSC Director. The arrangements will establish a foundation for a stable and consistent approach to the local regulation of NPP. The definition and clarity of role of the Directors in charge of the Regional Offices is sufficient to close this Recommendation.

Status of the findings in the initial missions

Recommendation 8 is closed.

The NSSC has established Regional Offices manned by NSSC and KINS staff; Presidential Decree defines the role and responsibility of the NSSC Director in charge of the Regional Office. The definition and clarity of role of the Directors in charge of the Regional Offices is sufficient to close this Recommendation.

New observations from the follow-up mission

There were no new findings from the follow-up mission in this area.

7.1.3 SCOPE OF INSPECTIONS

There were no findings in this area in the initial IRRS mission.

7.1.4 UTILIZATION OF INSPECTION RESULTS AND INSPECTION EXPERIENCE

There were no findings in this area in the initial IRRS mission.

7.1.5 RISK INFORMED INSPECTIONS AND GRADED APPROACH

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R9	**Recommendation**: Daily inspection programmes should be reviewed by KINS to ensure they are founded on the safety significance of the structures, systems and components such that they are inspected in a graded and systematic manner.

Changes since the initial IRRS mission

Recommendation 9:

The Team found that a quantitative and qualitative evaluation of the safety significance of structures, systems and components (SSCs) had been completed for each of the NPP sites, which had been used to inform a graded approach to the daily inspection programmes. The Team observed the tables that summarised the results of this work and were satisfied that the safety significance of SSCs has been used as the basis for developing revised Daily Inspection Guides. NSSC and KINS staff confirmed that they believed the daily inspections were now more safety focused, having previously been driven by the sites own test schedule, providing greater confidence in the areas being inspected.

The work in response to Recommendation 9 had only recently been completed and it was clear that arrangements had not been put in place to ensure the work on the safety significant SSCs remained current and up to date. It is important that it reflects changes to the plant and the safety case if it is to continue to adequately inform the daily inspection programme. Both NSSC and KINS recognised this and undertook to incorporate the requirement to periodically update the Guideline into the Guidelines for Field Inspection for each site. This will ensure that it remains up to date, reflecting the latest plant configuration and safety significance of the SSC's. As a result, Recommendation 9 is closed on the basis of progress made and confidence in effective completion.

Status of the findings in the initial mission

Recommendation 9 is closed on the basis of progress made and confidence in effective completion.

A quantitative and qualitative evaluation of the safety significance of SSCs has been completed to ensure the daily inspection programmes for NPPs are undertaken in a graded manner, and commitment was given to formalise the arrangement to maintain the currency of this within the Guidelines for Field Inspection for each site.

New observations from the follow-up mission

There were no new findings from the follow-up mission in this area.

7.1.6 INSPECTOR TRAINING AND QUALIFICATION

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S10	**Suggestion**: The regulatory body should ensure it implements a formal process to observe and assess the inspection methods and techniques of all of its inspectors to ensure they are being conducted in a suitable, consistent and effective manner.

Changes since the initial IRRS mission

Suggestion 10:

KINS has developed a checklist that has been incorporated into its Management System Manual, which sets out the steps and associated requirements for undertaking and completing an inspection that must be adhered to by its inspectors. The follow-up IRRS Mission also examined the Inspection Guidelines that set out in detail what checks must be undertaken and how they should be completed for each inspection. With the level of prescription evident it is difficult for the inspector to do anything but what is set down in the guidelines and hence, consistently follow the practice that they define.

A report is written detailing the results of the inspection, which must meet strict guideline requirements on content and this is reviewed by the relevant specialist technical head within KINS, who has ultimate responsibility for the quality of the inspection work within his area. Although there is no benchmarking of the actual conduct of inspections, the Team is satisfied that this level of prescription, combined with the level and frequency of training and the oversight by the relevant specialist technical lead, is sufficient to ensure that the required, consistent practice is adopted by KINS inspectors when undertaking inspections onsite and so Suggestion 10 is closed.

Status of the findings in the initial mission

Suggestion 10 is closed.

The Team is satisfied that the level of prescription within procedures, combined with the level and frequency of training and oversight by the relevant specialist technical lead, is sufficient to ensure that the required consistent practice is adopted by KINS inspectors when undertaking inspections.

7.1.7 STATUS OF COUNTERFEIT, FRAUDULENT AND SUSPECT ITEMS (CFSI) INITIATIVE

Since the mission in July 2011, Korea has suffered a serious setback in the activities of its domestic supply chain and the quality of the structures, systems and components provided to the nuclear industry. This CFSI event was reviewed by the follow-up IRRS Mission because it provides valuable insight into the role of the NSSC as the nuclear safety regulator in Korea, particularly in relation to its inspection and enforcement activities in response to a serious and unplanned event.

In 2012, an industry whistle-blower advised the utility KHNP that domestic suppliers to the industry had been supplying items with falsified quality assurance certification documents, where the supplier had falsely stated that it had conducted the required verification required by process for certain items. KHNP undertook an initial investigation into the claims and in November 2012, they found the allegations to be true. The KHNP investigation confirmed that 60 certificates had been forged by a broker between 2007 and December 2012 and they advised the NSSC immediately. Consequently, the NSSC Chairman decided that the NSSC would undertake a full investigation. NSSC and KINS worked with the utility and undertook a review of the practices within the supply chain for the type of materials of concern. However, a special committee chaired by the Prime Minister, subsequently charged the NSSC to undertake a much wider review that scoped all nuclear grade items for new build and operating reactor. This review discovered many cases of falsified reports in quality verification documents, equipment qualification test reports for parts and materials; falsified by vendors and a domestic testing house. Over 2,000 reports were identified as falsified, with another 3,500 designated as untraceable. Work is now

ongoing to review the practices of the overseas supply chain, which is more difficult as it is not governed by Korean Law, and wider international learning may arise from this investigation. The team is satisfied with the level of international engagement that NSSC and KINS undertakes and that any emerging lessons will be communicated to the international community.

The events around CFSI highlighted that the requirements for inspection of the supply chain that existed in Korean law were not adequate to detect CFSI. However, the Government acted to address this and in November 2014 the law was revised in Korea to provide the NSSC with the relevant powers, legislating to strengthen regulation of the supply chain via inspection and associated enforcement. Due to the very recent revision in the law in relation to the timing of the Mission, the Team was unable to check the adequacy of the implementation of the law and oversight of the supply chain, which includes for unannounced inspections.

Further revisions to the law make it a legal requirement for the supply chain to report non compliances to the NSSC and it also states that the NSSC will designate an expert organisation to evaluate the equipment testing laboratories in Korea. The changes to legislation also now require the Periodic Safety Review for NPP and research reactors to undertake an analysis and review of safety culture. At the time of the mission, additional legislative revisions were under consideration to grant additional authority to the NSSC to investigate potential criminal activities.

The Team undertook a site visit to Doosan Heavy Industries and Construction Ltd (DHI) in Changwon, South Korea. This was to gain an appreciation of its response to CFSI, including the actions to prevent a reoccurrence and to understand DHIs view of the NSSC and its technical support organisation KINS. DHIs response to CFSI has been robust. It has implemented major changes to its Quality Programme, Procurement System and QC Inspection regime, and begun a cultural improvement initiative. The detailed measures include the provision of a specific instruction on CFSI prevention. The team noted the Quality Response Code system that is now being adopted by KHNP and its suppliers for individual test records. However, it is now a legal requirement for all suppliers to take action to address CFSI.

A highly compliant culture was in evidence during the 2011 Mission, but CFSI has indicated that it is not prevalent in all areas of the nuclear industry in Korea. The CFSI investigation confirmed that the NSSC and KINS need to undertake inspections on safety culture of organizations directly responsible for operating facilities and activities and providing services, consistent with the relevant IAEA safety requirements. The Team was advised that a small number of reviews have been completed on safety culture in pursuance of the NSSC's 5-year plan for nuclear safety. They were conducted as follow-up inspections to incidents related to CFSI at Wolsong and station black out at Kori 1. There is currently no legal basis for NSSC or KINS to undertake inspections of safety culture across the nuclear industry in Korea.

No recommendations have been identified in this Module regarding the need to undertake inspections on safety culture. Section 9 on Regulations and Guides considers the need for establishing a legal requirement for organisations in the nuclear industry to ensure the provision of an integrated management system that serves to continually achieve and enhance nuclear and radiation safety. It also contains a second recommendation regarding establishing the legal basis to allow the undertaking of inspections on safety culture of organisations directly responsible for operating facilities and activities and providing services. The recommendations in Section 9.1 will place a requirement on the industry to promote and support a strong safety culture and secondly provide NSSC and KINS with the regulatory authority to inspect safety culture.

The new requirements placed on the NSSC and KINS by the revision to Article 22 of the NSA in November 2014, undertaken in response to CFSI to strengthen the regulatory oversight of the supply chain, will increase the scope of their inspection activities to encompass suppliers and testing laboratories. KINS has already drafted its procedures and guidelines for this type of work, it will require an increase in resources to ensure the regulatory body can adopt them and discharge its legal responsibilities. This issue is addressed by suggestion SF2 in Section 3.1.

7.2 INSPECTION OF RESEARCH REACTORS

There were no findings in this area in the initial IRRS mission.

7.3 INSPECTION OF FUEL CYCLE FACILITIES

The Enforcement Decree of the Nuclear Safety Act stipulates three types of inspection for fuel cycle facilities. These include:

- Pre-operational Inspection (Facility Inspection)
- Periodic Inspection
- Quality Assurance Inspection

A pre-operational inspection follows a documented procedure to inspect construction work and performance of a fuel cycle facility prior to its operation and it may occur over several site visits as the facility is constructed. As described in licensing basis documentation, the licensee may only proceed to operation if the results of a pre-operational inspection indicate that construction work is completed and the facility conforms to the required technical standards.

Periodic inspections occur when the facility is operating. These inspections follow procedures that are written specifically for each fuel cycle facility, with the detail set out in guidelines produced by KINS that are risk informed. They are undertaken to ensure that the facility continues to comply with technical standards and that the performance of the facility is maintained in a state in which the facility originally passed the pre-operational inspection. In addition, QA inspections are also undertaken by KINS inspectors.

Inspection frequencies for fuel cycle facilities are dependent on the radiological risks associated with the facility. The facility with the highest potential radiation risk (Nuclear Fuel Fabrication Facility) is inspected twice per year. In contrast, the facility with the lowest potential radiation risk (Spent Nuclear Fuel Research Facility) is inspected less frequently.

The KINS inspection program for fuel cycle facilities is extremely robust. Each fuel cycle facility inspection covers all elements of the facilities structures, systems and components, with more than 20 highly trained and qualified inspectors, that were well coordinated and who completed the inspection in a targeted and effective manner during a single fixed period of inspection.

Databases are used within KINS to record findings, issues, management information, corrective actions and operating experience as a result of inspection activities. Planning and preparation for periodic inspections makes use of this information from these databases to inform and focus some of the inspection activities, particularly where corrective actions are still to be completed.

There are no specific nuclear training/education requirements for NSSC inspection officers to be appointed. In contrast, KINS inspectors require participation in periodic inspections over the course of two years, completion of an established On the Job Training (OJT) program that includes completion of a short training class on regulatory fundamentals. Assignment as a KINS resident inspector requires further assessment by KINS management regarding the candidate's abilities and fitness to fulfill the position. After successful completion of the OJT program the inspector receives formal endorsement (an inspector card) that is valid for a 3 year period. The endorsement is renewed upon successful completion of training during the 3 year period.

7.4 INSPECTION OF RADIOACTIVE WASTE MANAGEMENT FACILITIES

KINS and NSSC have a structured and systematic approach to inspections. Inspections of radioactive waste management facilities are divided into pre-operational inspections, periodic inspections, disposal inspections, quality assurance inspections, etc. All inspections have defined assessment objectives ranging from assessment of technical systems to assessment of qualification and training/education of employees.

The review team had the opportunity to observe KINS's periodic inspection of WLDC. The procedures for communicating inspection results were explained in some detail. The inspection results are presented to the operator during the exit meeting. Once completed the inspection report is sent to NSSC. It was noted that the inspection results are also published on KINS's public web site.

NSSC and KINS do not inspect safety culture at the facilities since this is not stipulated in the Nuclear Safety Act. This is not in line with the IAEA Safety Standards and should be changed. Recommendation RF5 in section 9 addresses this issue.

7.5 INSPECTION OF RADIATION SOURCES FACILITES AND ACTIVITIES

Several types of inspections are defined through the NSA enforcement decree. During the production of radiation devices, radiation device inspections, sometimes referred to as witness inspections are performed. Facility inspections and radiation device inspections are carried out after authorization and before the operation starts in order to verify the safety of the device. The licensee submits an inspection application to KINS to initiate the process.

The standard inspection for verifying the compliance with the legal requirements is the periodic inspection. The NSA Enforcement Regulation prescribes the timing for inspections based on the handling purpose, method, quantity and capacity of radiation sources. The KINS establishes an annual inspection plan that is notified to the licensee.

The team had the opportunity to witness an inspection in the Konyang University Hospital. The RSO had prepared a self-assessment document and presented the main findings. Such self-assessment is done based on an internal policy and not because of a legal requirement. It seems though that it is common practice in many large-scale business licensees. The team got the impression that this is a very effective way of preparing for the inspection.

The KINS inspector records inspection results on the associated form in accordance with inspection guidelines and records non-compliances if identified. The inspection results are reviewed by the Inspection Project Manager of KINS (PM), and are also notified to the licensee. The inspection PM reports inspection results monthly to the NSSC. Of importance is the arrangement that a licensee who has good inspection results and safety management is recognized by the Commission to be excellent. The licensee can in such case be exempt from the next inspection and this approach has formed the basis of an inspection good practice highlighted below.

The NSA provides also the basis for Special Inspection that either concern a reactive inspection following the declaration of an incident or an unannounced inspection. The later one is essentially used for the inspection of the mobile use of sealed sources of Cat I and II in industrial radiography. It has been clarified that no announcement at all is done to the licensee. The licensee needs to declare all operations beforehand. On that basis KINS can program its unannounced inspections.

The counterpart explained that 6 inspectors are presently in charge with inspections of hospitals and medical applications.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	The NSA Enforcement Regulation prescribes the timing for an inspection of radiation sources practices into a one-year, three-year, and five-year cycle based on the handling purpose, method, quantity and capacity of radiation sources. Licensees with good previous inspection results and self-safety management are recognized by the Commission and can be exempted from the next inspection. The KINS fuel cycle facility inspection program is robust and efficient in that it covers all elements of the facilities structures, systems and components, over a fixed period by a team of highly trained and qualified inspectors, that were well coordinated and who completed the inspection in a targeted and effective manner.
(1)	**GSR part 1, R29 states that** *"Requirement 29: Graded approach to inspections of facilities and activities... Inspections of facilities and activities shall be commensurate with the radiation risks associated with the facility or activity, in accordance with a graded approach."*

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(2)	**GSR part 1, para 4.52 states that** *"[...] The manner, extent and frequency of inspections shall be in accordance with a graded approach."*
GPF2	**Good Practice: NSSC and KINS have implemented a well-balanced graded approach for inspections, including the possibility of exempting radiation sources licensees from inspections in the case of good safety records and completing comprehensive and integrated full scope inspections of fuel cycle facilities.**

7.6 INSPECTION OF DECOMMISSIONING ACTIVITIES

The Nuclear Safety Act currently does (see section 1.9) not contain comprehensive and detailed requirements on decommissioning inspections. There is only limited guidance on inspection of decommissioning activities. However, KINS has developed guides to "Verifying and checking the decommissioning of reactor research" and "Verifying and checking the decommissioning of nuclear fuel cycle facility" (KINS/GI-N022 and KINS/GI-F004). These guides were developed to facilitate the verification of decommissioning activities at the Uranium Conversion Facility (UCF) and the research reactors KRR 1 and 2.

Inspections were carried out at the UCF twice per year while decommissioning activities were occurring. The purpose of these inspections was to verify that the licensee was conducting inspection activities according to the approved decommissioning plan. Inspection of decommissioning activities does not include safety culture since it is not stipulated in the Nuclear Safety Act. Recommendation RF5 given in Section 9.1 addresses this issue.

7.7 INSPECTION OF TRANSPORT

Inspection of the testing of packages during design approval is done by KINS experts, including approving the testing plan and witnessing of the testing.

Inspection of manufacturing and repeat testing is conducted. Inspection of manufacturing is applied to subcontractors as well. After manufacturing, KINS completes a record on manufacturing and inspection of manufacturing. The results of the manufacturing inspection are sent to the manufacturer and are the basis for the use of the packaging. Repeat testing for certain lower-risk packages may be replaced by review of a report of self-inspection including assessment of the safety-record of the operator, submitted to KINS. This demonstrates a well-defined graded approach. For packages or parts of them manufactured abroad, the inspection of manufacturing or repeat testing may be replaced by review of an inspection report including records of the manufacture and periodical inspections performed by a foreign manufacturer and an inspection pass certificate issued by the regulatory agency of the foreign country.

KINS inspects all transport activities involving packages of Type B(U), B(M), C, packages for fissile material and transport under special arrangement on the day before the transport commences. Inspections are planned based on the application for shipment approval (transport report) which has to be submitted to KINS for all these shipments five days in advance. The scope includes inspection of the packaging before loading, the accuracy of the documentation, the packing procedure and checklist, the training of the workers, the transport and radiation protection equipment and safety control records.

Inspections during transport are not carried out frequently, based on the comprehensive inspections before loading and inspections at ports during receiving of radioactive material from abroad.

Results of a periodic transport inspection are compiled into a report. The applicant as well as NSSC are notified about the inspection findings and required corrective actions. After confirming the outcome of the corrective actions the report is loaded into the computer system of KINS/NSSC.

7.8 SUMMARY

The follow-up IRRS Mission reviewed the inspection practices by KINS across many areas of its regulatory activities. The 2 Recommendations and 1 Suggestion highlighted by the 2011 Mission have been closed as a result of the efforts of the NSSC and KINS. Clear control and management in Regional Offices will ensure that NSSC and KINS staff work well together, a graded approach to daily inspections has been implemented and the level of prescription, combined with the level and frequency of training and the oversight by the relevant specialist technical lead will ensure that KINS inspectors undertake inspections in a consistent manner and to the required level when onsite.

What came out during the Mission is that the KINS inspection programmes represent a good practice, a fact highlighted by a number of team members during the mission, who considered them to be well-balanced graded inspections, providing the option of exempting radiation sources licensees from inspections where they have a good safety record and the approach of completing comprehensive and integrated inspections of fuel cycle facilities during a single fixed period of inspection. The overall view of the IRRS Mission was positive with regard to inspection in Korea.

The details surrounding the CFSI issues have emerged in Korea over the last 12 months and highlighted the need for NSSC and KINS to improve the oversight of licensee safety culture. The recommendation RF5 in section 9 addresses this issue.

8. ENFORCEMENT

8.1 ENFORCEMENT FOR NUCLEAR POWER PLANTS

To establish the NSSC as the safety and security regulator of the nuclear industry in Korea, a whole suite of changes were made to the legislative framework from the Nuclear Safety Act, through Decrees and Regulations. The follow-up IRRS Mission has reviewed these changes and confirmed that they reflect similar powers of enforcement to those of the predecessor organisation reported in the previous Mission report. Where there are differences, they are discussed below. They are mainly focused on strengthening the nuclear regulatory regime to enable the NSSC and KINS to address corruption by providing inspection and enforcement powers to regulate the supply chain to the nuclear industry as a result of the CFSI occurrences identified in Korea during 2012.

8.1.1 ENFORCEMENT POLICY AND PROCEDURES

There were no findings in this area in the initial IRRS mission.

8.1.2 GRADED AND PROPORTIONATE APPROACH

There were no findings in this area in the initial IRRS mission.

8.1.3 APPEALS PROCESS

There were no findings in this area in the initial IRRS mission.

8.1.4 IN DEPTH REVIEW OF SELECTED CASES

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S11	**Suggestion**: The regulatory body should complete a review of its decision making processes that have been applied to significant events to determine whether the appropriate enforcement actions were taken and whether improvements are required to its decision making processes and associated enforcement strategies.

Changes since the initial IRRS mission

Suggestion 11:

In response to the Suggestion raised by the 2011 IRRS Mission, a review was conducted using the self-assessment method of the IAEA to determine whether the approach to enforcement in Korea was compatible with the IAEA Safety Standards. The regulatory body concluded that the legal framework in Korea complied with the requirements of the IAEA.

The suggestion was intended to enable Korea to reflect on its approach to enforcement. The review was intended to assist the regulatory body to recognise the need to consider the safety significance of events when determining the course of enforcement, including whether plant shutdown would have been more appropriate, in line with the graded approach to enforcement action required by GSR Part 1.

Since 2011, the Enforcement Decree to the NSA has been revised to significantly increase the penalty that can be imposed to a maximum of 50 billion KRW, which goes part way to addressing concerns mentioned in the report from the 2011 IRRS Mission regarding the scale of penalty that could be awarded at that time. However, there is still the option for penalties to be imposed on the utility in preference to ordering plant shutdown when a significant safety non-conformance or violation occurs. The Regulatory body needs to initiate the process to modify legislation to eliminate this option. Recommendation 6 in Section 5 of this report addresses this requirement specifically and

as this will address the final concern in relation to this suggestion, there is no need to keep the suggestion open and it can be closed.

Status of the findings in the initial missions

Suggestion 11 is closed on the basis of progress made and confidence in effective completion.

Legislative changes have ensured that the schedule of penalties that can be imposed is now proportionate to the significance of the violation or non-conformance. There is still a need to amend legislation to remove the option for penalties to be imposed on the utility in preference to ordering plant shutdown when a significant safety non-conformance or violation occurs. Recommendation 6 in Section 5 of this report addresses this requirement specifically and as this will address the final concern in relation to this suggestion, there is no need to keep the suggestion open and it can be closed.

8.1.5 STATUS OF CFSI INITIATIVE

A summary of the circumstances surrounding the CFSI event is provided in Section 7.1.7 above. This section of the report now discusses enforcement matters associated with CFSI.

The Team considers the NSSC and KINS enforcement response to this event appropriate and in accordance with powers available. The safety significance of the affected components was immediately assessed by KINS and the associated reactors identified. The NSSC then used its enforcement powers under Article 27 of the NSA to shut down the reactors of concern, Shin Kori 1 & 2 and Shin Wolsong 1. This was in addition to KHNPs voluntary decision to shut down the reactors at Hanbit 5 and 6 when it confirmed the initial issues around CFSI. The regulatory action in response to CFSI is an important demonstration of how the NSSC considered the safety significance of the violations to inform its enforcement decision. However, the Team confirmed that the option for the NSSC to impose a penalty in lieu of suspension of an activity or operation remains and there is no formal NSSC process for determining when this would apply.

It is the Team's view that penalties should not be imposed on the utility in preference to ordering plant shutdown when the safety significance of the non-conformance or violation would clearly require suspension of the activity. The NSA and its associate legislation should be amended to remove this option. A recommendation is not required here as the conclusion reinforces the decision stated in Module 5 to keep Recommendation 6 from the 2011 IRRS Mission open. It states "The Regulatory body should initiate the process to modify legislation to eliminate the option of replacing a suspension of the licensed activity by financial penalty when the safety violation would rightly call for suspension of the activity". Addressing this recommendation will address the concern highlighted here.

The NSSC, supported by KINS, also developed a set of requirements that the utility had to comply with to restore the status of the components, either by retesting, re-qualification or replacement, which has been progressed by the industry.

It was KHNP that brought the matter to the attention of the Prosecutor, as required by the law, and legal action was pursued through the courts by the Prosecutor against those organisations and individuals implicated. Legislation is currently being considered by the Korean Government which will give enhanced "Judicial Police" powers to the NSSC. When they become law they will provide a range of authorities to the NSSC including the ability to undertake investigations where a violation is suspected and to approach the courts directly for any warrants it considers necessary, without the need to go through a third party, such as the Prosecutor, as is currently the case. It is noted that this is a positive step and the Team endorses the approach being adopted by Korea to reinforce the responsibilities of the NSSC and provide it with appropriate powers as the independent body responsible for regulating nuclear safety.

The improved regulatory powers will need to be understood by the staff in the NSSC, and the organisation will need to ensure that it is able to use the new powers effectively. To this end, proposals are already being developed to enhance the resources and capability of the existing Audit Investigation Team within the NSSC, which will be the department dedicated to undertaking formal investigations and preparing and submitting the reports to the Prosecutor for consideration when the new legislation is passed.

8.2 ENFORCEMENT FOR RESEARCH REACTORS

There were no findings in this area in the initial IRRS mission

8.3 ENFORCEMENT FOR FUEL CYCLE FACILITIES

The enforcement policy for the Korean nuclear industry is enshrined in the Nuclear Safety Act. For fuel cycle facilities, the enforcement tools available to NSSC and KINS cover a range of topics including verbal and written warnings, orders to curtail specific tasks, modification or revocation of license/construction permits and punitive penalties. During interviews, the licensee demonstrated a clear understanding of the different roles and authorities of both KINS and NSSC.

The process for taking enforcement action is documented in NSSC Notice (Notice 2013-6 "Regulation on Control of Inspection Findings of Nuclear Power Utilization Facilities") and is dependent on the degree of enforcement that is considered necessary and the urgency of the situation. Legislation allows the inspector to verbally order the licensee to shutdown plant operations or to take other actions in an emergency situation. Otherwise, enforcement action is less immediate, with corrective actions tending to be decided and agreed upon after engagement and discussion between all parties. Enforcement actions generally relate to the notification of inspection findings and the associated corrective actions.

Regulatory enforcement actions are based on a graded approach set out in the NSA and NSSC Notice. Three classifications are applied:

- High significance e.g. matters of violation of permit or license and matters that need to be rectified for the purpose of nuclear safety.
- Medium significance e.g. procedural violation.
- Low significance – recommendations for improvement not amounting to regulatory violation.

The NSA sets out a schedule of penalty surcharges that can be levied on the utility dependent on nature of violation.

8.4 ENFORCEMENT FOR RADIOACTIVE WASTE MANAGEMENT FACILITIES

The types of enforcement for the radioactive waste management facilities are equivalent to those for nuclear power plants. There were no observations on enforcement specific to waste management facilities.

8.5 ENFORCEMENT FOR RADIATION SOURCES FACILITES AND ACTIVITIES

The types of enforcement for radiation sources are equivalent to those for fuel cycle facilities as elaborated in section 8.3.

KINS inspectors verify compliance and report non-compliances. However, imminent risk of danger is not comprehensively considered by the framework. KINS inspectors might request to stop an activity if the imminent risk results from non-compliance. In that case, their ad hoc decision would need confirmation by NSSC.

NSSC inspection officers sometimes join an inspection. Joint teams of NSSC and KINS inspectors conducted a campaign of unannounced inspections in October 2014. It is worth highlighting that the conducting joint inspections in areas of imminent risks, such as in industrial radiography, is a positive development to strengthen the enforcement by inspection teams.

8.6 ENFORCEMENT FOR DECOMMISSIONING ACTIVITIES

The types of enforcement for decommissioning activities are equivalent to those for operating nuclear facilities. The only enforcement activities observed were notification of inspection findings and the associated corrective actions found in inspection reports of the UFC facility that was recently decommissioned.

8.7 ENFORCEMENT FOR TRANSPORT

The NSA describes that in the case of non-compliance with the requirements for a package or shipment detected during review of transport report or inspection, the NSSC may order corrective measures. Additionally the NSA describes the punishment for transporting without approval of transport or shipment, if required.

In general, provisions regarding enforcement for transport of radioactive material are the same as for other facilities and activities.

8.8 SUMMARY

The Team found that the enforcement powers of the NSSC across all facilities and activities where very similar to those reported for NPP. It was observed that the majority of enforcement examples consist of programmes of corrective actions that the licensees willingly implement in response to inspections undertaken by KINS on behalf of the NSSC. Legislation clearly sets out a schedule of penalties that the NSSC can impose across the industry and examples where given were these have been applied.

During the 2011 Mission, 1 Suggestion was made regarding reviewing previous enforcement decisions applied to significant events to determine whether appropriate enforcement actions were taken and whether improvements were required to the decision making process. The review completed by the NSSC did not address the intent of the Suggestion, but it has been closed by the Team. Legislative changes have ensured that the schedule of penalties that can be imposed is now proportionate to the significance of the violation or non-conformance. There is still a need to amend legislation to remove the option for penalties to be imposed on the utility in preference to ordering plant shutdown when a significant safety non-conformance or violation occurs. Recommendation 6 in Section 5 of this report addresses this requirement specifically and as this will address the final concern in relation to this suggestion, and the suggestion has been closed.

The Team welcomes the changes in legislation that now mean the NSSC has the legal powers to regulate the supply chain and the maximum penalty that can be imposed by the NSC has been increased significantly to 50 billon KRW; more aligned with the hazard potential of the industry. The approach being pursued by Korea to provide the NSSC with “Judicial Police” powers is supported by the IRRS Mission Team. It will enable the NSSC to undertake investigations where there a violation is suspected and it will be able to approach the courts directly for any warrants it considers necessary, without the need to go through a third party organisation. This will reinforce the responsibilities of the NSSC and provide it with appropriate powers as the independent body responsible for regulating the industry.

9. REGULATIONS AND GUIDES

9.1 EXISTING REGULATIONS AND GUIDES

New observations from the follow-up mission

During the follow-up IRRS mission the Team found that the Nuclear Safety Act, its Enforcement Decree and Enforcement Regulation require the applicant for a construction permit or an operating licence for a nuclear power reactor to submit a quality assurance programme to the NSSC with its application. The same requirements are repeated elsewhere in the Act with regard to research reactors and fuel cycle facilities. However, it was confirmed that the requirements of the quality assurance (QA) programme identified in legislation do not satisfy the IAEA safety requirements for an integrated management system. There is no legal basis for NSSC to require licensees to develop and maintain integrated management systems covering also their suppliers.

The Team believes that the shortfall needs to be addressed to ensure that organisations in the nuclear industry establish integrated management systems that serve to continually achieve and enhance nuclear and radiation safety in accordance with the IAEAs general safety requirements.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	The requirements of the quality assurance (QA) programme identified in legislation do not satisfy the IAEA safety requirements for an integrated management system. There is no legal basis for NSSC to require licensees to develop and maintain integrated management systems covering also their suppliers.
(1)	**BASIS: SF-1 paragraph 3.12 states that: "***Leadership in safety matters has to be demonstrated at the highest levels in an organization. Safety has to be achieved and maintained by means of an effective management system. ... The management system also has to ensure... the regular assessment of safety performance and the application of lessons learned from experience".*
(2)	**BASIS: GS-R-3 paragraph 2.1 states that:** *"A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organization and shall contribute to their achievement."*
RF4	**<u>Recommendation</u>: The Government should amend the legal framework to enable NSSC to regulate integrated management systems of organisations directly responsible for operating nuclear facilities and activities and providing services, consistent with the relevant IAEA safety requirements.**

The recommendation above is aimed at establishing a legal requirement for licensees to make provision for an integrated management system, including the promotion and support of a strong safety culture. The review of the CFSI investigation confirmed that NSSC and KINS need to undertake a review of safety culture of organizations across the nuclear industry. The follow-up mission was advised that a small number of reviews have been completed on safety culture in pursuance of the NSSC's 5-year plan for nuclear safety, conducted as part of follow-up activities to incidents that had occurred. Currently, there is no legal basis for NSSC or KINS to inspect the safety culture of organisations directly responsible for operating facilities and activities and providing services. Consequently, this shortfall needs to be addressed and the Team has made the Recommendation below, which applies to all phases of the lifetime of the facility (design, construction, commissioning, operating and decommissioning).

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	There is no legal basis to inspect the safety culture of organisations directly responsible for operating facilities and activities and providing services.
(1)	**BASIS: SF-1 states that:** **Paragraph 2.1 states:** *"3.13. A safety culture that governs the attitudes and behaviour in relation to safety of all organizations and individuals concerned must be integrated in the management system."* **Paragraph 2.1 states:** 3.*32. Defence in depth is provided by an appropriate combination of: - An effective management system with a strong management commitment to safety and a strong safety culture.*
(2)	**BASIS: GSR Part 1, paragraph 4.53 states:** *"In conducting inspections, the regulatory body shall consider a number of aspects, including: ... Safety Culture ..."*
(3)	**BASIS: GS-R-3,** **Paragraph 2.1 states: "***A management system shall be established, implemented, assessed and continually improved. It shall be aligned with the goals of the organization and shall contribute to their achievement."* **Paragraph 2.5 States:** *"The management system shall be used to promote and support a strong safety culture."*
RF5	**Recommendation: The Government should establish the legal basis that enables oversight of safety culture of organizations directly responsible for operating facilities and activities and providing services.**

9.2 PROCESS FOR DEVELOPMENT OF REGULATIONS AND GUIDES (FOR NUCLEAR POWER PLANTS AND RESEARCH REACTORS)

2011 mission RECOMMENDATIONS, SUGGESTIONS	
S12	**Suggestion**: Although stakeholder involvement is encompassed in the drafting process for regulations and guides, general public involvement should be enhanced, especially by making them aware of the drafts being developed well before they are submitted to KINS Technical standard committee.

Changes since the initial IRRS mission

Suggestion 12:

NSSC developed a website, called SCALE, dedicated to disseminating information to the general public on development of regulations and guides on nuclear and radiation safety. Draft regulations and guidelines are posted on SCALE thus allowing the general public and stakeholders to access and comment on them. Comments are expected from interested parties within 20 days after publication. At the time of the IRRS follow-up mission, 14 draft documents have been uploaded to the site for public review and comment.

KINS is active in promoting SCALE and about 100 visits are recorded daily, but there were no public comments on the draft regulations by the time of the mission.

The KINS Technical Standard Committee compiles the suggestions obtained from the public. In case of substantially differing opinions a new round of publishing and collecting comments is initiated. The TSC includes

42 KINS members and 77 external members including representatives of operators, designers, manufacturers, research institutions and universities.

Status of the findings in the initial missions

Suggestion 12 is closed as drafts of the regulations and guides are being made available for the general public and for the stakeholders.

9.3 RELATION TO THE IAEA SAFETY STANDARDS (FOR NUCLEAR POWER PLANTS AND RESEARCH REACTORS)

There were no findings in this area in the initial IRRS mission

9.4 REGULATIONS AND GUIDES FOR FUEL CYCLE FACILITIES

The Regulation on Technical Standards for Nuclear Facilities etc. includes many technical requirements dealing with NPP. However, there are few specific requirements that are written solely for fuel cycle facilities. There is an article requiring provisions described for Nuclear Power Plants to be applied *mutatis mutandis* for fuel cycle facilities and Article 87 (Applicable Scope) and Article 100 (Corresponding Regulation) Para 2 of the Regulations on Technical Standards for Nuclear Reactor, etc. enables NSSC to waive the application of NSSC notices if appropriately justified.

Regulation and guidance for fuel cycle facilities requires the application of *mutatis mutandis*, justification for the waiver of the application of certain NSSC notices, and the use of NSSC notices that are written for NPPs. As a consequence, the selection of appropriate regulation and guides for fuel cycle facilities relies on expert judgment at the time of review and assessment rather than explicit requirements that are currently available for nuclear power plants.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	The graded approach to regulating fuel cycle facilities is challenged by the fact that NSSC notices are written for nuclear power plants, and expert judgment and interpretation is required to develop and implement a graded approach to regulation and ensure compliance with the Nuclear Safety Act and its statutory provisions.
(1)	**BASIS: GSR Part 1 Requirement 34 states that** *"The regulations and guides ... shall provide adequate coverage commensurate with the radiation risks associated with the facilities and activities, in accordance with a graded approach."*
SF3	**Suggestion: NSSC should consider the development of Notices specific for fuel cycle facilities and guidance to implement a graded approach to regulation.**

9.5 REGULATIONS AND GUIDES FOR WASTE MANAGEMENT FACILITIES

The Regulations on Technical Standards for Radiation Safety Control, etc., contain requirements for all types of radioactive waste, including spent fuel, and different types of predisposal management facilities and disposal facilities. Furthermore, NSSC has issued several Notices addressing different safety aspects of predisposal waste management and disposal.

KINS has recently completed a comparison (KINS/RR-1178 and KINS/RR-1179) of current domestic regulations with IAEA Safety Requirements for predisposal management of radioactive waste (GSR Part 5) and disposal (SSR-5). The purpose is to ensure that the regulations are consistent with the Safety Standards and to identify areas for improvement.

9.6 REGULATIONS AND GUIDES FOR RADIATION SOURCES FACILITIES AND ACTIVITIES

Korea puts a lot of effort in the review of the necessity of new regulatory requirements and NSSC also assesses the impact of new requirements to the operators and the public before a new piece of regulation is issued.

Before drafting new regulations, NSSC and KINS conduct the benchmarking against other nations like the US, UK, Australia and Japan. NSSC and KINS have started to use feedback from the international cooperation and exchanges of inspectors with other countries for improving their regulatory framework. This practice could be further developed to contribute to the international harmonization of the regulatory control of sources.

NSSC is making progress with regard to the requirements resulting from the Code of Conduct on the Safety and Security of Radioactive Sources (CoC). Although the CoC refers to the safety and security of high activity sealed sources, the relevant NSSC notices are expected to be enforced in the first half of 2015.

At the end of 2011 a comprehensive plan was made to transpose GSR-part 3 (see section 11.1) and other revisions. The requirement to align tissue weighting factors to ICRP103 from 2007 is being progressed, but has not yet integrated into the regulatory framework.

9.7 REGULATIONS AND GUIDES FOR DECOMMISSIONING ACTIVITIES

As a result of the IRRS mission in 2011 (see section 1.9) Korea has proposed changes to the Nuclear Safety Act that consider the requirements in IAEA GSR Part 6. The revised Act is currently under deliberation at the National Assembly, and it is expected that it will enter into force mid-2015. The revised Act will require decommissioning plans to be prepared for nuclear installations to be constructed and operated and will also require installations already in operation to prepare decommissioning plans.

KINS and NSSC have plans for developing a comprehensive set of regulations, guidance etc., with the objective to be consistent with GSR Part 6. According to the Action Plan this is planned to be completed in 2017.

When drafting the detailed requirements on decommissioning planning it is important to ensure that decommissioning aspects are considered for the entire lifecycle of a nuclear facility (siting, design, construction, commissioning and operation) and appropriately addressed in the safety analysis report. The requirements will among other things stipulate the radiological criteria for release and/or reuse of sites and buildings, which are essential for preparing decommissioning plans and for estimating decommissioning costs. The team expects these issues to be addressed as NSSC implements the new decommissioning regulations.

9.8 REGULATIONS AND GUIDES FOR TRANSPORT

Regulations for the transport of radioactive material have been established in the NSA and associated decrees and notices. These regulations cover all modes of transport. They are based on the IAEA Regulations for the Safe Transport of Radioactive Material TS-R-1 (2005 Edition), completed by national administrative requirements.

Korea is member of the international organizations for sea and air transport IMO and ICAO, respectively. International shipments are carried out by sea or air only; therefore the IMDG code and the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air apply to international shipments. However the latest revisions of these international regulations of IMO and ICAO have not been integrated into the Korean national regulations on transport of radioactive materials. As a consequence, an application for approval of international transport may require additional information from the applicant.

KINS has recently prepared documents for supporting revision of the national regulations according to the latest IAEA regulations SSR-6. SSR-6 will be the basis for the international dangerous goods transport regulations in January 2015. These international regulations, applicable to Korea are the IMDG code and the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air, are scheduled to be revised every two years, which may lead to frequent changes to the included requirements for the transport of radioactive material. Keeping the national regulations in line with the IAEA regulations and organization of international shipments can be supported significantly by reviewing and amending, if necessary, the national regulations for the transport of radioactive

material according to the regular Revisions of the IMDG code and the ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air.

Currently the Korean regulations do not support restrictions in compliance with the IAEA regulations regarding the use of packages which have been approved under earlier revisions of the regulations, which may limit the options of KINS to force improvements to package designs. The counterpart has explained that a repeated review of package designs was carried out by KINS during the extension of the package design approval, but this is not reflected in the regulations. Transitional arrangements in compliance with the IAEA regulations should be introduced during update of the national regulations for consistency with the international regulations as mentioned above.

Taking into account the international nature of transport and the international regulatory basis KINS recognizes the advantages of seeking international harmonization for approaches regarding transport of radioactive material. To this aim KINS actively participates in the review and development of the IAEA Regulations for Safe Transport of Radioactive Material. Currently, performance of this work is complicated by the fact that there is no dedicated organizational unit for transport at NSSC and KINS. Such a dedicated organizational unit would be of great benefit to guarantee continuity of work and cooperation with IAEA and other national and international organizations regarding transport of dangerous goods.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	The transitional arrangements implemented in the Korean national regulations for (off-site) transport of radioactive material do not comply with the IAEA Regulations for the Safe Transport of Radioactive Material, and the national regulations are based on outdated international safety standards and agreements.
(1)	**Basis: GSR Part 1 Requirement 33 states that:** *"Regulations and guides shall be reviewed and revised as necessary to keep them up to date, with due consideration taken of relevant international safety standards and technical standards and of relevant experience gained…."*
(2)	**Basis: TS-G-1.5 para. 3.7 states that:** *"In the preparation of national regulations and guides for the transport of radioactive material, all relevant international agreements, regulations and recommendations should be taken into account…"*
RF6	**Recommendation: NSSC should review and more promptly amend the national regulations for the transport of radioactive material when the provisions for transport of radioactive material in the international regulations are revised, including incorporating the transitional arrangements of the IAEA Regulations for the Safe Transport of Radioactive Material into the Korean regulatory framework.**

9.9 SUMMARY

The suggestion made during the previous mission in this area has been closed. It related to promoting public awareness of the development of draft regulations and guides and the SCALE website has been developed that enables the dissemination of information in a timely manner. Stakeholders, including the public are able to view drafts and comment on them.

A recommendation is made in this section for the Government to amend the legal framework to require organisations responsible for operating facilities and activities and providing services to establish integrated management systems, consistent with the IAEA safety requirements, which will serve to achieve and enhance nuclear and radiation safety. A second recommendation is made for legislative changes to provide NSSC and KINS with the authority to oversee safety culture in regulated organisations.

A new recommendation has been made to highlight the need to develop Notices and Guides specific to fuel cycle facilities as the majority are currently written for NPP, which requires expert judgement in their application to FCF.

For transport of radioactive material it is recommended to NSSC to review and more promptly amend the national regulations when the corresponding provisions in the international regulations are revised, including incorporating the transitional arrangements of the IAEA Regulations for the Safe Transport of Radioactive Material into the Korean regulatory framework.

10. EMERGENCY PREPAREDNESS AND RESPONSE

10.1 BASIC RESPONSIBILITIES

There were no findings in this area in the initial IRRS mission

10.2 FUNCTIONAL REQUIREMENTS

There were no findings in this area in the initial IRRS mission

10.3 REQUIREMENTS FOR INFRASTRUCTURE

2011 mission RECOMMENDATIONS, SUGGESTIONS	
R10	**Recommendation**: Emergency planning zones should be defined in accordance with the IAEA Requirements (GS-R-2) (PAZ and UPZ instead of the EPZ).

Changes since the initial IRRS mission

Recommendation 10:

Regarding Recommendation 10, NSSC (through KINS) conducted research on defining precautionary action zones (PAZs) and urgent protective action planning zones (UPZs) for domestic nuclear power plants from 2012 to 2013. In the research, the IAEA standards and the trends in defining emergency planning zones (EPZs) in other countries with operating NPPs were taken into account. Furthermore, an evaluation on the scope of PAZs and UPZs was performed based on a severe- accident scenario for domestic nuclear power plants. In the evaluation process, lessons learnt from the Fukushima nuclear accident were also taken into consideration.

NSSC and KINS provided their research results and promoted the exchange of opinions among related organizations through various research conferences and forums organized by the National Assembly, environmental groups, and others. In May 2014, the APPRE was amended to subdivide the previously existing Emergency Planning Zones (EPZ), which extended from 8 km to 10 km around nuclear power reactors, into Precautionary Action Zones (PAZ) and Urgent Protective Action Planning Zones (UPZ) with radii of 3-5km and 20-30km, respectively. The revised act took effect from November 22, 2014 and the actual EPZs will be precisely defined by the NPPs and the local governments, by May 2015, in pursuant to the revised act.

Several improvements have been completed since the 2011 mission, based partly on the discussions during the mission and also as a consequence of the Fukushima lessons learned, for example:

- Exercising multiple-unit accident scenarios;
- Exercising coincidence of natural disaster with nuclear emergency;
- Increasing the frequency of integrated emergency exercises (from 1 per 4 years per site to 1 per 2 years per site);
- Diversification of data communication means and methods;
- Installation of (additional) alarm and notification systems for the public in the new PAZ;
- Extension of HANARO research reactor emergency planning zone (from 0.8 km to 1.5 km), as a consequence of an upgraded safety assessment of the research reactors;
- Development and implementation of three-lateral emergency information exchange drills (Korea-Japan-China).

Status of the findings in the initial missions

Recommendation 10 is closed. The actions taken by NSSC and KINS have accomplished the necessary improvements. The remaining tasks of the practical implementation (with the above deadline of May 2015) are being implemented by the NPP licensees and the local governments.

Regarding emergency preparedness and response there are no new observations from the follow-up mission.

11. ADDITIONAL AREAS

11.1. OCCUPATIONAL RADIATION PROTECTION

Legal and regulatory framework

The Nuclear Safety and Security Commission (NSSC) and the Korea Institute of Nuclear Safety (KINS), as technical support organization (TSO), are the two main bodies in charge of the implementation of the standards as provided in GSR-Part 3 concerning the occupational exposure. The documents of reference are the Nuclear Safety Act (NSA), several Decrees on Enforcement of Act/ of Regulations of Acts, NSSC Notices and Regulations on Technical Standards.

In particular, NSSC and KINS review, among other things, the suitability of provisions for the control of occupational exposure to radiation, the medical checkups, the education and training strategy, the monitoring of the workplace and the reduction of occupational radiation dose in the process of granting permits to nuclear facilities.

Nuclear facilities implement occupational radiation safety programs according to the technical specifications for operation, the safety control regulations, the relevant procedures and the needs for records keeping.

KINS carries out periodic inspections of nuclear facilities and activities in order to check and monitor compliance of the radiation protection programs.

Regulations covering the optimization and limitation principles and radiation protection for workers are considered at different levels of completion for all kind of exposures situations (planned, existing and emergency). Special arrangements are also described for pregnant and lactating women. For nuclear facilities, the regulations establish clearly the responsibilities of the employer and also the need for cooperation between operators and contractors in order to ensure also compliance with the regulations for external workers.

Optimization principle is implemented in the nuclear facilities as a system using one or two constraints. At Wolsong units 3 and 4, these two constraints allow to consider different types of operations and as such, provide for more flexibility. This approach is commendable.

For non-nuclear facilities and activities the optimization principle is not yet put into practice, except for NDT operations where initial actions have been undertaken and new regulations are in preparation.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	Non-nuclear facilities have to provide a policy on how to achieve ALARA. However, NSSC does not have requirements and criteria for assessing the implementation of the policy and the adequacy of dose optimization. Moreover dose constraints are not used in non-nuclear facilities.
(1)	**BASIS: GSR Part 3, Requirement 11 states that** *"The government or regulatory body shall establish and enforce requirements for the optimization of protection and safety, and registrants and licensees shall ensure that protection and safety is optimized"*
SF4	**Suggestion: The NSSC should consider the establishment and enforcement of requirements for optimization of radiation protection in non-nuclear facilities.**

The team had the opportunity to visit the Advanced Radiation Technology Institute (ARTI) of the Korea Atomic Energy Research Institute (KAERI) located at Jeollabuk-do. The main purpose of this visit was to see how the regulations concerning the radiation protection programme are implemented in the KAERI-ARTI irradiation facilities. ARTI is mainly performing research activities related to the use of radiation for medical applications (sterilization), food treatment and material studies.

The IRRS team observed that the safety provisions at ARTI fully comply with the IAEA's Basic Safety Standards (BSS hereafter). Individual monitoring is performed using legal TLD dose meters whose readings are done every quarter and operational dose meters allowing for an appropriate follow-up of the radiation protection principles in

each irradiation facility. Information was also provided by the Radiation Safety Officer (RSO) regarding the transmission of the workers doses to the National Dose Records Register and of the dose records for external occupationally exposed workers having to enter in the controlled areas. Additional information was provided on the training for – and certification of – the RSO.

The NSA and its Enforcement Decree provide for the legal limits to be applied for occupationally exposed workers. These limits comply fully with GSR Part 3 except for the more restrictive and newly established dose limit on the dose to the lens of the eye. As already mentioned in section 9.6, a comprehensive plan is underway to transpose GSR-part 3 into the regulatory framework.

Legal limits are also defined for emergency workers, for the "persons with frequent access to nuclear installations (service providers,…)" and for persons performing transport activities.

Special arrangements are made for the pregnant and breast feeding women. From the notification of pregnancy until the "delivery", a limit of 2 mSv, equivalent dose to the surface of the lower part of the abdomen, is prescribed and additional measures have to be taken by the employer in order to reduce as far as possible the radiological risks for the women and the foetus.

People below 18 years are not allowed to handle radioactive sources/materials except for trainees under the survey of a certified training instructor and provided with an authorization from NSSC. There are at the present time no provisions for apprentices and students between 16 and 18 years old.

General responsibilities of registrants, licensees and employers

In order to limit the dose for workers and for persons with frequent access to the facility, Art. 91 of the Nuclear Safety Act and Art. 134 of the Decree require that the nuclear operator shall make provisions for protective organizational measures adapted to the tasks to be performed in the workplace, appropriate shielding and personal protective equipment.

Art. 62 of the Regulations on Technical Standards for Nuclear Facilities requires that the operator of a nuclear power reactor establish and implement a radiation protection program for the management and the assessment of all activities where exposure to ionizing radiation is likely to occur in order to keep the dose of the workers and of persons with frequent access to the facility as low as reasonably achievable. Moreover the operator has regularly to monitor compliance with the safety measures and keep records on occupational exposure and protective measures as prescribed by the technical specifications. Matters to be recorded and furnished by the employers include the pre-employment medical records and radiation exposure history of radiation workers. Accordingly, if radiation workers change their jobs, nuclear operators shall provide their new employers with their medical records and radiation exposure history. Nuclear operators are responsible for managing occupational exposure for all activities in the workplace regardless of the status (internal - external) of the occupationally exposed workers.

General responsibilities of workers

Responsibilities of the occupationally exposed workers are described, for the NPP's, in the technical specifications for operations and in the safety management regulations for other installations. Obligation for wearing the individual protective equipment as well as the need for reporting any unsafe situations to the employer and to the radiation safety officer are examples of specific obligations. There is no obligation for the workers for providing information on their dose history but employers are required to exchange information regarding the dose records of all workers acting in their installations.

Requirements for radiation protection programmes

The Nuclear Safety Act (Art.2,16) defines a "radiation control area" as an area where the external radiation dose rate, air radioactivity concentration and surface contamination caused by radioactive materials exceed the levels prescribed by the regulation of the NSSC and where, for people having access to this area, there is a need for ensuring monitoring in order to ensure their protection against the radiological risks. This definition complies with

the controlled area as described in the BSS. Nevertheless, as indicated in the preliminary self-assessment, "*the concept of a supervised area is not defined in the domestic nuclear safety regulations. However, the nuclear operator needs to conduct periodic monitoring of radiation at the boundaries of radiation controlled areas. When the operator finds any needs for further measures to ensure radiation protection and safety, he has to take action*". Although the decision of the NSSC for not defining supervised areas might be considered as a conservative approach for the delineation of zones, the need for periodic measures *at the boundaries of radiation controlled areas* show that this approach doesn't ensure full compliance with the IAEA Standards.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	Regulations make provisions for the definition and the implementation of controlled area, but there is no definition of supervised area as required by the GSR Part 3.
(1)	**BASIS: GSR Part 3, para 3.91 states that** *"Registrants and licensees shall designate as a supervised area any area not already designated as a controlled area but for which occupational exposure conditions need to be kept under review, even though specific measures for protection and safety are not normally needed"*
RF7	**Recommendation: NSSC should introduce in the regulatory framework the concept of the supervised areas in addition to the controlled areas and ensure they are implemented consistent with GSR Part 3.**

Monitoring programmes and technical services

Regulations make provisions for the radiation exposure monitoring programme. The description of the radiation protection programme to be implemented for each new installation is part of the safety report to be examined by the regulatory body when a demand for authorization is introduced. Before granting the authorization, KINS performs a facility inspection covering, among other things, the provisions for such programme. Based on the inspection report, NSSC will grant – or not – the authorization for operating the facility. Moreover, during the inspection, KINS checks whether the operator has established an agreement with a service provider for ensuring the monitoring of the workers.

For nuclear installations, individual monitoring makes use of legal dose meters and operational dose meters and internal exposures are also monitored. Dose records are collected on a three months basis, sent to a dedicated TSO, which sends the results of the readings to the Radiation Safety Foundation which is in charge of the management of the national dose records register. Access to these data is allowed only under -secured way and for the workers and the RSO. As already mentioned, cooperation between employers, registrants and licensees is mandatory. TSO for occupational monitoring services need to be qualified and to be certified by NSSC.

The monitoring in the medical areas is performed for all occupationally exposed workers. Employers are responsible for the monitoring of the medical workers acting in nuclear medicine and in radiotherapy activities (4734 in 2013). Dose records keeping is ensured by the Korea Radiation Safety Foundation (KORSAFe). Korea Centers for Disease and Prevention (CDC) under the Ministry of Health and Welfare (MOHW) is responsible for the monitoring of the medical workers acting in diagnosis (60173 in 2013). Dose records are registered by the Ministry of Health. In hospitals where medicine-, radiotherapy- and diagnosis activities are present, monitoring is usually done by the same service provider. The existence of two official registers requires strong cooperation between KORSAFe and the MOHW in order to ensure a full coverage of all workers and an easy access to the dose records when appropriate for radiation protection actions.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	There are currently two registers for occupational dose record keeping at the national level and there is insufficient coordination between KORSAFe and MOHW in order to ensure the full coverage of occupationally exposed workers.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**GSR-Part 1, Requirement 35, para 4.63 and 4.64 state that** "*The regulatory body shall make provision for establishing and maintaining the following main registers and inventories:* *…* *Records of occupational doses;* *"… The regulatory body may or may not be the sole entity responsible for the maintenance of these registers and inventories, but it shall be involved in their proper retention and use."*
SF5	**Suggestion: NSSC and MOHW should consider the need for establishing a unique national dose record register to facilitate dose records keeping and for allowing easier access to the data for radiation protection purposes.**

While high levels of individual dose are still recorded for NDT activities, NSSC and KINS have already undertaken actions in order to reduce these values as mentioned previously (see "Legal and regulatory framework").

IAEA GSR Part 3 requires the regulatory body to determine whether to assess the exposure of the flight crew to cosmic radiation and to reflect the details concerning the exposure dose assessment method and records on the regulating structure. Article 18 of the Act on Protective Action Guidelines against Radiation in the Natural Environment states that the airline operators should control the annual exposure dose of their international flight crew by flight route through its assessment. It also requires airline operators to take the necessary actions to reduce the dose of their flight crew by adjusting the flight routes and frequencies so that their annual dose does not exceed 20 mSv, including providing the crew with information concerning the dose. The Ministry of Land and Transportation has performed an inspection of the airline operators and confirmed that the annual exposure dose of the flight crew in 2013 was lower than 4.8 mSv.

Besides the monitoring of aircrew, the BSS requires regulatory provisions to be made for other occupational exposure in existing exposure situations. This is addressed in section 11.3.

For non-nuclear installations, as mentioned in the self-assessment, there are no provisions concerning the cooperation between employers and licensees in order to ensure the protection of radiation workers. Moreover, for nuclear medicine activities, regulations require that protective measures are taken at the design stage in order to ensure that the potential committed dose remains lower than 2 mSv. But assessment for compliance with this level is at the present time only based on biokinetic models for the intake of radionuclides. The regulatory body is aware about the lack of appropriate monitoring for such activities and intend to develop a pilot project using mobile vehicle allowing in vitro and in vivo measurements. Such mobile installation could also be used in emergency situations. This project should be implemented during one year in two or three main hospitals in the country.

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	There is a lack on individual monitoring for internal contamination for activities in nuclear medicine.
(1)	**BASIS: GSR Part 3, para 3.102 states that "***Employers shall ensure that workers who could be subject to exposure due to contamination are identified, including workers who use respiratory protective equipment. Employers shall arrange for appropriate monitoring to the extent necessary to demonstrate the effectiveness of the measures for protection and safety and to assess intakes of radionuclides and the committed effective doses"*
RF8	**Recommendation: NSSC should ensure that measures are taken to ensure appropriate monitoring of internal exposure in nuclear medicine.**

Follow up Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	For non-nuclear installations, the regulations requiring cooperation between employers and licensees in order to ensure that safety and radiation protection for all workers (internal, contractors) operating in these installations do not exist.
(1)	**BASIS: GSR Part 3, Requirement 23 states that "***Employers and registrants and licensees shall cooperate to the extent necessary for compliance by all responsible parties with the requirements for protection and safety"*
SF6	**Suggestion: NSSC should consider establishing regulations to protect workers who are engaged in work that involves a source that is not under the control of their employer in non-nuclear facilities and activities consistent with GSR Part 3.**

Information, instruction and training

Provisions for information of all workers are made in the regulations. Appropriate training is required and in particular, re-training is mandatory when workers start with a new job, or have been absent for a long period of time, or when there are significant changes in the installations and/or in the working procedures. RSOs need to have a basic education in scientific or technical fields and to follow a specific training on radiation protection and safety issues. An experience of two years is required and after positive completion of tests, they are recognized as RSOs for the facility they belong to. Refresher training is required on a three year basis. For small installations and non-nuclear installations, the TSO could be in charge of ensuring RSO missions but need to be certified by NSSC.

11.2. CONTROL OF MEDICAL EXPOSURE

The NSSC and the Ministry of Health and Welfare (MOHW) both regulate medical radiation practices. Given the complimentary nature of the radiation protection requirements, the NSSC and the MOHW should coordinate on legal controls, supplementary legislation, advisory materials, radiation safety and competency requirements to avoid potential overlaps. Suggestion SF1 in Section 1.7 addresses this issue.

Responsibilities of the government

Korean regulation of medical exposure is broadly governed by two parallel streams of legislation and regulatory requirements. The NSSC regulates radiation safety aspects of the delivery of radiation therapy and diagnostic nuclear medicine (including personnel) via the *Nuclear Safety Act*, while the Ministry of Health and Welfare (MOHW) regulates radiation safety of radiological imaging (including personnel) via the *Medical Services Act*. Both primary Acts have substantial accompanying subordinate legislative instruments, i.e. radiation rules, technical standards, notices, enforcement decrees and substantial guidance materials. In addition, the Ministry of Food and Drug Safety approves equipment for both imaging and therapy via the Medical Devices Act and assures radiopharmaceutical quality via the *Pharmaceutical Affairs Act.*

Responsibilities of the regulatory body

Both regulatory bodies impose requirements to assure proper authorization, inspection, enforcement, assessment and regulation are defined according to the scope of medical exposure or radiation safety delineated by the respective Acts.

The MOHW imposes requirements to ensure proper training and competency of respective medical and allied health professionals who use radiation in the medical sector. The *Medical Services Act* specifies requirements for the fields of specialization with regard to medical radiation practice. The MOHW liaises with the respective teaching universities in Korea and respective professional medical and allied health bodies to assure continuing competencies of trained personnel. The mission team is satisfied that the education and training requirements for MOHW licensed persons meet Requirement 35 of GSR Part 3.

The NSSC requires health professionals with duties in radiation safety control of medical institutions to complete a certain amount of supplementary annual radiation safety training appropriate to their license. The MOHW defines the education requirements for medical and allied health personnel who deliver therapeutic radiation medical exposures to patients. The NSSC legislation also defines the requirements for a combination medical physicist and radiation safety officer to perform calibration and ensure equipment safety. Medical and allied health professionals delivering radiation therapy within NSSC regulated medical practices and providing imaging services via MOHW regulated practices have the appropriate level of training.

Responsibilities of registrants and licensees

Responsibilities of licensees are described in respective regulatory areas. The NSSC prescribes requirements for the safety of therapy equipment. Diagnostic imaging patient safety responsibilities are contained in the Medical Services Act *Rules regarding the safety of diagnostic radiation emitting devices* and ascribed to a formally trained Radiation Safety Officer. The NSSC places the requirement on licensees to obtain individual patient or guardian informed consent prior to the delivery of radiation therapy. Discussions with staff at the Konyang University Hospital confirm that the generally accepted professional medical practice standards apply for both diagnostic imaging and the delivery of radiation therapy with respect to referrals and informed consent.

Justification of medical exposure

Clinical justification of medical exposure of patients is dealt with differently in the two regulatory programs. For NSSC, the requirements ensure responsible parties perform clinically justified therapeutic procedures. However there are slight differences with the IAEA requirements, as acknowledged in the Advance Reference Material provided by the NSSC and there is no identified operational method of enforcing this provision. No explicit requirements exist in the *Medical Services Act* and subordinate legislative instruments. The MOHW has implemented guidelines for the justification and optimization of medical exposure. The alignment of clinical justification requirements between the two regulatory programmes would be beneficial for clinicians and regulators (the latter with respect to enforcement).

It was noted that the practice-level justification decision for the authorization of medical radiation practices that deliver significant patient doses in radiation therapy is made by the NSSC. When the introduction of significant new therapy treatment technologies are being considered it was noted that the NSSC liaised heavily with the MOHW. This practice should continue.

It was also noted that local government bodies effectively authorize the majority of diagnostic imaging facilities. There are over 75,000 imaging devices and over 60,000 medical radiation workers. This in effect places the review of justification of the medical radiation practice in the hands of local government.

Discussion with the MOHW and Korea Centers for Disease and Prevention (CDC) provided assurance that these reviews are being conducted effectively in accordance with the official framework.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	There is no operational method for oversight of clinical level justification of medical imaging or radiation therapy.
(1)	**BASIS: GSR Part 3 Requirement 37 para 3.154 states that: "** *Registrants and licensees shall ensure that: The radiological medical practitioner performing or overseeing the radiological procedure has assumed responsibility for ensuring overall protection and safety for patients in the planning and delivery of the medical exposure, including the justification of the radiological procedure as required in paras 3.155–3.161 and the optimization of protection and safety, in cooperation with the medical physicist and the medical radiation technologist as required in paras 3.162–3.177."*
(2)	**BASIS: GSR Part 3 Requirement 37 para 3.157 states that:** *"The justification of medical exposure for an individual patient shall be carried out by means of consultation between the radiological medical practitioner and the referring medical practitioner, as*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	appropriate, with account taken, in particular for patients who are pregnant or breast-feeding or are paediatric, of: (a) The appropriateness of the request; (b) The urgency of the radiological procedure; (c) The characteristics of the medical exposure; (d) The characteristics of the individual patient; (e) Relevant information from the patient's previous radiological procedures."
SF7	**Suggestion: The NSSC in cooperation with the MOHW should consider developing an oversight method for clinical level justification of medical imaging and radiation therapy.**

Optimization of medical exposure

The NSSC regulates diagnostic nuclear medicine but currently has no formal requirements for optimisation of patient exposure.

The MOHW provides Diagnostic Reference Levels for patient exposure for different imaging modalities. In order to encourage medical institutions to adopt the reference levels and optimize protection and safety in radiological procedures, the MOHW created and distributed guidelines so that medical institutions can refer to standard imaging settings.

Pregnant women and breast feeding women

NSSC regulations prescribe requirements to protect pregnant, possibly pregnant or breast feeding patients and, a recently drafted notice is expected to be issued by the government in the first quarter of 2015 to further strengthen these requirements.

Medical and allied health staff involved in radiation therapy asks patients about their status and use checklists to ensure that pregnancy/breast feeding status has been established prior to the delivery of the therapy dose.

Release of patients after radionuclide therapy

The NSSC regulations specifically state dose criteria for patient release and provide advice regarding keeping doses to third parties as low as reasonably achievable. Provisions also exist to have separate accommodation of patients prior to release.

Unintended and accidental medical exposures

NSSC regulations require all persons responsible for radiation therapy to minimize unintended and accidental exposures.

MOHW regulations require pre- and post-examinations of the generator, examinations of radiation protection facilities, and the prevention of radiation injury to patients and radiation staff. The intention of the regulation is to specifically prevent the accidental irradiation of patients.

Reviews and records

The *Nuclear Safety Act* stipulates that medical institutions shall autonomously maintain a certain level of therapeutic radiation prescribed and the records of treatment time including the amount of radiation delivered. Licensees shall also make an investigation of unintended and accidental medical exposure caused as a result of use of radioactive isotopes and take corrective actions. The NSSC also requires all persons to periodically review and maintain records of cases involving medical exposure to justify or optimize the medical exposure performed at facilities using radiation.

Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	There are no diagnostic reference levels, or optimisation advice in the diagnostic nuclear medicine sector.

Mission RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 3, Requirement 34 para 3.148 states: "***The government shall ensure, as part of the responsibilities specified in para. 2.15, that as a result of consultation between the health authority, relevant professional bodies and the regulatory body, a set of diagnostic reference levels is established for medical exposures incurred in medical imaging, including image guided interventional procedures. In setting such diagnostic reference levels, account shall be taken of the need for adequate image quality, to enable the requirements of para. 3.169 to be fulfilled. Such diagnostic reference levels shall be based, as far as possible, on wide scale surveys or on published values that are appropriate for the local circumstances."*
(2)	**BASIS: GSR Part 3, Requirement 38 para 3.163 states: "***For diagnostic radiological procedures and image guided procedures, the radiological medical practitioner, in cooperation with the medical radiation technologist and the medical physicist, and if appropriate with the radiopharmacist or radiochemist, shall ensure that the following are used: (a) Appropriate medical radiological equipment and software, and, for nuclear medicine, appropriate radiopharmaceuticals; (b) Appropriate techniques and parameters to deliver a medical exposure of the patient that is the minimum necessary to fulfil the clinical purpose of the radiological procedure, with account taken of relevant norms of acceptable image quality established by relevant professional bodies and of relevant diagnostic reference levels established in accordance with paras 3.148 and 3.169."*
SF8	**Suggestion: NSSC should consider defining diagnostic reference levels consistent with the principle of optimization.**

11.3. CONTROL OF DISCHARGES AND MATERIAL FOR CLEARANCE, ENVIRONMENTAL MONITORING, EXISTING EXPOSURE SITUATIONS AND CONTROL OF RADON

Control of discharges and material for clearance

The requirements of setting authorized discharge limits for both nuclear and radiation facilities are established in the NSSC regulations. For the case of nuclear facilities this document defines the concentration of radionuclide and annual expected dose at the exclusion area boundary of the facility. Additional criteria for discharges suggested by the operator of the facility during the application for a license can be approved as part of the authorization of the facility, and the regulatory body verifies the adequacy of the criteria. For the case of radiation facilities requirements for controlling the release of radionuclides in order to comply with discharge limits set in NSSC regulations are established. Conditions to be applied in each installation in regard of discharges are approved by the regulatory body as part of the licensing process and compliance is verified during the inspections. Discharge limits are optimized on the basis of dose constraints.

Criteria for clearance of materials from regulatory control are established in the Nuclear Safety Act and its subsequent regulations. These criteria are based on the dose criteria established in GSR Part 3, and clearance values from Schedule I of this IAEA standards document have been adopted. These regulations do not exclude the clearance of materials with radioactive content above these levels in specific situations after being properly authorized by the regulatory body. In particular for the clearance of bulk amounts of contaminated materials with a mixture of artificial radionuclides, the requirements are in line with GSR Part 3, whereas for the case of a mixture of artificial radionuclides and natural radionuclides as considered in the Nuclear Safety Act, the clearance criterion is the same for artificial ones, and for the natural radionuclides more restrictive criteria based on risk are established.

As part of the Action Plan, NSSC and KINS proposed action concerning the consideration of a more systematic approach in setting optimized operational limits and conditions for radioactive discharges from major nuclear

facilities. These can be expressed, for example, in setting more specific procedures for adopting additional conditions for discharge to be required from the operator of these installations.

Environmental monitoring

Requirements for environmental monitoring to be carried out by nuclear installations are established in the NSSC regulations on the basis of Article 104 of Nuclear Safety Act. The operator of any "relevant facility" (a nuclear power reactor, a nuclear research reactor with thermal power above 100 kW, a nuclear fuel cycle facility, an interim storage facility for spent nuclear fuel or a waste disposal facility) shall implement an environmental monitoring program in the surroundings of the facility. The operator must prepare and submit to the regulatory body for approval at least one year before the beginning of the operation of the facility a monitoring plan, in which among other elements the responsibilities for monitoring have to be identified. The description of the facility and the surroundings must be provided; the scope and contents of the monitoring program shall be described, as well as the technical details concerning the sampling and measurement techniques, the equipment to be used and the statistical treatment to apply to results. For the rest of facilities that release radioactive materials to the environment, requirements for environmental monitoring are established in the Enforcement Regulation of Nuclear safety Act.

Operators of relevant facilities are required to report to NSSC twice a year on the results of monitoring programs they carry out, and report immediately in case of any deviation from the expected monitoring results. Results of monitoring programs carried out by the operators are verified through independent monitoring performed by KINS upon delegation by the NSSC pursuant to the Nuclear Safety Act. Regulations also require the operator to review and update their monitoring programs every three years and keep the records of results of monitoring program during the whole life cycle of the facility

In fulfillment of requirements established in the Official Information Disclosure Act, operators of relevant facilities have to make their monitoring results publicly available through their web pages. Additionally, KINS is responsible for compiling of their own monitoring results for all relevant facilities and producing an annual report, which is available to the public in a dedicated web site "CLEAN" (clean.kins.re.kr).

As a complement of these monitoring programs, nationwide environmental monitoring consists of a radiation monitoring network (Integrated Environmental Radiation Monitoring Network: IERNet) at 128 posts in terrestrial environment and radioactivity monitoring program at 56 points in marine environment. The results of the dose rate measurements carried out in real time in the frame of the IERNet are available to the public through the web site at iernet.kins.re.kr. These results can be accessed by the public also by means of a mobile phone application (eRAD@NOW). Additionally annual reports on the network measurements results are issued by KINS and published in the "CLEAN" web site.

As part of quality control activities for ensuring the reliability of measurements of radioactivity, KINS participates in a quality control program and intercomparison exercises with the International Atomic Energy Agency (IAEA) on an annual basis. Korea regulatory authorities organize domestic proficiency tests annually since 1997 to improve the analysis capability of domestic radioactivity analysis laboratories.

Existing exposure situations and control of radon

In Korea no areas have been identified as contaminated with residual radioactive material. Identified scenarios for chronic exposure of the public to radiation are: water and food consumption and exposure indoors due to radon and construction materials. For exposure scenarios associated with water consumption and radon inhalation in public buildings, the regulatory authority is the Ministry of Environment (MoE). For exposure due to food consumption and exposure to products containing radionuclides of natural origin the authorities are the Ministry of Food and Drug Safety and NSSC, respectively.

Regarding the exposure of Korean population to radon, KINS has developed during several years extensive studies for characterization of radon concentrations in houses, public buildings and schools. A radon map of the Korean territory has also been obtained as result of these studies and provisional radon prone areas have been identified. Radon concentrations values of 1000 Bq m-3 and above have been found in dwellings and schools. Korea has established a recommended maximum level of 148 Bq m-3 for public buildings. Radon concentrations in the public

buildings are verified once every two years, but these verifications produce only non-mandatory recommendations when radon concentrations above this level are detected. For dwellings reference levels have not been established.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	Nationwide studies carried out by KINS on the radon air concentrations indicate the potential existence in the country of significant chronic exposure situations related with radon inhalation scenarios. However, reference levels for radon are not in place in the regulations neither for workers nor for the public. Therefore a basis for further actions does not exist.
(1)	**BASIS: GSR Part 3 para. 5.2 states that** *"The government shall ensure that, when an existing exposure situation is identified, responsibilities for protection and safety are assigned and appropriate reference levels are established.*
(2)	**BASIS: GSR Part 3 para. 5.20 states that** *"Where activity concentrations of radon that are of concern for public health are identified on the basis of the information gathered…, the government shall ensure that an action plan is established comprising coordinated actions to reduce activity concentrations of radon in existing buildings and in future buildings….*
(3)	**BASIS: GSR Part 3 para 5.27 states that** "*The regulatory body or other relevant authority shall establish a strategy for protection against exposure due to 222Rn in workplaces, including the establishment of an appropriate reference level for 222Rn. The reference level for 222Rn shall be set at a value that does not exceed an annual average activity concentration of 222Rn of 1000 Bq/m3, with account taken of the prevailing social and economic circumstances."*
RF9	**Recommendation: The regulatory body should develop and implement an action plan to address existing exposure situations in particular in relation to radon to ensure adequate protection of the public and the workers consistent with GSR Part 3.**

Under the terms of the Drinking Water Management Act, the MoE controls the uranium content in drinking water on the basis of monitoring criteria of 30 μg L^{-1}. According to the regulations, water suppliers should analyse on a periodical basis the content of uranium in drinking water and report to the MoE. K-water, a public corporation under the Ministry of Land and Transportation, as well as local governments carry out inspections on the water quality and reports to the MoE. Additionally, in some minor areas of the country, where the water for consumption is obtained from groundwater sources, a survey on radon and gross alpha is being conducted. Reference levels for drinking water are not in compliance with IAEA Standards. The Ministry of Environment has launched a project for characterizing the environmental radiation levels in the country and on this basis new reference levels for drinking water should be established in the near future.

The Ministry of Food and Drug Safety has adopted for foodstuffs the reference values recommended in the Codex Standard 193-1995 for both imported and locally produced in food products with the exception of I-131 and Cs-137. In case of Cs-137, a value of 100 Bq kg-1 was adopted after the Fukushima accident.

In Korea, reference values for artificial radionuclides have not been established for all commodities. In the case of products containing radionuclides of natural origin, relevant regulations establish a reference level of 1 mSv yr-1, which is the recommended upper dose criterion for commodities recommended in GSR Part 3. However, this reference value expressed in term of effective dose to the representative person, is not applicable since a practical point of view when deciding on whether a product can be authorized for use or not. This is relevant for the case of construction materials, for which there are not practical criteria for controlling their use in terms of radionuclides concentrations. Presently there is an on-going project carried out by NSSC for establishing these derived reference levels for construction materials.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	In Korea specific reference levels for exposure due to radionuclides in commodities are not fully in compliance with IAEA safety standards.
(1)	**BASIS: GSR Part 3 para. 5.22 states that** *"The regulatory body or other relevant authority shall establish specific reference levels for exposure due to radionuclides in commodities such as construction materials, food and feed, and in drinking water, each of which shall typically be expressed as, or be based on, an annual effective dose to the representative person that generally does not exceed a value of about 1 mSv.*
SF9	**Suggestion: The regulatory body should consider establishing specific reference levels in compliance with IAEA Standards for commodities containing radionuclides, including those of natural origin, in terms of activity concentrations.**

11.4 SUMMARY

Korean regulations are generally in compliance with the IAEA Standards on occupational exposure, medical exposures, discharges and material for clearance and existing exposure situations. Medical exposure of patients is broadly well controlled by NSSC and MOHW and optimized at the clinical level by competently trained medical and allied health staff. The establishment of authorized discharge limits for relevant facilities and activities is required and enforced in Korean regulations.

Under the present section recommendations were made for non-nuclear facilities to improve the delineation of controlled and supervised areas and the monitoring of internal exposure. Another area that needs further improvement relates to the need of developing and implementing an action plan to address existing exposure situations in particular in relation to radon to ensure adequate protection of the public.

Suggestions were provided for non-nuclear activities for further strengthening cooperation between employers and contractors and for optimizing radiation protection. In cooperation with the MOHW, the NSSC should further consider developing an oversight method for revising clinical level justification of medical imaging and radiation therapy. Defining diagnostic reference levels consistent with the principle of optimization and the establishment of specific reference levels for commodities containing radionuclides are other areas of suggested improvements.

12. INTERFACE WITH NUCLEAR SECURITY

12.1. LEGAL BASIS

There is a legal framework established in Korea for oversight and enforcement of security arrangements needed for maintaining nuclear safety. The activities taken to establish the legal basis covering the safety and security interface include:

- Establishment of the NSSC in October 2011 as a single governmental body for integrated management of nuclear safety and security, having two subordinate regulatory expert organizations, KINS and KINAC, entrusted for their regulatory tasks by the Nuclear Safety Act and Act on the Physical Protection and Radiological Emergency (APPRE), respectively.
- Revision of the Act and the Enforcement Decree on the Physical Protection and Radiological Emergency (APPRE) in December 2013 and May 2014 respectively, defining the interface between nuclear safety and security and requiring evaluation of safety effects caused by the physical protection system and complementary measures for nuclear facilities.
- Revision of regulatory standards for cyber security (KINAC RS-015, November 2014), which requires the analysis of effectiveness of cyber security control and regular inspection of the general cyber security plan, including mutual interface between safety and cyber security.
- Development of KINS regulatory guide 8.22 (July 2011) for assessment of the construction permit and operating license as well as a periodic inspection guide (June 2012) for the instrumentation and control systems in NPPs as a basis for the evaluation of cyber security in nuclear facilities.
- Establishment of the Guidelines for Fostering a National Nuclear Security Culture in December 2013 to promote and enhance the nuclear security system including provisions for promoting and enhancing interface between nuclear safety and security in every organization responsible for nuclear security.
- Revision of Regulation for Education and Training for persons in charge of physical protection (in November 2014) covering requirements on education and training of persons who perform functions related to safety measures.

Further development of the legal framework is underway aimed at addressing the interface between safety and security at the design stage of NPPs to be described in the Preliminary SAR. There are also plans to develop specific guidelines and a manual for the licensees on implementation of measures for adequate treatment of interfaces between safety and security in their organizations.

12.2. REGULATORY OVERSIGHT ACTIVITIES

There are a number of specific activities associated with and integration of regulatory oversight related to nuclear safety and security, such as:

1. Coordination of activities for the mutual interface between safety and security in emergency response in accordance with the “National Radiological Emergency Plan”. These activities cover both emergency response to incidents of nuclear safety as well as emergency response to incidents of nuclear security, with involvement of both KINS and KINAC.
2. Establishment since March 2010 of a Working Group on Nuclear I&C Security including extensive involvement of industry (about 20 industrial organizations), addressing regulatory, research, design and operational matters.
3. Organization of a series of workshops on legal and technical aspects associated with cyber security: 4 workshops were organized in 2014, with participation of experts from nuclear facilities and various engineering institutions.
4. Holding annual workshops on operational experience feedback (covering safety and security issues) organized every year with nuclear installations licensees (KHNP, KNF, KAERI, KORAD) invited. In these workshops the experiences from the operational events are discussed, with overview of best practices and suggestions from inspections in nuclear facilities.

5. Establishment of NSSC regional offices in 4 nuclear sites and enhancing their activities, in particular performing joint (NSSC, KINS, KINAC participating) emergency response inspections focused on the general emergency response systems for nuclear safety, radiological emergency, and radiological terrorism incidents for nuclear facilities with the objective to prevent disasters and enhance risk control. The inspections led to the conclusion that there is a need to integrate the emergency framework for safety and security and to reinforce the public education and relations.
6. Acquiring practical insights on potentially sensitive areas for interfaces between safety and security from research & development projects, such as
    - "Integrated cyber security program", addressing the issue of nuclear I&C cyber security
    - "A Study on the Interface between Security and Safety" identifying and addressing potential interface areas, e.g. Establishment of Regulation and Guidelines; SSI Practice Committee; SAR Interface; Vital Area Identification; Cyber Security; Interface between contingency and emergency response; Vitalization of Safety-Security cooperation in NSSC Regional offices; Safety and Security in Design
    - "Development of National Interface Technology between Nuclear Safety and Security", addressing the issues of physical sabotage on domestic nuclear facilities, vital area identification and sabotage response, cyber terror treat and the response and nuclear safety and security issues on spent fuel storage and transportation facilities
    - "A Study on Status of Regulations of Interface between Safety and Security and Its Applications", addressing the issues of interface between DBA and Design Basis (DBT) Threat, interface between safety and security, insider threat and cyber security
    - "Development of cyber security program for nuclear security including SSI analysis".

Specific efforts aimed at enhancing the safety and security interface planned for the near future include:

- Reviewing the Preliminary Safety Analysis Report (PSAR) with the objective of considering the design of a nuclear facility for the purpose of preventing gaps or conflicts between nuclear safety and nuclear security
- Organizing joint inspections for safety and security; inspections are planned to begin in 2015 for facilities that produce, sell, and use isotope with activity of 18.5 PBq or higher.

It can be concluded that the regulatory oversight activities are sufficiently comprehensive, cyber security being the most comprehensively covered.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
Observation:	The findings of the follow-up mission demonstrated that Korea has established very effective system to address safety and security interface, with coordinated involvement of all stakeholders, with identification of specific provisions important for integration of safety and security, thus providing sufficient background for strengthening regulatory oversight in licensed organizations.
(1)	**BASIS: GSR Part 1 para. 2.4 states that** *"Safety measures and nuclear security measures shall be designed and implemented in an integrated manner so that nuclear security measures do not compromise safety and safety measures do not compromise nuclear security."*
(2)	**BASIS: GSR Part 1 para. 4.23 states that** *"…The regulatory body, while maintaining its independence, shall liaise with authorized parties to achieve their common objectives in ensuring safety…."*
GPF3	**Good Practice: The NSSC, KINS and KINAC have established a comprehensive system for addressing the interface between safety and security, including identification of specific technical areas sensitive to conflicts between safety and security, joint safety security inspections, organization specific workshops and**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	training.

12.3. INTERFACE AMONG AUTHORITIES

Establishment of the NSSC as a single governmental body for integrated management of nuclear safety and security including interfaces provides the basis for comprehensive and coordinated treatment of safety and security matters. The NSSC is strongly supported by two its subordinated organizations with reasonable manpower available: KINS (about 450 people) and KINAC (about 70 people).

KINS is primarily responsible for the matters of nuclear safety and KINAC for matters of nuclear security and safeguards. Both organizations closely cooperate on matters with potential interference between safety and security. In addition, three expert organizations, KINS, KINAC and KAERI, signed a cooperation agreement in June 2014 to enhance the effectiveness of mutual interface among the relevant expert organizations responsible for the technical matters associated with the regulation, control and research in the area of safety and security needed for the governmental framework.

Other authorities are also involved in tasks related to nuclear safety and security, such as chemical forces, medical support, fire services and others. Emergency response is a typical area where integration is necessary. There is a standard manual prepared for various situations (part of which was presented to the Mission), further subdivided into sub-manuals, in particular for emergency response, but also for cases of radiological terrorist acts, or for crisis management. In the manual, the role of all authorities and all other stakeholders is specified in details.

12.4. SUMMARY

NSSC, KINS and KINAC have developed a comprehensive approach addressing the interface between safety and security in a very effective manner. The approach is in full compliance with the IAEA Safety Standards. It includes availability of necessary legal provisions, availability of adequate manpower and intensive cooperation between the safety and security staff of the NSSC with its support organizations KINS and KINAC. Mutual activities include the organization of ad-hoc combined committees, performing joint safety-security inspections, organization of specific workshops and other educational and training activities, revision of regulatory standards and developing other guidance documents and supporting research projects on the relevant problems. Coordination with other authorities is well developed including availability of manuals for involvement of stakeholders in various relevant emergencies.

Identification of specific technical areas that are potentially susceptible to interference between safety and security is particularly important for focusing the activities and together with comprehensiveness of the approach with active involvement of the stakeholders was a reason for a good practice.

A continuous improvement of the framework is underway. There are specific plans to address the interfaces between safety and security in the SAR and to strengthen regulatory oversight of safety and security interfaces in the licensed organizations based on the guidelines and manual for the licensees on implementation of measures for adequate treatment of interfaces between safety and security in their organizations.

13. REGULATORY IMPLICATIONS OF THE TEPCO FUKUSHIMA DAI-ICHI ACCIDENT

13.1. UPDATE ON THE ACTIONS FOR ADDRESSING THE REGULATORY IMPLICATIONS OF THE TEPCO FUKUSHIMA DAIICHI ACCIDENT

Safety improvement actions

As reported in the initial IRRS mission report, the Korean regulatory body (then MEST) performed Special Safety Inspections (SSI) in the NPPs in Korea in the period between March 23 and April 30, 2011 in six areas:

- Area 1: Design of structures and equipment against earthquakes and coastal flooding;
- Area 2: Integrity of electrical power, cooling, and fire protection systems in case of inundation;
- Area 3: Counter measures against severe accidents;
- Area 4: Emergency response and emergency medical systems;
- Area 5: Long-term in-service plants;
- Area 6: Research reactors and nuclear fuel cycle facilities.

The first four inspection areas were common for all operating NPPs, area 5 concerned NPPs above service times of 20 years.

As a result of SSI a list of 50 actions to improve the safety of Korean nuclear installations has been established. Seven groups of actions have been defined, related to:

1. Earthquakes (5)
2. High water and flooding (4)
3. Power generation, cooling and fire protection (11)
4. Severe accident management (6)
5. Emergency preparedness and radiation protection (11)
6. Performance monitoring, ageing management (10)
7. Research reactor (3)

(The number of actions in the group is given in parentheses.) The nuclear power plants were requested to prepare their actions plans and are to report on the progress made every six months. In addition to the actions requested by the regulatory body 10 more actions were determined by the utilities based partly on international experience and partly on self-evaluation. In total 56 action items relate to NPPs, 3 to the research reactor and one to the medical system.

The planning and implementation of the actions are being performed in three phases. Phase 1 included SSI and compilation of action plan and was completed in 2012. Phase 2 extends to 2015 and includes implementation of all actions related to NPPs. Phase 3 includes update of action items, performance of Stress Test and modification of safety objectives, regulations and guides to include beyond DBAs. The ultimate goal is the establishment of an integrated accident management system.

Implementation status of improvement measures

At the time of the IRRS follow-up mission, 33 actions from among the 46 pertaining to NPPs have been completed, 7 are expected to be completed in 2014 and 13 remain to be implemented in 2015. Important safety improvements still in progress are e.g.: improving the seismic capacity of the safe shutdown system; securing movable power generators and batteries; improving the design basis of alternative emergency diesel generator; improving fire protection facilities and response ability; installing hydrogen removal equipment; containment ventilation; improving emergency response facilities. 15 out of utility's completed actions are still being reviewed by NSSC.

The number of actions in progress in the various action groups related to NPPs are as follows: 1 in group 1; 2 in group 2; 5 in group 3; 3 in group 4; 1 in group 5; and 1 in group 6.

Stress Test of selected Korean NPPs

In January 2013 the Government decided to initiate performing a Stress Test exercise (ST) of the reactor units being over their design lifetime. The target units are Wolsong Unit 1, which is shut down since November 2012 and is under review for continued operation; and Kori Unit 1 which is operating after lifetime extension since December 2007. Extension of the ST to other operating NPPs is under consideration.

The ST performed by the EU member states served as example for the definition of the Korean ST. In April 2013 KINS prepared a specification of the Stress Test exercise. In May 2013 NSSC issued a Stress Test evaluation guideline. The utility's result from the ST is being evaluated by two teams, one consisting of KINS experts and another including 19 representatives of the local citizens and of NGOs. The teams provide recommendations to be taken into account in the finalization of the ST plans.

The ST covers six areas: earthquakes, tsunami, storm surge and other natural hazards; loss of electrical power and loss of ultimate heat sink; severe accident management; emergency preparedness, and other.

The exercise consists of three steps: self-assessment; technical review of the ST results by review teams; reporting and evaluation of the results.

The ST of Wolsong 1 is about to be completed at the time of the follow-up IRRS mission, that of the Kori 1 is due to be completed in 2015. The evaluation teams have no deadline for performing their review.

Further future actions

1) In March 2014 NSSC decided on requiring further complementary measures related to the consequences of the TEPCO Fukushima Daiichi accident. Based also on lessons learned from international experience the following areas are foreseen to be covered by complementary safety improvement measures:

- redefined scope of extreme events including human-induced consequences
- reinforcement of fundamental safety functions with dedicated equipment or solutions
- development of organization and guidance for emergency response to BDBAs

2) The effectiveness of the actions and measures is expected to be evaluated and the complementary measures are expected to be applied to all operating and new plants.

3) The regulations and guides are expected to be revised to cover BDBAs including aircraft crash.

4) Revision of safety objectives and goal to cover extreme natural hazards.

CONCLUSION (1)
The Team concluded that the NSSC and KINS reached considerable progress in the application of lessons learned from the TEPCO Fukushima Daiichi accident to the improvement of nuclear safety in Korea. The team commends Korea on the progress made to date and the commitment to complete the remaining actions by the end of 2015 and notes the comprehensive beyond design basis assessment being undertaken of the safety of the two oldest nuclear power plants.

13.2. FOLLOW-UP/ UPDATE ON THE 2011 MODULE-WISE CONCLUSIONS

The initial IRRS mission to Korea drew conclusions on the regulatory implications of the TEPCO Fukushima Daiichi accident on each core IRRS Modules. In the Advance Reference Material to the follow-up IRRS missions some of the topics discussed in these conclusions are revisited and developments since the initial mission are discussed. The IRRS team reviewed these topics and concluded as described below.

Effectively independent regulatory body

The conclusion on the roles and responsibilities of the government suggested that the establishment of an effectively independent regulatory body is an opportunity to address the regulatory lessons learned from the accident. The IRRS follow-up mission reviewed this issue and, as discussed in Chapter 1 of the present report, concluded that establishment of NSSC and the legal background ensuring it provide the possibility of an effectively independent regulatory body in Korea.

International operational experience feedback

The initial mission suggested a systematic analysis of the international operational experience feedback in order to derive and enforce adequate improvement measures.

The licensees and the regulatory body in Korea conducted extensive analyses of the experience of other countries, especially of France, the United States and Japan. Based on this experience, the regulatory body derived improvement measures additional to those decided after the accident at Fukushima. Details of these measures are given in the previous section. Furthermore a six-year research plan was compiled consisting of three stages of one, three and two years, respectively, extending from June 2012 to June 2018.

In this research programme several regulatory issues are investigated related e.g. to the dynamics and effects of tsunamis; filtered venting of containment; power supply systems. The programme is expected to lead to new regulatory requirements and on the 3 issues. It is found that operator has also conducted a research related to the Extensive Damage Mitigation Guide (EDMG) in addition to the Fukushima follow-up measures imposed by the regulatory authorities.

A further application of international experience feedback is the initiation of the Korean Stress Test exercise as discussed in the previous section.

Revision of the Management System

The initial mission noted that at the time of the mission lessons learned from the accident regarding the Management System of the regulatory body had not been incorporated as the planned audit had not yet been performed.

The follow-up IRRS review team was informed that the annual reviews of the Management System (MS) since 2011 took into account the relevant lessons learned. It was noted that there is no separate process in the MS for the actions related to the TEPCO Fukushima Daiichi accident, processes related to authorization and to review and assessment incorporate the relevant actions. Therefore the report on the MS assessment and review does not specifically refer to the consequences of the accident. On the other hand it is found by the Management System assessment that a regulatory verification process for the ST should be established.

Site selection

In the context of authorization the initial IRRS mission concluded that the importance of the site selection procedure might be further emphasized if Early Site Approval were a compulsory part of the authorization process of a new nuclear power plant.

Following the specific inspections conducted by the regulatory body the site selection procedure was modified in two aspects: Re-evaluation of the design input parameters on earthquake and tsunami hazards and upgrade of the regulatory standards on site safety evaluation. The design earthquakes and design sea-levels for Korean NPP sites were re-evaluated and the results of the evaluation were submitted to KINS at the end of 2013 and at the time of the follow-up IRRS mission they were being evaluated. Draft regulatory standards for site safety evaluation were established in light of the Fukushima lessons in order to strengthen the siting procedure especially in site monitoring of external hazards and a QA program for site survey/evaluation in accordance with NS-R-3 to replace

the US regulations previously in force. The new standards were approved by the Code and Standards Committee and shall be submitted to NSSC for approval.

Early Site Approval remains not to be a compulsory part of the site selection, although this is not an issue as in the near future no new site is foreseen to be selected.

Updating the review and assessment process

According to recent changes in the regulatory requirements, the licensee has to evaluate beyond design basis accidents and – for the new build reactors – has to perform PSA of all three levels as well as for external events and low power shutdown states. Extension of PSA Level 3 for the existing reactors is under consideration.

The review and assessment capabilities of the regulatory body need to cope with these new tasks. The regulatory body has sufficient resources to perform their actual review and assessment tasks, yet when assessment of Design Extension Events and effects of Extreme Natural Hazards will be required by regulations, the necessary regulatory resources need to be re-evaluated.

Review of the inspection process

The initial mission noted that the post-Fukushima review was not introspective and concluded that future inspection activities should look to focus on improvements (implemented in a targeted and systematic manner), and an introspective review of the inspection function should be completed.

Besides the regular comprehensive inspections (performed by KINS once in every 18 months) special inspections are held to check the implementation status of the safety improvement measures decided in connection with the accident as discussed in the previous section. The inspection results are evaluated and recorded in an organized manner.

Inspection of safety culture and human performance has recently been included into the process and is in a pilot phase. Regional offices have been established at four sites, their inspection activity is based on risk informed approach, also in a pilot phase. Inspection of cases related to counterfeit and fraudulent suspect items pose a specific challenge.

CONCLUSION (2)
The Team concludes that the NSSC and KINS effectively addressed the issues raised by the conclusions of the initial IRRS mission on the regulatory implications of the TEPCO Fukushima Daiichi accident. The Team encourages the newly established regulatory body NSSC to collect and evaluate their experience related to the core regulatory activities (authorization, review and assessment, inspection, enforcement and regulation and guides) in order to set the basis for further improvements.

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		NSSC	KINS
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6.	**REVIEW AND ASSESSMENT**		
	LUX Ivan MAJERUS Patrick MISAK Jozef PALTEMAA Risto REICHE Ingo RINKER Michael VESTERLIND Magnus WIDMARK Anders	Lee Jeongmin Wang Jigyun Kang Cheongwon Kim Yunwoo Bark Weonsang Kong Byoungmoon Jung Hwanjong Park Daehoon Shin Jonghan Kim Keunwoo	Woo Swengwoong Kim Taehyeong Nah Wonjoon Kim Bonghyun Kim Seokhun Lee Saeyul Jeong Seungyoung Park Sanghyun Kim Wantae Song Minchul Kim Kyunghwa Jang Kiwon Lee Seunghaeng

	IRRS Experts	Counterpart	
		NSSC	KINS
			Park Byeonghyeon Lee Byungsoo Cheong Jaehak Seo Eunjin Kim Sungil Lee Byungsoo Ahn Sangmyeon Cho Woonkap Yook Daesik Park Younhwan
7.	**INSPECTION**		
	FOY Mark LUX Ivan MAJERUS Patrick PALTEMAA Risto REICHE Ingo RINKER Michael VESTERLIND Magnus WIDMARK Anders	Lee Jeongmin Wang Jigyun Kang Cheongwon Kim Yunwoo Bark Weonsang Kong Byoungmoon Jung Hwanjong Park Daehoon Shin Jonghan Kim Keunwoo Ahn Jihyun Bae Jonggun Won Sungchan	Ha Jongtae Oh Jangjin Chung Kuyoung Yi Kyungjoo Kim Bonghyun Hwang Taesuk Jin Changyong Kim Bonghyun Kim Seokhun Lee Saeyul Jeong Seungyoung Park Sanghyun Kim Wantae Song Minchul Kim Kyunghwa Jang Kiwon Lee Seunghaeng Park Byeonghyeon Lee Byungsoo Cheong Jaehak Seo Eunjin

	IRRS Experts	Counterpart	
		NSSC	KINS
			Kim Sungil Lee Byungsoo Ahn Sangmyeon Cho Woonkap Yook Daesik Park Younhwan Yang Sungho
8.	ENFORCEMENT		
	FOY Mark LUX Ivan MAJERUS Patrick PALTEMAA Risto REICHE Ingo RINKER Michael VESTERLIND Magnus WIDMARK Anders	Lee Jeongmin Wang Jigyun Kang Cheongwon Kim Yunwoo Bark Weonsang Kong Byoungmoon Jung Hwanjong Park Daehoon Shin Jonghan Kim Keunwoo Ahn Jihyun	Lee Saeyul Lee Dukhun Yu Seonoh Jhung Myungjo Lee Jinho Jang Youngsoon Kim Bonghyun Kim Seokhun Lee Saeyul Jeong Seungyoung Park Sanghyun Kim Wantae Song Minchul Kim Kyunghwa Jang Kiwon Lee Seunghaeng Park Byeonghyeon Lee Byungsoo Cheong Jaehak Seo Eunjin Kim Sungil Lee Byungsoo Ahn Sangmyeon Cho Woonkap

	IRRS Experts	Counterpart	
		NSSC	KINS
			Yook Daesik Park Younhwan Yang Sungho
9.	**REGULATIONS AND GUIDES**		
	LUX Ivan MAJERUS Patrick PALTEMAA Risto REICHE Ingo RINKER Michael VESTERLIND Magnus WIDMARK Anders	Lee Jeongmin Wang Jigyun Kang Cheongwon Kim Yunwoo Bark Weonsang Kong Byoungmoon Jung Hwanjong Park Daehoon Shin Jonghan Kim Keunwoo	Jhung Myungjo Lee Jinho Jang Youngsoon Kim Bonghyun Kim Seokhun Lee Saeyul Jeong Seungyoung Park Sanghyun Kim Wantae Song Minchul Kim Kyunghwa Jang Kiwon Lee Seunghaeng Park Byeonghyeon Lee Byungsoo Cheong Jaehak Seo Eunjin Kim Sungil Lee Byungsoo Ahn Sangmyeon Cho Woonkap Yook Daesik Park Younhwan
10.	**EMERGENCY PREPAREDNESS AND RESPONSE**		
	ZOMBORI Peter	Kim Yunwoo	Lee Saeyul Jeong Seungyoung Park Sanghyun

	IRRS Experts	Counterpart	
		NSSC	KINS
11.	**ADDITIONAL AREAS**		
	CASSELS Brad DEBOODT Pascal TOMAS ZERQUERA Juan	Kim Sangtae Jung Hwanjong Park Daehoon Park Eunyoung Seong Keehwal Lee Sanghwa Kang Seulki (Ministry of Health and Welfare) KimKyungho (Ministry of Health and Welfare) Lee Hyunkoo (CDC), (Ministry of Health and Welfare) Lee Jung-eun (CDC), (Ministry of Health and Welfare) Kim Min-Jeong (National Evidence-based Healthcare Collaborating Agency), (Ministry of Health and Welfare) Lee Jungjun (Ministry of Environment) An Sanghyuk (Ministry of Environment) Ham Changsoon (Ministry of Environment)	Lee Seunghaeng Yang Jeongsun Kim Jiyoung Lee Jaeseong Kim Wantae Park Jaejeong Lee Byungsoo Cheong Jaehak Lee Saeyul Yun Juyong Byun Jongin Chang Jaikwon
12.	**INTERFACE WITH NUCLEAR SECURITY**		
	MISAK Jozef	Kim Sunggil Lee Sulki	Yoo Hosik (KINAC) Ko Munsung (KINAC) Jeong Choongheui Kang Youngdoo
13.	**REGULATORY IMPLICATIONS OF THE TEPCO FUKUSHIMA DAI-ICHI ACCIDENT**		
	LUX Ivan	Chu Hoseong	Sung Keyyong Kim Kyuntae Kim Minchul Kang Kyungmin
	POLICY ISSUES		

	IRRS Experts	Counterpart	
		NSSC	KINS
	IRRS Experts	Counterpart	
		NSSC	KINS
		Baek Min	Ha Jongtae Oh Jangjin Chung Kuyoung Yi Kyungjoo

APPENDIX III - MISSION PROGRAMME

SCHEDULE OF THE IRRS EXTENDED FOLLOW-UP MISSION TO REPUBLIC OF KOREA

<table>
<tr><th>Time</th><th>SAT
6 Dec</th><th>SUN
7 Dec</th><th>MON
8Dec</th><th colspan="2">TUE
9 Dec</th><th colspan="2">WED
10 Dec</th><th colspan="2">THU
11 Dec</th><th colspan="2">FRI
12 Dec</th><th>SAT
13 Dec</th><th colspan="2">SUN
14 Dec</th></tr>
<tr><td>9:00-10:30</td><td rowspan="11">Arrival of Team Members</td><td></td><td></td><td rowspan="2">Interviews</td><td rowspan="2">Visits</td><td rowspan="2">Interviews</td><td rowspan="2">Visits</td><td rowspan="2">Interviews</td><td rowspan="2">DTC writes introductory parts</td><td rowspan="3">TM write Report
TL and DTL review introductory part

Draft text to TL</td><td rowspan="3"></td><td rowspan="3">• Discussing and improving Draft Report
• Cross-Reading
• TL, DTL, TC and DTC read everything</td><td rowspan="11">Free day, Social Tour</td><td rowspan="11">Reading, Cross-reading of the Report</td></tr>
<tr><td rowspan="2">Team building meeting:
• 5 minutes/TM self-intro
• Refresher training</td><td rowspan="2">Entrance Meeting</td></tr>
<tr><td>12:00-13:00</td><td rowspan="2">Lunch with Host</td><td colspan="2">Standing lunch</td><td colspan="2">Standing lunch</td><td colspan="2">Standing lunch</td><td>Standing lunch</td></tr>
<tr><td>13:00-14:00</td><td>Lunch</td><td rowspan="4">Interviews</td><td rowspan="4">Interviews</td><td rowspan="4">Visits</td><td rowspan="4">Interviews</td><td rowspan="4">Visits</td><td rowspan="4">Interviews</td><td rowspan="4">DTC writes introductory parts</td><td colspan="2">Policy Issues Discussion</td><td rowspan="4">Finalisation of the Draft Report</td></tr>
<tr><td>14:00-15:00</td><td rowspan="3">Initial Team Meeting:
• Welcome
• Intro LO
• Logistics
• First observations
• In-Group discussion</td><td rowspan="3">Secretariat edits the report
Preliminary Draft Report Ready</td><td rowspan="3">Cross-reading by TM</td></tr>
<tr><td>15:00-16:00</td></tr>
<tr><td>16:00-17:00</td><td>Written preliminary findings delivered</td></tr>
<tr><td>17:00-18:00</td><td>Daily Team Meeting</td><td colspan="2">Daily Team Meeting</td><td>Daily Team Meeting: Discussion of findings</td><td colspan="2">Daily Team Meeting</td><td colspan="2">Daily Team Meeting</td><td>Daily Team Meeting</td></tr>
<tr><td>18:00-20:00</td><td>Informal dinner</td><td>Team Dinner</td><td>Dinner</td><td colspan="2">Dinner</td><td>Dinner</td><td colspan="2">Dinner</td><td colspan="2">Dinner</td><td>Dinner</td></tr>
<tr><td rowspan="2">20:00-24:00</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Writing of the report</td><td colspan="2">Team meeting</td><td>Team meeting</td><td colspan="2">Team meeting</td><td colspan="2" rowspan="2">TM Read Draft</td><td rowspan="2">Secretariat edits the report</td></tr>
<tr><td colspan="2">Writing of the report</td><td>Writing of the report</td><td colspan="2">Writing of the report</td></tr>
</table>

SCHEDULE OF THE IRRS EXTENDED FOLLOW-UP MISSION TO REPUBLIC OF KOREA

<table>
<tr><th></th><th>MON
15 Dec</th><th>TUE
16 Dec</th><th>WED
17 Dec</th><th>THU
18 Dec</th><th>FRI
19 Dec</th><th></th></tr>
<tr><td>9:00-10:00</td><td rowspan="2">Individual discussions of follow-up analysis and R, S and GP with counterparts</td><td rowspan="2">Cross-Reading
TL, DTL, TC and DTC read everything
Finalisation</td><td>Common read through and finalisation by the Team</td><td rowspan="2">Written comments by the Host
General discussion on the draft report with host</td><td>Submission of the Final Draft</td><td>9:00-10:00</td></tr>
<tr><td>10:00-12:00</td><td>Submission of the Draft to the Host</td><td>Exit Meeting
Press Conference</td><td>10:00-12:00</td></tr>
<tr><td>12:00-13:00</td><td>Standing lunch</td><td>Standing lunch</td><td>Lunch</td><td>Standing Lunch</td><td rowspan="2">Lunch</td><td>12:00-13:00</td></tr>
<tr><td>13:00-14:00</td><td rowspan="2">Policy Issues Discussion</td><td rowspan="3">Discussion of the report by the team</td><td rowspan="3">TC, DTC prepare Executive Summary and exit presentation</td><td rowspan="3">Host reads Draft</td><td rowspan="3">TL finalises Executive Summary and exit presentation</td><td rowspan="3">TC Drafts the Press Release</td><td rowspan="2">Team meeting for finalisation of the Report</td><td>13:00-14:00</td></tr>
<tr><td>14:00-15:00</td><td rowspan="4">Departure Home</td><td>14:00-15:00</td></tr>
<tr><td>15:00-17:00</td><td>Individual discussions of follow-up analysis and R, S and GP with counterparts</td><td>15:00-17:00</td></tr>
<tr><td>17:00-18:00</td><td>Daily Team Meeting</td><td>Discussion of Executive Summary</td><td>Briefing of the DDG
Finalisation of the press release</td><td>17:00-18:00</td></tr>
<tr><td>18:00-20:00</td><td>Dinner</td><td>Dinner</td><td>Dinner</td><td rowspan="2">Farewell Dinner</td><td>18:00-20:00</td></tr>
<tr><td>20:00-21:00</td><td rowspan="2">TL, DTL, TC and DTC includes changes</td><td rowspan="2">Secretariat finalises text</td><td rowspan="2">Free</td><td>20:00-21:00</td></tr>
<tr><td>21:00-24:00</td><td>Free</td><td>21:00-24:00</td></tr>
</table>

APPENDIX IV - SITE VISITS

Facilities visited:

KORAD low-level and intermediate level radioactive waste facility

Konyang University Hospital, Daejeon

Advanced Radiation Technology Institute (KAERI)

KEPCO Nuclear Fuel (KNF)

Doosan Heavy Industries and Construction Ltd, Changwon

APPENDIX V - RECOMMENDATIONS (R) AND SUGGESTIONS (S) FROM THE PREVIOUS IRRS MISSION THAT REMAIN OPEN

Module	R/S	Recommendations/Suggestions
5.1.6	**R6**	**Recommendation:** The Regulatory body should initiate the process to modify the Atomic Energy Act in order to eliminate the option of replacing a suspension of the licensed activity by financial penalty when the safety violation would rightly call for suspension of the activity.

APPENDIX VI - RECOMMENDATIONS (RF), SUGGESTIONS (SF) AND GOOD PRACTICES (GPF) FROM THE 2014 IRRS FOLLOW-UP MISSION

Module	RF/SF/GPF	Recommendations, Suggestions or Good Practices
1.7	SF1	Suggestion: The Government and NSSC should consider further strengthening the coordination of and liaison between the various authorities involved in nuclear and radiation safety.
3.1	SF2	Suggestion: The Government should consider future allocation of human resources to the regulatory body commensurate with the nature and number of facilities and activities to enable the fulfilment of necessary regulatory functions and responsibilities.
3.7	GPF1	Good Practice: The operation of the real-time Radiation Source Location Tracking System (RADLOT) for High Activity Sealed Sources in NDT applications contributes to a high level of safety.
5.3	RF1	Recommendation: The Government and NSSC should develop the legal basis for the requirement of an integrated safety assessment for fuel cycle facilities, that includes chemical and industrial hazards and require a safety analysis report (SAR) as part of a licence application.
6.3	RF2	Recommendation: The Government should establish the legal basis for periodic safety review for fuel cycle facilities and all radioactive waste management facilities.
6.4	RF3	Recommendation: The NSSC should ensure that arrangements are put in place for the justification of any type of practice involving radiation sources to be included in the review and assessment programme to ensure that only justified practices are authorized.
7.5	GPF2	Good Practice: NSSC and KINS have implemented a well-balanced graded approach for inspections, including the possibility of exempting radiation sources licensees from inspections in the case of good safety records and completing comprehensive and integrated full scope inspections of fuel cycle facilities.
9.1	RF4	Recommendation: The Government should amend the legal framework to enable NSSC to regulate integrated management systems of organisations directly responsible for operating nuclear facilities and activities and providing services, consistent with the relevant IAEA safety requirements.
9.1	RF5	Recommendation: The Government should establish the legal basis that enables oversight of safety culture of organizations directly responsible for operating facilities and activities and providing

Module	RF/SF/GPF	Recommendations, Suggestions or Good Practices
		services.
9.4	**SF3**	**Suggestion: NSSC should consider the development of Notices specific for fuel cycle facilities and guidance to implement a graded approach to regulation.**
9.8	**RF6**	**Recommendation: NSSC should review and more promptly amend the national regulations for the transport of radioactive material when the provisions for transport of radioactive material in the international regulations are revised, including incorporating the transitional arrangements of the IAEA Regulations for the Safe Transport of Radioactive Material into the Korean regulatory framework.**
11.1	**SF4**	**Suggestion: The NSSC should consider the establishment and enforcement of requirements for optimization of radiation protection in non-nuclear facilities.**
11.1	**RF7**	**Recommendation: NSSC should introduce in the regulatory framework the concept of the supervised areas in addition to the controlled areas and ensure they are implemented consistent with GSR Part 3.**
11.1	**SF5**	**Suggestion: NSSC and MOHW should consider the need for establishing a unique national dose record register to facilitate dose records keeping and for allowing easier access to the data for radiation protection purposes.**
11.1	**RF8**	**Recommendation: NSSC should ensure that measures are taken to ensure appropriate monitoring of internal exposure in nuclear medicine.**
11.1	**SF6**	**Suggestion: NSSC should consider establishing regulations to protect workers who are engaged in work that involves a source that is not under the control of their employer in non-nuclear facilities and activities consistent with GSR Part 3.**
11.2	**SF7**	**Suggestion: The NSSC in cooperation with the MOHW should consider developing an oversight method for clinical level justification of medical imaging and radiation therapy.**
11.2	**SF8**	**Suggestion: NSSC should consider defining diagnostic reference levels consistent with the principle of optimization.**
11.3	**RF9**	**Recommendation: The regulatory body should develop and implement an action plan to address existing exposure situations in particular in relation to radon to ensure adequate protection of the public and the workers consistent with GSR Part 3.**
11.3	**SF9**	**Suggestion: The regulatory body should consider establishing specific reference levels in compliance with IAEA Standards for**

Module	RF/SF/GPF	Recommendations, Suggestions or Good Practices
		commodities containing radionuclides, including those of natural origin, in terms of activity concentrations.
12.2	**GPF3**	**Good Practice: The NSSC, KINS and KINAC have established a comprehensive system for addressing the interface between safety and security, including identification of specific technical areas sensitive to conflicts between safety and security, joint safety security inspections, organization specific workshops and training.**

APPENDIX VII - REFERENCE MATERIAL PROVIDED BY NSSC and KINS

1. ··Nuclear Safety Act
2. ··Enforcement Decree of the Nuclear Safety Act
3. ··Enforcement Regulation of the Nuclear Safety Act
4. ··Regulations on Technical Standards for Nuclear Reactor Facilities, Etc.
5. ··Regulations on Technical Standards for Radiation Safety Control, Etc.
6. ··Act on Physical Protection and Radiological Emergency
7. ··Enforcement Decree of the Act on Physical Protection and Radiological Emergency
8. ··Enforcement Regulation of the Act on Physical Protection and Radiological Emergency
9. ··Act on Protective Action Guidelines against Radiation in the Natural Environment
10. · Enforcement Decree of the Act on Protective Action Guidelines against Radiation in the Natural Environment
11. · Enforcement Regulation on the Act on Protective Action Guidelines against Radiation in the Natural Environment
12. · Nuclear Liability Act
13. · Enforcement Decree of the Nuclear Liability Act
14. · Act on Indemnity Agreements for Nuclear Liability
15. · Enforcement Decree of the Act on Indemnity Agreements for Nuclear Liability
16. · Act on Establishment and Operation of the Nuclear Safety and Security Commission
17. · Enforcement Decree of the Act on Establishment and Operation of the Nuclear Safety and Security Commission
18. · Rules on Operation of Meetings of the Nuclear Safety and Security Commission
19. · Korea Institute of Nuclear Safety Act
20. · Enforcement Decree of the Korea Institute of
21. · Nuclear Safety Act
22. · Comprehensive Plan of Nuclear Safety ('12-'16)
23. · The NSSC and organization of its affiliated agencies
24. · Enforcement Rules of the NSSC and organization of its affiliated agencies
25. · A Proposal for Partial Revision of the Act on the Persons Performing the Duties of the Judicial Police Officers and the Scope of Their Duties
26. · Korea's efforts to strengthen Nuclear Safety Culture (Y.S.Choi)
27. · Regulation on Reporting and Public Announcement of Accidents and Incidents for Nuclear Power Utilization Facilities
28. · Operation Rule of the Regional Office of Nuclear Safety and Security Commission
29. · Instruction on NSSC and KINS Inspector Certificate

30. · Guideline for Field Inspection of Kori Site Office
31. · Regulations on Classification and Clearance of Radioactive Waste
32. · Notice No. 201412-General Standards of Deep Geologic Disposal of High-level Radioactive Waste
33. · KINS-IMS-100,Rev.0 (Management System Manual)
34. · Notice No. 2014-xx Standards for Radiological Environmental Evaluation of Design Basis Accidents in Nuclear Power Plants (Proposal)
35. · Notice No. 2013-18 Standard format and content of radiation safety report
36. · Notice No. 2014-22 Standard format and content of safety control regulation
37. · Notice No. 2013-21 Standards for design approval and inspection of radiation equipment
38. · Notice No.2013-49 Standards for Radiation Protection, etc.
39. · Guidance after nuclear medicine examination by KunYang University Hospital- Nuclear Medicine Department
40. · Guidance after Radioactive Iodine Treatment by KunYang University Hospital- Nuclear Medicine Department

APPENDIX VIII – IAEA REFERENCE MATERIAL USED FOR THE REVIEW

1. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Fundamental Safety Principles, No SF-1, IAEA, Vienna (2006)

2. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Governmental, Legal and Regulatory Framework for Safety, General Safety Requirements Part 1, No. GSR Part 1, IAEA, Vienna (2010).

3. **INTERNATIONAL ATOMIC ENERGY AGENCY** – The Management System for Facilities and Activities. Safety Requirement Series No. GS-R-3, IAEA, Vienna (2006).

4. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Preparedness and Response for Nuclear and Radiological Emergencies, Safety Requirement Series No. GS-R-2, IAEA, Vienna (2002).

5. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3, No. GSR Part 3, IAEA, Vienna (2014).

6. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety assessment for facilities and activities, General Safety Requirements Part 4, No. GSR Part 4, IAEA, Vienna (2009)

7. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Predisposal Management of Radioactive Waste, General Safety Requirement Part 5, No. GSR Part 5, IAEA, Vienna (2009).

8. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Decommissioning of Facilities, Safety Requirement Series No. GSR Part 6, IAEA, Vienna (2014).

9. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Nuclear Power Plants: Design, Specific Safety Requirements No. SSR-2/1, IAEA, Vienna (2012).

10. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Nuclear Power Plants: Commissioning and Operation, Specific Safety Requirements Series No. SSR-2/2, IAEA, Vienna (2011).

11. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Site Evaluation for Nuclear Installations, Safety Requirement Series No. NS-R-3, IAEA, Vienna (2003).

12. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Research Reactors, Safety Requirement Series No. NS-R-4, IAEA, Vienna (2005).

13. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Safety of Nuclear Fuel Cycle Facilities, Safety Requirement Series No. NS-R-5, IAEA, Vienna (2014)

14. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Disposal of Radioactive Waste, Specific Safety Requirements No. SSR-5, IAEA, Vienna (2011)

15. **INTERNATIONAL ATOMIC ENERGY AGENCY** – Regulations for the Safe Transport of Radioactive Material, Specific Safety Requirements No. SSR-6, IAEA, Vienna (2012)

16. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Organization and Staffing of the Regulatory Body for Nuclear Facilities, Safety Guide Series No. GS-G-1.1, IAEA, Vienna (2002).

17. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Review and Assessment of Nuclear Facilities by the Regulatory Body, Safety Guide Series No. GS-G-1.2, IAEA, Vienna (2002).

18. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body, Safety Guide Series No. GS-G-1.3, IAEA, Vienna (2002).

19. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Documentation Used in Regulating Nuclear Facilities, Safety Guide Series No. GS-G-1.4, IAEA, Vienna (2002).

20. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Arrangements for Preparedness for a Nuclear or Radiological Emergency, Safety Guide Series No. GS-G-2.1, IAEA, Vienna (2007)

21. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Criteria for use in Preparedness and Response for a Nuclear or Radiological Emergency, General Safety Guide Series No. GSG-2, IAEA, Vienna 2011)

22. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Commissioning for Nuclear Power Plants, Safety Guide Series No. SSG-28, IAEA, Vienna (2014)

23. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Periodic Safety Review of Nuclear Power Plants, Safety Guide Series No. SSG-25, IAEA, Vienna (2013)

24. **INTERNATIONAL ATOMIC ENERGY AGENCY** - A System for the Feedback of Experience from Events in Nuclear Installations, Safety Guide Series No. NS-G-2.11, IAEA, Vienna (2006)

25. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Occupational Radiation Protection, Safety Guide Series No. RS-G-1.1, IAEA, Vienna (1999)

26. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Assessment of Occupational Exposure Due to Intakes of Radionuclides, Safety Guide Series No. RS-G-1.2, IAEA, Vienna (1999)

27. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Assessment of Occupational Exposure Due to External Sources of Radiation, Safety Guide Series No. RS-G-1.3, IAEA, Vienna (1999)

28. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Radiological Protection for Medical Exposure to Ionizing Radiation, Safety Guide Series No. RS-G-1.5, IAEA, Vienna (2002)

29. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Environmental and Source Monitoring for Purposes of Radiation Protection, Safety Guide Series No. RS-G-1.8, IAEA, Vienna (2005)

30. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Radiation Generators and Sealed Radioactive Sources, Safety Guide Series No. RS-G-1.10, IAEA, Vienna (2006)

31. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Deterministic Safety Analysis for Nuclear Power Plants, Specific Safety Guides Series No. SSG-2, IAEA, Vienna (2010)

32. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants, Specific Safety Guide Series No. SSG-3, IAEA, Vienna (2010)

33. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants, Specific Safety Guide Series No. SSG-4, IAEA, Vienna (2010)

34. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Safety of Conversion Facilities and Uranium Enrichment Facilities, Specific Safety Guide Series No. SSG-5, IAEA, Vienna (2010)

35. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Safety of Uranium Fuel Fabrication Facilities Specific Safety Guide Series No. SSG-6, IAEA, Vienna (2010)

36. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Safety of Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities, Specific Safety Guide Series No. SSG-7, IAEA, Vienna (2010)

37. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Licensing Process for Nuclear Installations, Specific Safety Guide Series No. SSG-12, IAEA, Vienna (2010)

38. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Geological Disposal Facilities for Radioactive Waste Specific Safety Guide Series No. SSG-14, IAEA, Vienna (2011)

39. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Storage of Spent Nuclear Fuel Specific Safety Guide Series No. SSG-15, IAEA, Vienna (2012)

40. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, Specific Safety Guide No SSG-26, IAEA, Vienna, (2014)

41. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, Safety Guide No TS-G-1.2 (2002)

42. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Radiation Protection Programmes for the Transport of Radioactive Material, Safety Guide No TS-G-1.3, IAEA, Vienna, (2007)

43. **INTERNATIONAL ATOMIC ENERGY AGENCY** - The Management System for the Safe Transport of Radioactive Material Safety Guide No TS-G-1.4, IAEA, Vienna, (2008)

44. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Compliance Assurance for the Safe Transport of Radioactive Material, Safety Guide No TS-G-1.5, IAEA, Vienna, (2009)

45. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2009 Edition), Safety Guide No TS-G-1.6 (Rev.1), IAEA, Vienna, (2014)

46. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Classification of Radioactive Waste, General Safety Guide No. GSG-1, IAEA, Vienna (2009)

47. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Regulatory Control of Radiation Sources, General Safety Guide No. GS-G-1.5, IAEA, Vienna (2004)

48. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Decommissioning of Nuclear Power Plants and Research Reactors, Safety Guide Series No.WS-G-2.1, IAEA, Vienna (1999)

49. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Decommissioning of Medical, Industrial and Research Facilities (1999) Safety Guide Series No.WS-G-2.2, IAEA, Vienna (1999)

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