

Safety Regulation for the Transport of Radioactive Materials in Korea

Woon-Kap Cho, Bok-Hyoung Lee, Dae-Hyung Cho

Korea Institute of Nuclear Safety, Daejeon, Korea

Abstract

Currently in Korea, there are 20 commercial nuclear power plants in operation and six additional nuclear reactors are under construction. And also there are more than 1800 organizations utilizing radioisotopes for industrial, medical and research purposes. In November 2005, Korean government designated a geological repository site for the disposal of medium and low level radioactive waste. As the use of nuclear energy and application of radioisotopes steadily increase in Korea, the volume of radioactive materials, such as nuclear materials, radioisotopes, radioactive waste, transport is also rapidly increasing in recent years.

The Ministry of Science and Technology (MOST) is the Korean competent authority responsible for the safe transport of radioactive materials and the Korea Institute of Nuclear Safety (KINS) is performing practical regulatory activities to support the MOST. Regarding the transport of radioactive materials, all types of transport such as land, sea and air transport, are regulated by the MOST and the KINS.

The governing regulation for the use of nuclear energy including safe transport of radioactive materials is the Atomic Energy Act (AEA) and the AEA consists of four parts; the AEA, the Enforcement Decree of the AEA, the Enforcement Regulation of the AEA, and the Notice of the MOST. Specific issues including regulatory requirements and technical standards for the safe transport of radioactive materials are described in the Notice of the MOST. These regulations apply to every step of packaging approval and package handling, such as packaging design, manufacturing, inspection, maintenance and package preparation, loading, carriage, storage, unloading etc. The AEA and the related Notices of the MOST are consistent with the IAEA regulations for the safe transport of radioactive material 1996 edition (Revised) No. TS-R-1. Amendment to the national transport safety regulations is being considered in line with the up-to-date IAEA transport regulations and relevant international regulations

1. Introduction

Korea has 20 nuclear power plants in commercial operation and six additional nuclear reactors under construction. Number of organizations utilizing radioisotopes for industrial, medical and research applications are more than 1,800 at the end of 2006 and the number are continuously increasing with about 10% of annual growth rate. As the use of nuclear energy and application of

radioisotopes steadily increase in Korea, the transport demand of radioactive materials, such as nuclear materials, radioisotopes, radioactive waste has been rapidly increasing in recent years. In November 2005, Korean government designated Kyoung-Ju as a geological repository site for the disposal of medium and low level radioactive waste and it is expected that the radioactive waste transport by vehicles and ships will begin at the beginning of 2009.

The Ministry of Science and Technology (MOST) is the prime agency of the Korean government entrusted with regulating all activities related to the use of nuclear energy and radioactive materials including the packaging and transport of radioactive materials. The Korea Institute of Nuclear Safety (KINS) as a safety regulatory expert body supports the MOST and performs practical regulatory activities such as safety review and inspection of radioactive material transport. The governing regulation for the use of nuclear energy including safe transport of radioactive materials is the Atomic Energy Act (AEA) and the AEA consists of four parts; the AEA, the Enforcement Decree of the AEA, the Enforcement Regulation of the AEA, and the Notice of the MOST.

This paper presents the status of Korea's safety regulations, regulatory systems and requirements related to the transport of radioactive material.

2. Regulatory Authorities

The MOST and KINS are national competent authorities for the safe transport of radioactive material and have authority to officially communicate to the IAEA. The mission of the MOST is to regulate the use of nuclear energy and materials to protect health, safety, security of the person and the environment and to respect Korea's international commitments on the peaceful use of nuclear energy. Concerning the transport safety except radioactive material, the Ministry of Construction and Transportation (MOCT) regulates the land and air transport and the Ministry of Maritime affairs and Fisheries (MOMAF) regulates the sea transport. But as for the transport of radioactive materials, the MOST has complete authority and responsibility for the safety regulation of all types of transport such as land, sea and air transport according to the AEA.

The MOST entrust the KINS with the practical regulatory works such as safety reviews and inspections for the safety regulation of radioactive material transportation. The KINS as a safety regulatory expert body performs the safety reviews for the design approval of transportation packages, transport activities, transport under special arrangements and inspections of the packages performances, compliance inspections of transport etc. The KINS reports the safety review and inspection results for radioactive material transport to the MOST and the MOST finally issues approval or certificate on the basis of the technical review submitted by KINS.

3. Atomic Energy Act and the Associated Regulations

The Atomic Energy Act (AEA) is the national law regulating the utilization of atomic energy and radiation including safe transport of radioactive material. The AEA was established for the peaceful use and development of nuclear energy in 1958 and all provisions on safety regulation of transport of radioactive material are entrusted to the AEA. The legal system concerning the safety regulation of radioactive material consists of four Parts: the Atomic Energy Act (AEA), the Enforcement Decree of the AEA, the Enforcement Regulation of the AEA, and the Notice of Minister of Science and Technology. The AEA is enacted as the main law concerning the safety regulation of transport of radioactive materials. The Enforcement Decree of the AEA as the

Presidential Decree is necessary for the enforcement of the main Act (AEA) and it describes technical standards and particulars, entrusted by the AEA. The Enforcement Regulation of the AEA states particulars such as detailed procedures and document forms, as entrusted by the AEA and the Decree. The Notice of the Minister of MOST prescribes specific issues including regulatory requirements and technical standards, as entrusted by the AEA, the Decree and the Regulation.

Detailed regulations of radioactive material transport are described in the Enforcement Regulation Concerning the Technical Standards of Radiation Safety Management, etc., and Notices of MOST. The notices of MOST related to the transport of radioactive material are the notice 2001-23 titled as "Regulation on the Packaging and Transport of Radioactive Materials" and the notice 2001-19 titled as "Regulation on Inspection of Manufacture and Use of Radioactive Material Transport Containers".

As an IAEA member state, Korea generally follows the requirements of IAEA regulations with few deviations. The domestic transport regulations for radioactive material follow the technical requirements of the IAEA "Regulations for the Safe Transport of Radioactive Material" 1996 edition (Revised) No. TS-R-1. The transport regulation of IAEA has been revised periodically on two or three years basis but the latest regulation is not incorporated into the domestic transport regulation. Amendment to the national transport safety regulations is being considered in line with the latest edition of IAEA transport regulations and relevant international regulations.

4. Regulatory Activities for Transport of Radioactive Materials

In Korea, regulatory activities for radioactive material transport can be separated into two parts as the transport package related part and the transport activities related part. Regulatory activities related to the transport packages include design approval, manufacturing inspection and in-service inspection of the transport packages. Regulatory measures related to the transport activities include the safety reviews and inspections for radioactive material transport noticed to the regulatory body including transport under special arrangement.

4.1 Approval of Package Designs

The design approval of transport package prescribed in the AEA are applied to the type B, type C packages and packages for the fissionable material manufactured in Korea or imported from foreign countries. The application for design approval should be made according to the package design. Applicants who want to get design approval for a package should submit the required documents for the safety review of package design. Necessary documents for the safety reviews include the design data including drawings, safety analysis report, quality assurance manual and procedures and package performance test plans. If the results of the safety review comply with the safety requirements, the MOST issues the certificate of design approval for the package. The design approval of the transport package is effective for 5 years and the packages should be re-approved every 5 years to extend the expiration date of the design approval.

4.2 Manufacturing Inspection of Packages

Manufacturing inspection of the transport packages is an inspection performed at the point of manufacturing time. The purpose of the inspection is to confirm that the package is manufactured according to the approved design and have the necessary safety performance for the intended transport. Main inspection items include material inspection for the main structural and functional parts, welding and non-destructive inspection on important functional parts, package performance inspection and quality assurance inspection. The performance inspection of the packages covers visual inspection of inner and outer parts, load inspection for the lifting fixtures and tie-down structures, maximum operating pressure inspection, leakage inspection on the containment boundaries, radiation shielding inspection and heat transfer performance inspection. Manufacturing inspection is performed at the manufacturing site of the package and every transport package should undergo the manufacturing inspection to confirm the safety functional integrity of the package.

4.3 In-service Inspection of Packages

Design approved packages in use should undergo the in-service inspection every 5 years in order to confirm the safety in continued use of the packages. Packages subject to in-service inspection are type B, C packages and packages for fissionable materials. A person who needs to undergo the in-service inspection of a package may file a self-checkup report as prescribed by regulation. In this case, the regulatory body examines whether the report can be regarded as substitute for the inspection. The inspection items depend on the package types as the package characteristics are different according to the package types such as packages for NDT irradiator, new nuclear fuel assembly, spent nuclear fuel, etc. Major in-service inspection items are almost same with the manufacturing inspection, but generally surface contamination inspection is added in the in-service inspection. If the results of the in-service inspection meet the safety requirement, a confirmatory document for the in-service inspection is issued and the package can be used for additional 5 years.

4.4 Safety Review of Transport

Anyone who wants to transport type B, C packages or packages containing fissionable materials should report to the regulatory body before transport. The transport report should be made 5 days before the transport date and include the detailed information of the transport such as radioactive contents, the type of radioactive material, written transport and emergency response procedure, etc. The regulatory body should review the safety aspects of the informed transport and give order to rectify factors to improve safety, if any, before transportation.

In principle, transport report should be made whenever the transport takes place and the safety review of the transport should be made. But the transport report can be given annually in case of the transport related enterpriser having the permit of mobile use, production, sales of radioisotopes. In these cases, transport of radioactive materials is carried out continuously throughout the year.

4.5 Safety Inspection of Transport

Compliance inspection of transport is to make an inspection of the transport safety at the field of transport. There are two kinds of inspection, that is, periodic inspection and individual inspection. Periodic inspection is carried out with one year to three years period according to the characteristics of the transport activities of the transport related organization. Operator of a nuclear power reactor, installer of a research reactor, nuclear fuel cycle enterpriser, constructor or operator of disposal facilities of radioactive waste and a person specializing in the mobile use of radioisotopes should be inspected on the safety aspects of their transport activities every year. Producer or seller of radioisotopes is inspected annually or every three years depending on their permitted amount of radioactive materials they can handle each year. As for the individual request of transport inspection, the inspection is conducted whenever the transport is carried out. If the packaging and transportation are made within the company, the inspection can be carried out with one year period. A person who needs to get an inspection of radioactive material transport should submit the required documents for the inspection to the regulatory body.

Through the safety inspection of transport, the regulatory body can check whether the scheduled transport comply with the requirements of the regulations and maintain the transport safety. Main checking points of the transport inspection are the suitability of transport vehicle, safety management personnel and workers involved, marking, labeling, placarding, transport documents, safety managements and emergency response equipments, emergency response procedures and transport route, etc.

4.6 Transport under Special Arrangement

Transport can be carried out under the special arrangements when it is extremely difficult to transport radioactive material as provided in the transport regulation. For instance, large-sized machinery contaminated with radioactive material is difficult to put into a transport container and in this case the MOST may approve the transport under special arrangement notwithstanding the provisions of the related regulations.

Under the special arrangement, necessary safety measures should be taken to prevent the spread or leakage of radioactive materials or to prevent other hazards from materials contaminated by radioactive materials. When a transport is carried out under special arrangement, the MOST may order the execution of necessary measures to ensure the transport safety and if necessary the compliance inspection of the transport is performed by the regulatory body.

4.7 Utilization of Real time Source Tracking System

KINS has developed a real-time radiation source tracking system, under the support of the Korean government, that uses the technology of Global Positioning System(GPS) and Code Division Multiple Access(CDMA) technology in order to locate industrial radiography sources when they are stolen or misplaced. A central control system has been established in KINS and the KINS has been monitoring the location of the sources in real time. This system can be utilized to enhance the transport safety of radioactive material and to coup with the emergency situations related to the transport of radioactive material.

4.8 Radiation Safety Information System

For effective control of radiation sources, KINS has developed the Radiation Safety Information System (RASIS). RASIS is an integrated network system forming powerful network of the authorization and management of radiation sources by sharing RASIS database with MOST and other organizations. RASIS makes it possible to trace radiation sources from manufacture (or import) to disposal and to manage the inventory of radiation sources efficiently. RASIS brings together the tasks of regulation authorities, related institutions and organizations using radioactive materials, thereby contributing to active usage of radioactive materials and ultimately boosting national competitiveness.

In Korea, overall management for safety regulations of radioactive material transport is carried out through RASIS. Applicant can submit their application to the regulatory body through RASIS and check the processing status on their application on internet. KINS put the safety review or inspection reports on RASIS and report the safety evaluation results to the MOST. The MOST issues necessary certificates or permit to the applicant through RASIS on internet. Various statistics concerning the safety regulation of transport can be produced and accessed through RASIS system.

5. Several Issues related to Radioactive Material Transport

5.1 Transport of Spent Nuclear Fuel

At present, the amount of spent nuclear fuel transport in Korea is relatively small and transport is usually carried out inside NPP sites. In Wolsong NPP which is a PHWR plant, spent fuel is being transported to the dry storage facilities constructed inside the site area and the transport distance is only few hundred meters. In other PWR NPPs, transport of spent fuel is frequently carried out between the spent fuel storage pools of neighboring reactors. As the capacity of spent fuel storage pool and the dry storage facilities in the NPP site area are not sufficient and the operation of the new nuclear reactor is steadily increasing, the amount of spent fuel transport will substantially be increasing. The capacity of storage facilities in NPP sites will be reached to the saturation point around 2016, therefore, preparation of the interim storage facility of spent fuel is urgent tasks in Korea. The regulatory body needs to prepare in advance the necessary safety regulations for the spent fuel transport to the interim storage facility and nuclear power related companies should prepare the comprehensive measures to ensure the transport safety of spent nuclear fuel.

5.2 Transport of the Intermediate and Low Level of Radioactive Waste

The disposal site for the intermediate and low level of radioactive waste was designated to Kyoung-Ju and a large amount of radioactive waste stored in the NPP site is expected to be transported to the disposal site from the beginning of 2009. An exclusive transport ship is under construction and specially designed IP type transport containers for radioactive waste are being manufactured. As the IP type package is not subject to competent approval for the package

design, reasonable and effective method to confirm the safety of the package design need to be prepared. New safety regulations for the transport of radioactive waste by the exclusive ship are under development.

5.3 Consideration of TransSAS

IAEA provides a Transport Safety Appraisal Service (TranSAS) mission to a member state on request to make a comprehensive assessment of state's regulatory activities in the area of transport safety of radioactive material. It should be considered and prepared to receive the TranSAS on the overall safety status of radioactive material transport in Korea. TranSAS mission to Korea can be a good opportunity to make a through check on the current status of transport safety regulatory activities and make some amendments to the existing regulatory procedures or activities. Through TranSAS mission, Korea can enhance transparency as to what the Korea's regulatory bodies are doing for transport safety by making the results available to the public and build up public confidence in both the regulatory bodies and the licensees.

5.4 Non-Competent Approved Package Design

Non-competent approved packages such as type A and IP packages are widely used and the number of those packages is expected to increase continuously. Type A and IP packages are usually manufactured and used without a complete demonstration of the compliance of the package design to the regulatory requirements. It is necessary to prepare an appropriate review programme for non-competent approved package design.

5.5 Emergency Response Plans

The Atomic Energy Act requires that the transport-related licensees should prepare the emergency response plan to cover transport incidents or accidents involving radioactive material. Although the majority of the transport-related licensees established their emergency response plan, the response procedures should be described more clearly to cope with specific emergency situation especially considering the transport package type in use. It is necessary to develop and distribute the modal emergency response plan by the regulatory body.

5.6 Consideration of Transport Accidents

The safety record with the transport of radioactive material in Korea has been excellent until now. There have never been any serious injuries, over exposures or fatality or environmental consequences attributable to accidents during the transport of radioactive material. Although radioactive materials in Korea have safely transported to date without causing any radiological releases to the environment or harm to the public, the Korean competent authorities should carefully handle existing and potential issues or concerns about transport safety. An accident during radioactive material transport, even if it does not cause radiological damage to the public, might lower the public trust in both the regulatory authorities and the transport related licensees. In order to preclude such deterioration in radioactive material transport, the Korean competent

authorities need to implement comprehensive measures to improve the transport safety of radioactive material.

7. Summary

Korea is one of the most nuclear energy driving countries. Demand for the radioactive material transport has been increasing continuously with increasing number nuclear power plants and organizations utilizing radioisotopes. The MOST has complete authority and responsibility for the safety regulation of all types of radioactive material transport such as land, sea and air transport. The KINS as a safety regulatory expert body supports the MOST technically in practical safety review and compliance inspection of radioactive material transport.

Korea's transport regulations for radioactive material follow the technical requirements of the IAEA "Regulations for the Safe Transport of Radioactive Material" 1996 edition (Revised) No. TS-R-1. These regulations apply in every aspects of packaging and transport of radioactive material including the design, manufacturing, use, inspection, maintenance and repair of packages and preparation, consigning, handling, loading, carriage, storage, receipt and unloading of packages. Amendment to the national transport safety regulations is being considered in line with the latest edition of IAEA transport regulations and relevant international regulations.

Although there have never been any serious accidents related to transport of radioactive material, the MOST and KINS should be more careful in handling existing and potential issues about transport safety.