SAFETY AND SECURITY OF RADIOACTIVE MATERIALS – THE INDIAN SCENARIO

A. KUMAR, S.P. AGARWAL, U.B. TRIPATHI, B.K.S. MURTHY AND B.C. BHATT
Radiological Physics and Advisory Division
Bhabha Atomic Research Centre,C T & C R S , Anushaktinagar, Mumbai, India

Introduction

There has been a phenomenal increase in the use of radiation sources in diverse fields such as medicine, industry, agriculture, research and teaching in India and elsewhere. Though the radiation safety record in these applications has been good, there have been a few incidents/ accidents during transport / use of radioactive materials. Current status and various aspects of regulatory control to ensure safety and security of radioactive material including incidents of missing/orphan sources in India are discussed in this paper.

Regulatory Infrastructure

Government of India enacted the Atomic Energy Act in 1962 to provide a regulatory infrastructure for control and use of radioactive materials and radiation sources. Radiation Protection Rules, 1971, were promulgated under this Act and Chairman, Atomic Energy Regulatory Board (AERB) was appointed as the Competent Authority to enforce these rules. Radiological Physics & Advisory Division (RP&AD) of Bhabha Atomic Research Centre provides technical and executive support to AERB in implementation of the regulations in the non-nuclear applications of radiation. Under the Rules, the Competent Authority has notified the surveillance procedures for various applications.

Various codes and guides on regulatory procedures relating to specific applications of radioactive material have also been issued by the Competent Authority. As per the regulatory procedures, each practice and source requires specific authorisation. The pre-requisites for the procurement of radioactive material for various applications are: (a) Approved source and equipment, (b) Approved installation, (c) Provision of an exclusive safe and secure storage facility for radioactive material when not in use or pending installation, (d) Trained manpower duly approved by the competent authority, (e) Radiation monitoring devices(area and personnel), (f) Emergency preparedness and (g) Commitment from the licensee for safe disposal of disused/decayed sources.

When the applicant complies with all the prerequisites for source procurement, the authorisation is issued with specific terms and conditions. Each source replacement , sale, transfer, transport and disposal requires a specific authorisation. In India, sources for all applications, are allowed to be imported only after obtaining prior permission from the regulatory authority. The user is required to submit safety status report with respect to the use of all radiation sources including physical inventory of the sources, at regular intervals to the Competent Authority as well as to RP & AD, BARC. For the spent/disused sources, the user is required to make sure that the sources are sent back to the original supplier and an undertaking to this effect is to be submitted to the competent authority. Full inventory of all radiation sources possessed by various users is maintained by RP&AD and updated regularly.

Incidents of missing/ orphan sources in various applications of radiation sources

In spite of regulatory procedures and inventory control in force, there have been a few cases of accidents/incidents involving missing/lost sources which might have ended up as orphan sources. The probable causes of these incidents are (a) unsecured temporary storage pending installation, (b) temporary suspension of the use of sources, (c) unsecured storage after decommissioning, (d) poor quality of labelling and marking on packages during their transport, (e) improper packages used for their transport, (f) temporary storage prior to disposal of sources, (g) illicit procurement of imported sources and (h) mobile /portable industrial radiography devices left unattended. The incidents which occurred during 1986-1999 in various applications of radioactive sources are presented in the following sections:

A. ***Industrial Radiography***

In India there are about 400 institutions spread among private and government undertakings engaged in industrial gamma radiography throughout the country. Remote operated equipment, imported as well as those indigenously fabricated, form the major support base for the use of ^{192} Ir and ^{60}Co sources. There are nearly 1100 radiography sources including 75 ^{60}Co units. These sources are used in about 500 radiography sites in India. About 800 radiography devices are annually transported for replacement and movement from one field radiography site to another by different modes such as air and road. There have been 43 radiation accidents in this field including loss of sources during use, storage and transport. Eighteen incidents relate to de-coupling or source getting stuck up in the guide of exposure device. Although most of them were of minor nature, a few of them resulted in radiation exposure to the exposed individuals. Analysis of these incidents reveals that there were 25 cases of missing radiography sources/equipment during 1986-99 out of which 28% (7 cases) relate to loss of sources due to improper transport, 20% (5 cases) relate to negligence of the operator during use and 52% (13 cases) relate to theft from the storage facility at the radiography sites. However, 13 sources could not be traced. In all the cases where the source could not be traced extensive search and interrogations were conducted before abandoning search operations so as to ensure that the source would not reach the hands of members of the public. In these cases, the chances of tracing the source are low mainly due to the delay in noticing/reporting the loss. From the above analysis, it is very clear that the improper storage or transport coupled with carelessness on the part of radiography personnel are the main reasons for the source loss. Among the possible incidents/ accidents, loss of radiography source needs to be viewed seriously because the source can readily get into the hands of members of public who may be totally ignorant of the hazards associated with radiation sources. The lost source, if not traced quickly, can lead to serious consequences.

B. ***Nucleonic Gauges/Well Logging Devices***

There are 6500 nucleonic control systems used in about 1100 institutions. ^{60} Co and ^{137}Cs sources are widely used in nucleonic gauges for level control purpose, ^{241} Am is used for thickness gauge and smoke detectors. Neutron sources such as ^{241} Am-Be and gamma sources such as ^{137}Cs are widely used for well logging. There are more than 500 Neutron & gamma sources in use in well logging at present.

A total of sixteen incidents have taken place during the period involving the well logging devices. Of these, in 50% of the cases the sources were successfully recovered and

the remaining sources (five ^{137}Cs and three ^{241}Am-Be) were abandoned since these could not be fished out of the well. These wells, with abandoned sources, were plugged with appropriate thickness of concrete.

Sixteen incidents involving nucleonic gauge sources were reported including 12 lost sources, out of which 3 sources were recovered. The recovered sources included three well logging sources stolen from the storage room and these were finally recovered from a river into which they were thrown. This was an act of sabotage. In three incidents, the sources were involved in fire.

C. ***Medical Brachytherapy Sources***

There are 102 brachytherapy units operating in India. There have been 9 incidents of lost sources out of which 5 sources could not be recovered. After 1990 no incident/ accident was reported as majority of the centres have switched over to remote/ manual afterloading techniques where source security is effectively ensured. The causes of these incidents are mainly improper handling and violation of safety norms.

Safety and Security of Radioactive Materials

Instances of theft of radioactive sources and equipment and illicit trafficking of radioactive materials have been brought to notice of concerned authorities in India and other countries. This problem has been addressed internationally in meetings and conferences which have been organised to highlight the seriousness of the problem and evolve the preventive measures. In India, a two- day workshop was organised during April 14-15, 1999 at BARC with participants from various organisations representing the central and state governments such as Airport Authorities, Port Trusts, Intelligence Bureau, Excise and Customs, Border Security Force, Coast Guard and Civil Defence College.

As a follow-up of this programme, one day training programme has been planned for personnel drawn from the above mentioned organisations, in order to familiarise them with radiation protection procedures, identification of radioactive package, detection of radiation using appropriate radiation measuring instruments, detectors etc. Three such training programmes have been organised in Mumbai and New Delhi specifically for the customs officials. More such courses for above agencies are planned at their training centres throughout India.

Conclusion

A well-established regulatory infrastructure coupled with regular surveillance procedures and inventory of all the sources in use and disuse will minimise the incidents of orphan sources. Such an inventory should be updated constantly. Procedures should be devised for maintaining strict control in respect to safe and secure storage of radioactive material, specially when the sources are used in public domain e.g. industrial radiography. Regular training/awareness programmes for users, maintenance staff /administrators; periodical surveillance of practices and a regulatory procedure to obtain a periodic radiation safety status from the user, say once in 6/12 months, will go a long way in ensuring safety and security of the sources and minimising chances of their loss.