



## ORPHAN SOURCES CONTROL IN THE REPUBLIC OF KOREA

C.-W. KIM

Nuclear Energy Bureau, Ministry of Science and Technology, Republic of Korea

**Abstract.** In this paper, the orphan source control programme in Korea will be discussed. Orphan sources are, in general, classified into three groups: 1) Illegally trafficking radioactive sources; 2) Domestic loss of radioactive sources due to the bankruptcy of licensees or authorized suppliers; and 3) Contaminated metal scrap, which has been imported.

There are, currently, two approaches going on to control and manage orphan sources in Korea. First, the Korean regulatory authority (Ministry of Science and Technology: MOST) will fully run an information system on radiation safety to effectively trace and monitor all radioactive sources in the country by the year 2001. Second, the regulatory authority strongly advises steel mill companies to closely scrutinize and inspect scrap metal through a scrap monitoring system when they attempt to reutilize it in order to prevent it from being contaminated by uncontrolled sources.

The Korea Institute of Nuclear Safety (KINS), a regulatory expert organization, is carrying out a three-year multiphase project to control and monitor orphan sources in Korea. The system, called the Information System on Integrated Radiation Safety (ISIRS) on the inter- and intra-net system has been developed to effectively control and accurately monitor radioactive sources on a real time basis since 1998. If the system is successfully set up as scheduled by the middle of May next year, the regulatory authority will be able to control any reutilization of uncontrolled sources efficiently. At the same time, the system can also provide, not only licensees, suppliers, or perspective end users but also the Korean general public of interests with information on radiation safety, safe radiation management tools and public services.

The system has been created because of the necessity to effectively control radioactive sources safely. Also, it serves to prepare necessary protective measures in a timely manner for abnormal events of uncontrolled radiation from radioactive sources such as those involving loss of radioisotopes. By the 2001, the system will be able to provide both licensees and the general public with information on radiation safety more actively and effectively. At the same time, it will serve to guarantee the right to knowledge of the Korean people and to facilitate and effectuate the control of radioactive sources both by industry and by the regulatory authority. The system is composed of three parts; 'Information System on Regulatory Activities for Radioactive Sources including Radiation Generators', 'Cyber Information System Radiation Safety', and 'Radioactive Source Life-Cycle Tracking and Inventory Management System'. With this system, we are going to trace the life cycle of radioactive sources; enabling inventory, prophylactic measures for accidents or abnormal events such as from loss of radioactive sources, usage history, transportation, waste management, etc. Since the system traces radioactive sources 'from the cradle to the grave', we expect to prevent illegal trafficking of the radioactive sources.

All steel mill companies and suppliers of scrap metals in Korea should install the Scrap Monitoring systems to detect the contamination of recycled metals in the nearest future. Currently, large numbers of major steel mill companies have installed fixed-type scrap monitoring systems and operate them to detect any contaminated scrap metals existed before melting for reutilization. They have detected radioactive substances in recycled scrap metals before melting more than 20 times since 1998. However, the levels of radioactivity were found to be very low.

The orphan sources programme being developed in Korea will be a timely and efficient method for bringing orphan sources under control. The dissemination of information to the public and industry will increase awareness of the problem of orphan sources. The improved oversight of licensed devices by MOST will help reduce the number of sources that have become orphaned and MOST is encouraging the installation of additional fixed radiation monitoring systems at seaports and at other locations where radiation sources may appear. Finally, international action is necessary to control sources.

## INTRODUCTION

In the Republic of Korea, radioactive sources are being used in various areas; industries, industrial radiography, medical facilities, research laboratories, educational institutions and public organizations. There are many different types of radioactive sources, including sealed and unsealed radioisotopes, X-ray generators, ion implanters and medical accelerators.

The Ministry of Science and Technology (MOST), Korea's regulatory authority, began its regulatory management of radioactive sources in 1962 when it issued the first licence for radioactive-source users. In Korea, more and more companies or institutions are applying for licences for the use of radioactive sources, increasing by about 10% every year. Currently, there are about 1600 nuclear and radiation facilities, including medical facilities using radiation sources. However, this number does not include medical uses of radiation generators for diagnostic purposes. They are under the regulation of a different authority, the Korean Food and Drug Administration (KFDA). Table 1 shows the increase in the number of radioactive-source users in Korea.

**Table 1.** Licensing Status of Users of Radioisotopes and Radiation Generators in Korea

Year	1962	1990	1995	1996	1997	1998	1999	2000 Sept
No. of Licensees	2	698	1064	1175	1315	1394	1570	1660

As the number of licenses for radioactive source user was growing rapidly, MOST decided, in 1985, to entrust part of its duty of regulation of radiation safety to the Korea Institute of Nuclear Safety (KINS), an expert regulatory organization. Hence, the MOST and KINS are currently both responsible for the control of radioactive sources in Korea.

Orphan sources occur when radiation sources slip from the grip of regulation. We can classify the causes of orphan sources into three categories: 1) illicit trafficking 2) the loss of sources due to the bankruptcy of licensee or suppliers and 3) contaminated metal scrap imported for recycling.

Presently, the Korean Government uses three approaches for controlling orphan sources. Firstly, a regulatory authority has conducted a three-year project to build an information system on the web which is supposed to be in full operation by the year 2001. By then, the authority will be able to effectively manage radiation sources by overseeing them through the system. Secondly, the Government strictly monitors the recycling procedures for scrap metal to prevent the inflow of scrap from uncontrolled sources. Currently, all licensed steel mills are supposed to install radiation detecting systems in their mills and at docks to make sure that the scrap metal is radiation source free. Lastly, MOST sees the need for taking some concrete measures and actions to bring these unwanted radioactive sources under regulatory control and thus reduce the potential hazards of exposure of the general public, workers and the environment to the radiation from these radioactive sources.

This paper introduces Korea's orphan source control programme, which is designed to reduce the number of radioactive sources which might be contained in scrap metal.

## **ILLICIT TRAFFICKING SOURCE CONTROL IN KOREA**

Illicitly-trafficked radiation sources are usually either in the possession of unlicensed entities of licensees which are not authorized to possess those particular radioactive materials. These sources can be categorized, based on our findings, as follows:

- Items not declared, identified or legally cleared by the Korea Custom Services (KCS);
- Tax-free items imported by public or Government organizations;
- Items illegally administered by an agent to evade customs control, charges or taxes;
- Items deemed as tax-exemption items by KCS officers, without recommendation or inspections from radiation or nuclear regulatory authority.

In 1999, the Korean Government investigated all the illicit trafficking and successfully convinced the owners of radioactive sources to inform and report all the illicitly-trafficked sources in their possession to the regulatory body (in this case, to KINS) for registration. To encourage reporting, the regulatory body did not question the informers about their knowledge of the radioactive sources beforehand. MOST conducted the investigation in the following manner:

- The regulatory authority urged unidentified owners to report all the illegally possessed sources to KINS for registration by publicizing efforts through mass media.
- it ordered the unlicensed users, who were identified by the sales records of suppliers of radiation sources, to register all the sources in their possession at KINS; and
- it encouraged users to report and register all the unlicensed imported sources to KINS.

This type of sources are often identified when the end users submit the applications for the purchase of new sources to replace old ones. Old sources are usually found to be almost decayed and no longer in use, since their radioactivity levels are not strong enough.

## **INFORMATION SYSTEM ON RADIATION SOURCES IN KOREA**

KINS has been carrying out a three-year multiphase project to control and monitor all orphan sources imported to Korea. In order to effectively control and closely monitor radioactive sources on a real time basis, Korea has begun to develop the so-called Information System on Integrated Radiation Safety (ISIRS) on the web, using both the inter- and intra-net since 1998. If the system is successfully set up as planned by May 2001, the regulatory authority will be able to control any possible contamination by radioactive sources efficiently and effectively.

The system is designed to effectively control radioactive sources. For example, in case of emergencies like loss of radioisotopes, the system can track them and prepare any possible protective measures in a timely manner.

The system consists of three subsystems; 1) 'Information System on Regulatory Activities for Radioactive Sources including Radiation Generators', 2) 'Cyber Information System on Radiation Safety', and 3) 'Radioactive Source Life-Cycle Tracking and Inventory Management System'.

The first and second parts of the ISIRS system have been completed in the second quarter of 2000 and are now in full operation. Comprehensive data on the radiation sources currently in use or owned by licensees in Korea is accurately collected through the system almost in real time. All the information on licensing activities conducted by the regulatory authority since 1996 has been stored in the system. Previous licensing information will have been deposited in the system by late 2001. MOST and KINS can now conduct a wide range of statistical analyses using the data in the information system. They can also monitor licensing processes on a real time basis through the system.

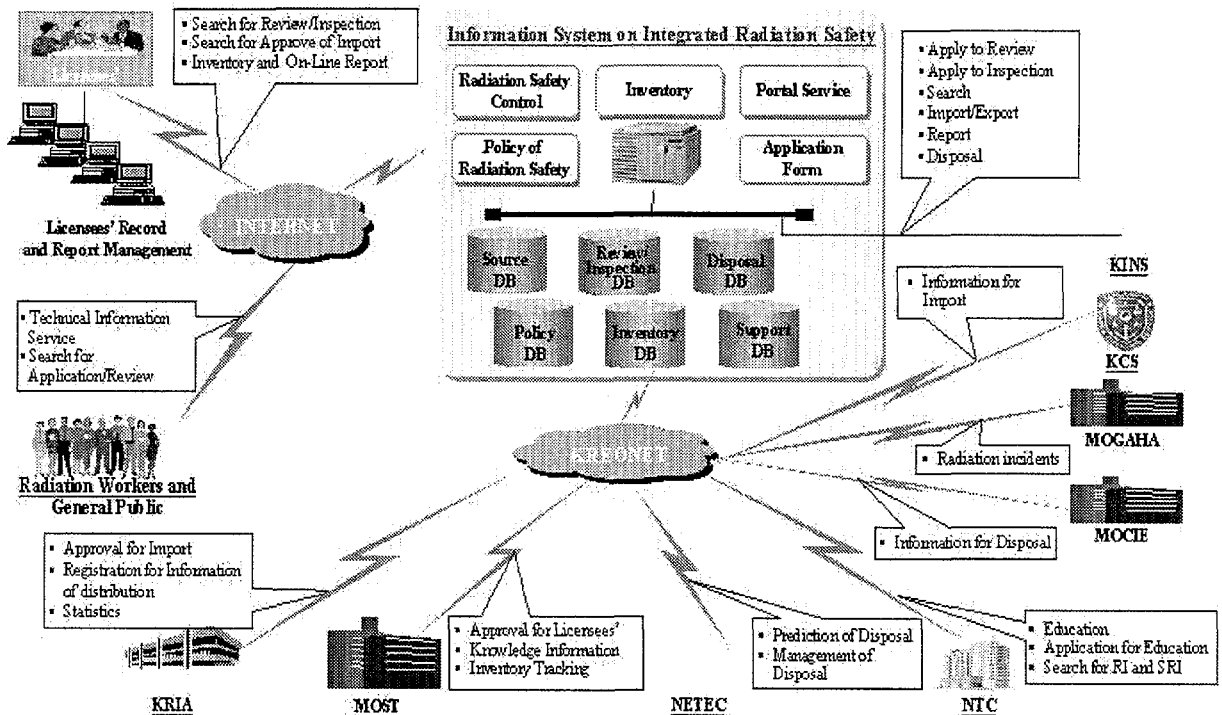


Figure 1. Layout of the network of the ISIRS, which shows the inter- or intra- net used among the organizations.

With this system, we are going to actively trace the life cycle and from an inventory of radioactive sources to prevent accidents or emergencies resulting, for instance, from loss of radioactive sources. We can also keep track of usage record, transportation, and waste management of radioactive sources. In other words, the system serves as a comprehensive tool to trace radioactive sources 'from the cradle to the grave', and we expect to prevent all illegal trafficking of radioactive sources. Figure 1 shows a layout of networking among various government offices, the regulatory authority, competent organizations, licensees and the general public and also information available either through inter- or intra-net when the system is completed.

## MONITORING OF RADIATION SOURCES IN SCRAP METAL

All steel mills and suppliers of scrap metal in Korea shall install the fixed-type scrap monitoring systems in the near future to detect any contamination of metals. Currently, a large number of major steel mills have already installed the monitoring systems and are operating them to detect any contamination of scrap metal prior to the melting process for recycling. Figure 2 shows a typical scrap monitoring system installed at a steel mill's yard in Korea.



*Figure 2. Fixed type scrap monitoring system installed in a steel mill company in Korea, photographed in November, 1999.*

**Table 2. Monitoring of Radioactive Substances in Scrap Metal in Korea**

Date	Company imported	Radioactive Materials	Imported from	Arrangement
'98.04.03	POSCO	NORM	Japan	Stored by NETEC
'98.06.04	POSCO	I-131	Domestic	KINS
'98.07.13	Young-il Industry	Ra-226	Indonesia	NETEC
'98.10.03	POSCO	NORM	Ukraine	NETEC
'98.10.16	Young-il Industry	Unknown	Malaysia	Returned
'98.11.05	POSCO	NORM	Ukraine	Returned
'99.11.01	Kangwon Ind.	Ra-226	Domestic	NETEC
'99.05.10	Kia Steel Co.	Cs-137	Russia	NETEC
'00.01.10	Inchon Steel Co.	NORM	USA	NETEC
'00.05.29	Young-il Industry	Unknown	Mexico	Returned

Many steel mill companies have detected radioactivity in scrap metals and more than 30 times have detected radioactive substances in the scrap before the melting process. Most of the scrap metal found to be contaminated was suspected to be either demolition debris from chemical plants or from those used for industrial purposes. In a few cases, we were not able to identify the sources at all.

We have also found that most of the contaminated scrap metal were imported from foreign countries. In almost half of the contaminated scrap metals, the source of radioactivity was the accumulated precipitation on the inner wall of piping with naturally occurring radioactive material (NORM). Table 2 shows a result of our survey on the contaminated scrap metals before the melting process. Most of the contaminated metal was imported from southeast Asian countries or from Russia. The rest, not shown in Table 2, were imported from countries such as Hong Kong, Thailand, the Philippines, the Netherlands, or the United Arab Emirates.

The levels of radioactivity in the scrap metal were very low except in a few cases. We also detected orphan sources of Ra-226 and Cs-137 from scrap metal used for industrial purposes.

When Korean steel mills or suppliers find scrap metal contaminated with radioactive substances before melting or at the docks, they shall return all the scrap metal to the original supplying countries as soon as possible. Otherwise, steel mills must transport contaminated scrap metal to the Nuclear Environment Technology Institute (NETEC) in Taejon for disposal. NETEC is the one and only organization licensed by the Korean Government to dispose of radioactive waste.

According to the Minister's Notice, wastes contaminated with extremely low radioactivity may be exempted from the stipulation for the disposal of radioactive waste. According to the standards, special radionuclides with 100Bq/g radioactivity may be disposed of by the users themselves. However, we do not have any standards on the contamination of scrap metal. Therefore, the regulatory authority advises users to return all scrap metals to the original suppliers if they are monitored to be contaminated above a certain level.

The Korean Government is going to prepare a provision for recycling, such as standards for scrap metals for recycling, regulatory guidelines on the monitor and control of scrap metals so that they are free of radioactive contamination.

## **CONCLUSION**

The orphan source control programme which the Korean Government is working on will bring all the orphan sources under regulatory control as much as possible in a timely and efficient manner. The Government's publicizing efforts targeting the general public and industry will raise their awareness of the problems of orphan sources. We believe that the improved supervision procedures of the regulatory authority will help reduce the number of orphan sources. For instance, the Korean regulatory authority is encouraging industry to install fixed-type radiation monitoring systems at the docks of Korean seaports and at other locations where radiation sources may appear.

Finally, we strongly believe that all countries concerned should co-operate closely so that we may be able to prevent any possible accidents involved with orphan sources throughout the world.