Sealed Radioactive Sources

IAEA

Issues for Government Agencies

Introduction

Governments are charged with ensuring the social and economic well being of their citizens. This involves balancing the risks and benefits of a wide variety of technology, some of which may involve the use of radiation. This brochure is intended as an introduction to some of the issues for government agencies to consider — first and foremost being the need for an appropriate infrastructure for the safety and security of sealed radioactive sources.


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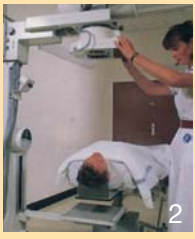
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1 — Teletherapy equipment uses powerful radioactive sources to treat cancer.

2 — Medical radiographer.

3 — Industrial radiography source. This type was used in the USA during the 1930s and 1940s to inspect welds and metal casting. Photo Credits and Copyright 1999: Oak Ridge Associated Universities.

4 — Industrial radiographer wearing a TLD badge (thermoluminescent material in a special holder) used to measure radiation exposure.

5 and 6 — Sealed radioactive sources/M. Al-Mughrabi, Waste Technology Section (IAEA).

7 — Blistering of the palm of the right hand caused by an overexposure to radiation (IAEA).

8 — Conditioning of a sealed radioactive source/ M. Al-Mughrabi, Waste Technology Section (IAEA).

Sealed Radioactive Sources:

Uses and Risks

Radiation occurs when unstable isotopes of elements release excess energy as invisible waves or particles. Depending on the amount of energy released, these waves or particles are able to penetrate solid matter to varying degrees. Because of these unique properties, radiation has many diverse uses such as:


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- killing bacteria in commercially packaged food and medical equipment
- diagnosing disease with pharmaceuticals labelled with radioactive elements
- treating cancer and other diseases
- mapping underground sources of water and prospecting for oil and gas reserves
- checking levels or density in manufacturing processes


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Two broad types of devices exist: those that generate radiation and those that are themselves radioactive. Devices capable of generating radiation include particle accelerators and X ray machines. When the power supply is cut, however, these devices produce no radiation. Other devices contain materials that are radioactive. These devices always produce radiation, but the intensity of the radiation will decrease naturally over time.


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A sealed radioactive source, typically called a sealed source, refers to radioactive material that has been sealed inside a capsule or is permanently bonded in a solid form. Sealed sources within devices are commonly used to deliver a defined dose of radiation, such as that used in cancer therapy or in irradiators that sterilize food and medical equipment. But there are also other uses such as: in industrial gauges, in radioisotope thermoelectric


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Sealed Radioactive Sources:

Uses and Risks *(cont.)*

generators used to provide electric power in remote areas, in gamma radiography to check welds on pipelines, and in well logging sources used to explore for coal, oil, and natural gas.

Sealed source transportation container in poor condition / V. Friedrich (IAEA)

Nuclear materials (such as enriched uranium and plutonium) can produce a self-sustaining nuclear fission reaction and are radioactive, but they are not normally used in sealed sources. The radioactive materials in a sealed source (cobalt, caesium, iridium, etc.) on the other hand, are not capable of fission; and the amount of radiation they emit decreases over time.

Sealed radioactive sources within devices, when used as intended, are designed to limit radiation exposure to users. Despite their design safety features, some sealed source devices may produce a potentially lethal amount of radiation if used improperly. People using sealed source devices must be trained and knowledgeable about their proper, safe and secure use. In untrained hands, such devices can injure and kill. Malevolent acquisition and use of radioactive sources may cause radiation exposure or dispersal of radioactive material into the environment. Such an event could cause significant social, psychological and economical impacts.

If a source becomes too weak for its use, it does not mean that the source is safe. Many accidents have resulted from sources that are no longer being used for their original purpose.

The relative risk for sources has been categorized by their potential to cause serious health effects.

Category 1 sources *could lead to the death or permanent injury of individuals who are in close proximity to the source for a short period of time (minutes to hours). Category 1 sources include: radioisotope thermoelectric generators, irradiators, teletherapy machines, and fixed multi-beam teletherapy machines.*

Category 2 sources *could lead to the death or permanent injury of individuals who are in close proximity to the source for a longer period of time than for Category 1 sources. Category 2 sources include: industrial gamma radiography equipment and high/medium dose-rate brachytherapy.*

Category 3 sources *could lead to the permanent injury of individuals who are in close proximity to the source for a longer period of time than Category 2 sources. Sources in Category 3 could, but are unlikely to, lead to fatalities. Category 3 sources include: fixed industrial gauges (level gauges, dredger gauges, conveyor gauges, and spinning pipe gauges) and well logging gauges.*

Category 4 sources *could lead to the temporary injury of individuals who may be in close proximity to the source for a longer period of time than Category 3 sources. Permanent injuries are unlikely. Category 4 sources include: low dose-rate brachytherapy sources, thickness gauges, portable gauges, and bone densitometers.*

Category 5 sources *could, but are unlikely to, cause minor temporary injury of individuals. Category 5 sources include X ray fluorescence devices, static eliminators, and electron capture devices.*

Physical security measures should be implemented for all sources to avoid the possibility of theft. A graded approach needs to be taken with the most dangerous sources (categories 1–3) to assure their safe and secure use and storage.

Government Infrastructure

Sealed radioactive sources are manufactured in only a small number of countries, but because of their wide range of uses, they are used in virtually all countries of the world. Manufacturers that make sealed sources must comply with their government's regulation and inspection programmes. Governments of importing countries must ensure that the sealed sources meet their national laws and regulations. If regulations do not exist, the sealed source might be imported without any type of regulatory control over its use, safety, security and appropriate disposal. To minimize such risks, national authorities must have an infrastructure with laws and regulations for the importation, use and disposal of sealed radioactive sources; a regulatory authority to authorize work with sealed sources, inspect facilities where sealed sources are used and enforce the regulations; an appropriate registry of sources; and the capacity to respond to an accident or a lost or stolen sealed source. Users are responsible for complying with the laws and regulations governing safe and secure use and storage of sources.

Laws and Regulations

Comprehensive national laws and regulations need to be in place to establish requirements for the safe and secure use of sealed radioactive sources. Laws provide for the establishment of the legal authority through which a national regulatory authority can be established to authorize, inspect and enforce compliance with regulations that control the sale, import, export, use and disposal of sealed sources. These regulations may specify the type of facility or individual permitted to possess and use a sealed source and may require all users to obtain an authorization for their possession and use of a source. The authorization process specifies the education and training

required for those responsible for the sources and the requirements that a facility must meet with respect to physical security over the source to prevent its loss or unauthorized transfer. Procedures that must be in place for monitoring radiation when the source is stored, used or transported. The user must notify the regulatory authority of any changes in use of sources at the facility (including when sources are removed from active use).

A "Code of Conduct on the Safety and Security of Radioactive Sources" has been established by the IAEA as a non-binding international instrument aimed primarily at governments, with the objective of achieving a high level of safety and security of radioactive sources through the national policies, laws and regulations, and international co-operation. You may obtain a copy of the Code of Conduct at the following website: *http://www-pub.iaea.org/MTCD/publications/PDF/code-2004_web.pdf*.

Regulatory Authority

A regulatory authority is normally empowered to authorize and inspect regulated activities and to enforce laws and regulations. The regulatory authority needs to have adequate legal authority for its activities (either through laws or regulations), sufficiently trained staff, and a sufficient budget to undertake regular inspection of facilities. The size of the staff required is dependent on the number of facilities using sealed radioactive sources. Most countries in the world will have many facilities using sources in medical and industrial applications. Inspections are the primary means to verify safe practices. Over the years, numerous accidents have occurred when sources have been lost during industrial use, pipeline welding or road work, or when foreign contractors have abandoned sources used in

mineral and gas exploration. Without an effective regulatory authority to inspect the facilities, there is a risk of similar accidents or theft harming people and the environment with radioactive contamination.

Inventory of Sources

In order to ensure that sources can be tracked throughout their lifetime, an inventory of high activity sealed radioactive sources should be established. Each facility using a sealed source should be required to maintain an inventory of high activity sources on its premises, and a national or regional inventory of sources should also be maintained by the regulatory authority to ensure that sources can be traced if ownership changes. Such an inventory can help maintain regulatory control of a source throughout its lifetime.

Emergency Preparedness:

Safety and Security Issues

National authorities must be prepared to deal with emergencies that can arise with use of sealed radioactive sources. Regulatory authorities must not only have procedures in place to respond to such emergencies, but must require all users and facilities as part of the licensing process to have appropriate emergency plans and emergency reporting mechanisms in place, at the local, regional and national level. Depending on the nature and activity of the source involved, such accidents could have lethal consequences and cause widespread radioactive contamination as well as financial losses to businesses and people. Clean up and monitoring of exposed persons requires significant resources, careful planning, and coordination between government agencies (such as environmental protection, health and social services). The IAEA offers technical assistance in the emergency response and medical assessment of injured persons. However, preventing an accident from happening in the first place is far more cost effective. The IAEA regularly publishes the findings of its investigations into major accidents so that lessons learned can be used to prevent similar accidents. Such findings are also reflected in IAEA technical and Safety Series documents.

With the recent rise in terrorist activity, the likelihood of a terrorist group using a source as a radioactive dispersal device must be included in preparedness planning both by the regulatory authority and the facilities where sources are used or stored. High activity industrial radiography sources, industrial irradiators, thermoelectric generators and teletherapy sources are especially hazardous. The security needed depends on the potential consequence of a stolen source. Some security measures are intended to protect a source, to detect any unauthorized access, and to delay thieves until a response is made. Facilities

should have procedures in place to prevent, detect and respond to a possible theft. Customs officers should be given clear guidance on how to proceed if a source is found, for example, at a border control point. Similarly, national regulatory and police authorities should be prepared to respond to such situations.

Although most sealed radioactive sources have a relatively long life time, at some point they must be replaced. Most countries with nuclear power programmes have some capacity for long term storage of radioactive waste that could also be used for such disused sources. One of the major challenges facing countries without waste facilities is how to safely manage disused sources. Waste management must ensure that sources can be kept secure without risk of loss, theft or accident over very long time periods. Source management includes conditioning the source, checking the status of the source regularly and keeping records of all transactions by the waste operator.

The importation of a source creates a long term obligation to manage the source when it no longer has a useful purpose, both for the importer and for the regulatory authority. If the source cannot be returned to the supplier the waste operator should condition the sources and store them in a secure central facility. Some manufacturers may be willing to take back sources they supplied. Final disposal of sources in a licensed disposal site is the ultimate solution.

In Conclusion

To balance both the risks and benefits of sealed radioactive sources from social, health and economic perspectives, national governments will require an adequate infrastructure to effectively control the use of sealed radioactive sources. Detailed technical information to assist governments to establish an effective infrastructure to ensure the safety and security of sealed radioactive sources is available from the IAEA Safety Series and technical documents: *http://www-pub.iaea.org/MTCD/publications/publications.asp*.

See "Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, Safety Standards Series No. GS-R-1 (2000)", http://www-pub.iaea.org/MTCD/publications/PDF/Pub1093r_web.pdf

Cover photo: Entrance of the underground shelter, where a radioactive source was inadequately stored/Lilo Training Centre, Georgia (IAEA).

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