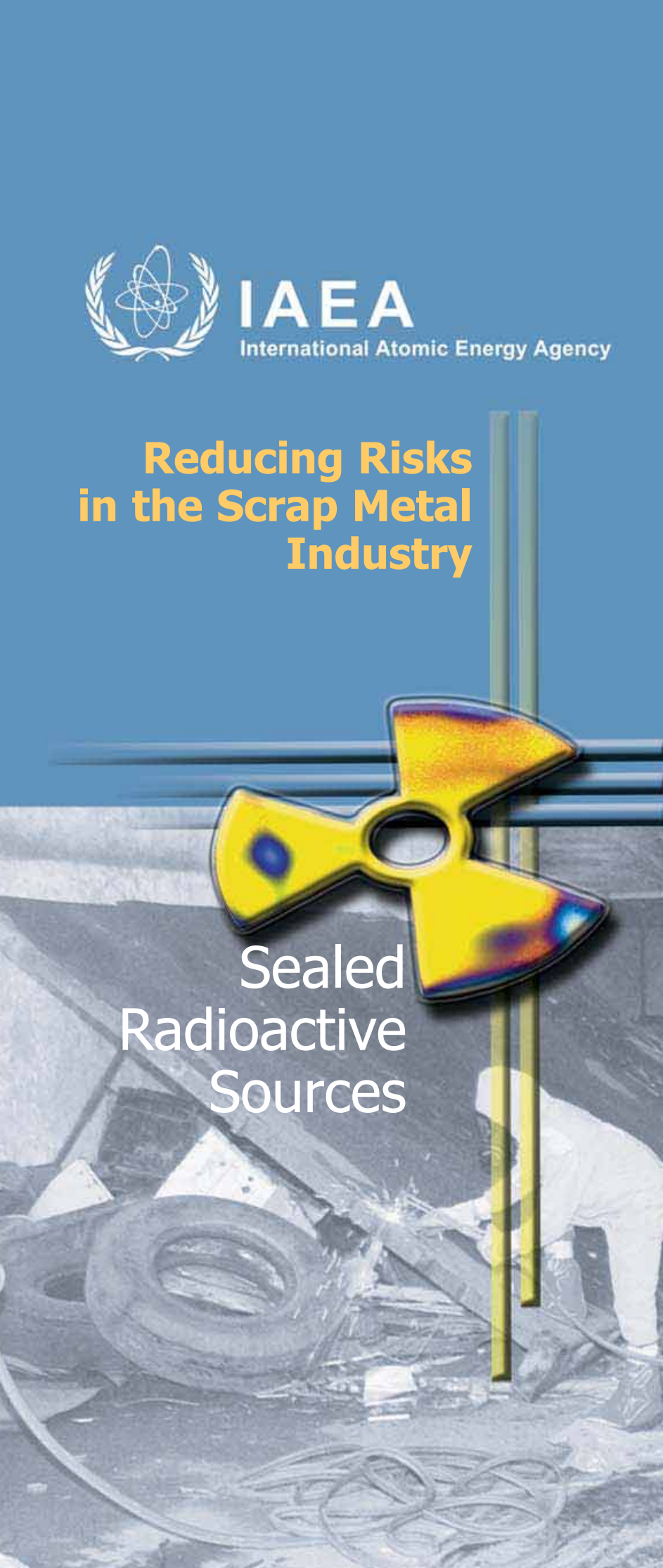
IAEA
International Atomic Energy Agency

Reducing Risks in the Scrap Metal Industry



Sealed Radioactive Sources

Introduction

In November 2000, a worker set off a radiation detector on his way into a French nuclear power plant. Fearing that the worker might somehow have been exposed at the plant, a thorough check for radioactive contamination was made. The results sparked concern not just in France, but also around the world. The worker himself was not contaminated, but parts of the metal bracelet of his watch were found to be radioactive. Further analysis revealed that the steel pins in the bracelet were contaminated with traces of cobalt-60, a radioactive form of the metal cobalt.

The watches were imported from Hong Kong, where they had been assembled. The source of contamination was later traced to a small plant in China that had provided steel for the bracelet pins. It is thought that a teletherapy head, a device used in radiation treatment of cancer patients, had been inadvertently melted down as scrap at this plant. In France, the watches were sold through a large, international department store, raising fears that the watches could also have been on sale in Europe, Asia, and South America. Fortunately, an investigation by regulatory authorities around the globe, did not find any further watches in distribution. But had one contaminated watch not been detected at the French nuclear plant, many people might have been exposed to low doses of radiation. The one hundred kilograms of contaminated steel found at the plant in China might never have been discovered and could have been used to make other consumer products.

Sealed radioactive sources are used widely in medicine, industry, and agriculture. When used as designed, these sources have far-reaching benefits. When these sources are lost, misplaced, or stolen, they can have equally far-reaching, and unfortunately even deadly, consequences. How can such losses be prevented? How can

contaminated material be detected before it makes its way into consumer or other products?

In most countries, radioactive materials and activities that produce radiation are regulated. Those working with sealed radioactive sources are required not just to have proper credentials, but also the needed training and support to deal with unexpected circumstances that may arise when a source is used. Despite these measures, accidents continue to occur. Serious or life threatening injuries involving sealed sources have been reported to the International Atomic Energy Agency (IAEA).

Among its many activities to improve the safety and security of sealed sources, the IAEA has been investigating the root causes of major accidents since the 1980's and publishing the findings so that others can learn from them. This information needs to be in the hands of those whose actions and decisions can reduce accidents by preventing a lost source from making its way into scrap metal. It is hoped that this booklet will improve the awareness of those involved in collecting, dealing, importing, or melting scrap metal of the potential problems and, thereby, reduce accidents and injuries from sealed radioactive sources.

Lessons to be learned

The following are but a few of the accidents that have occurred over the last 20 years when lapses in good practice, human error, or lack of knowledge have resulted in serious injuries and deaths. A review of the root causes of these accidents reveals a worrying similarity.

Severe radiation accident in Turkey. In 1993 in Ankara, Turkey, three disused cobalt-60 teletherapy sources were packaged for re-export to the United States. The sources were not exported

immediately, but were stored without the permission of the regulatory authority at the company's premises. Over time, two of these packages were taken to Istanbul and eventually transferred to empty premises that were not secure. In November 1998, these premises were sold, and the new owners sold the packages as scrap metal to two brothers. By December 1998, the brothers had taken the packages to the family home and began dismantling the protective containers over a period of a few days, until they and others became ill with nausea and vomiting. Over a period of about two weeks, it seems that pieces of the dismantled containers and at least one unshielded radioactive source were left in a residential area before being taken to a local scrapyard. By the time doctors suspected exposure to radiation, and not food poisoning, was the cause, a total of 18 persons were admitted to hospital. Ten of these persons had symptoms of severe radiation syndrome. Five of these had to be hospitalized for 45 days. Authorities recovered one source at the scrapyard, before it was melted down. The second source, reported to be in one of the packages, has not been recovered to this day.

Investigations found that there were several contributing factors, including inadequate security over the sources and inadequate periodic inventory checks. These were the main factors that allowed the unauthorized sale of the packages to take place. Lack of recognition of the radiation symbol (trefoil) on the source by those trying to dismantle the source was also an important factor. Transfer of the

Damaged teletherapy heads (IAEA).

sources to a qualified and licensed waste operator would have prevented such accident.

Contamination in Spain. In May of 1998, an unnoticed caesium-137 source was melted in an electric furnace of Acerinox, a stainless steel factory located in Los Barrios, Spain. As a consequence, the vapours were caught in a filter system resulting in contamination of the 270 tonnes of dust already collected. The dust was removed and sent to two factories for processing as a part of their routine maintenance. One factory received 150 tonnes that they then used in a marsh stabilization process, increasing the mass of the contaminated material to 500 tonnes and contaminating the marsh. The first warning of the event was in early June from a gate monitor that alarmed on an empty truck returning from delivering the dust. Several days later elevated levels of caesium-137 were also detected in Southern France and Northern Italy.

The radiological consequences of this event were minimal, with six people having slight levels of caesium-137 contamination. However, the economic, political and social consequences were major. The estimated total costs for clean up, waste storage, and interruption of business at the affected companies exceeded $25 million US dollars.

The root causes of this accident were the loss of control over the caesium source and the fact that the steel factory did not detect the lost source in the load of scrap metal when it was received.

Multiple deaths in Thailand. In February 2000, a serious accident occurred in Samut Prakarn, Thailand, which resulted in death, injury, and widespread concern. A disused cobalt-60 teletherapy source was being stored, apparently without knowledge or permission of the regulatory authority, in insecure outdoor premises normally used for

storing new cars. Two local scrap collectors allegedly bought some scrap that included the source and took it home to dismantle and resell. They later took the partially dismantled teletherapy head to a junkyard where an employee cut open the protective shielding with an oxyacetylene torch. Those who had been nearby when the protective shielding was cut began to experience nausea and vomiting. Those who had touched some parts of the exposed metal began to suffer burn-like injuries. Their symptoms worsened over a period of days. It was not until about 10 days later that some began to seek medical treatment for their symptoms. By the time medical authorities reported a suspected radiation accident, some 17 days had passed since the source was exposed. The accident resulted in radiation injuries to 10 people of whom three died within the first two months despite medical treatment. Approximately 1870 individuals living within 100 metres of the junkyard were exposed, with many seeking medical attention. The Ministry of Health is continuing to monitor about 258 of these individuals who live within 50 metres of the junkyard for possible long-term effects from the accident.

Investigation revealed that the root cause of the accident to be that the disused source was not stored securely. However, as in the previous example, if those who acquired the teletherapy head as scrap had recognized the radiation symbol (trefoil), they might not have tried to dismantle it and would not have been exposed to radiation.

Measures to detect radioactive sources

These accidents show that it is important to be aware of the potential hazards from radioactive materials and recognize materials that may be radioactive. Smaller companies and independent scrap dealers are particularly at risk, if they do not have proper detection systems and procedures in

place to check the origin of the scrap and if their workers are not trained to recognize international symbols. Those working with scrap metal should be aware of the labelling used to indicate the presence of radiation.

Unusually heavy metal objects may contain radioactive sources

High activity sealed radioactive sources are usually in heavy containers because of the density of metals used to shield their radioactivity. Heavy metal containers (lead, tungsten or depleted uranium) are used to block the gamma rays. This shielding is used to protect those who work with sources and by-standers during transport.

Top left: Exchange container (IAEA).
Sealed radioactive sources/M. Al-Mughrabi (IAEA).

Radioactive sources have labels

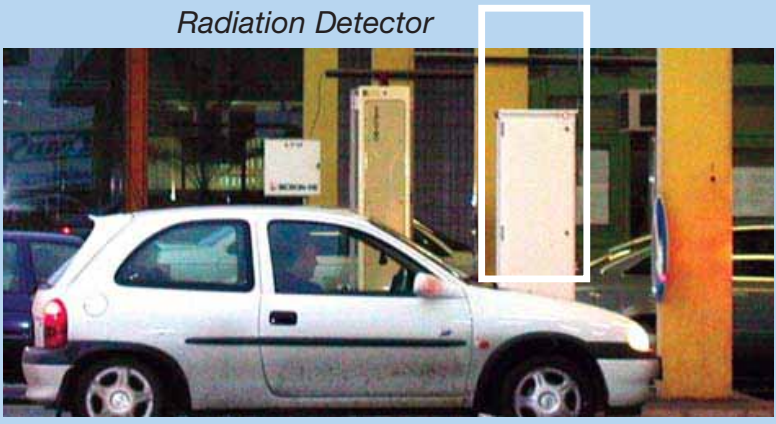
The “trefoil” is the official international radiation symbol used to label sources, containers, or devices. In addition to the trefoil symbol, the word “radioactive” may also appear. Some containers used for transporting sources will have other information on the amount of radioactivity or the type of protective container. Some sources, such as fine needles used for killing tumours, are too small to have any symbols. However, their containers will be labelled.

The display of printed material (e.g., posters) that show typical devices containing the sealed sources at the premises will provide a constant reminder for the staff of their potential risk.

Monitoring incoming scrap for radioactivity

Several countries have set up monitoring equipment at ports of entry to detect undeclared radioactive materials before they enter the country. Many large scrap yards and foundries also use radiation detectors to check loads of incoming scrap for signs of radioactivity. Improved record keeping on the origins of scrap metal may also help reduce the risk of undetected radioactive materials.

Radiation Detector



Preventing radiation exposures, contamination, and economic loss

In addition to the exposure risks, melting down a radioactive source can contaminate equipment, requiring very costly clean-up, long-term waste management, and interruption of business. It is in the best interest of operators at foundries and steel factories to have procedures in place to detect radioactive material.

Procedures and instructions

If radioactive material is found or suspected, the staff need to know what to do and who to contact. Operators should develop procedures to follow and make sure they are understood by workers. Emergency numbers for relevant agencies should be posted and updated regularly.

Abandoned radioisotope thermal generators

Decontamination work in a scrap yard

Training

All staff responsible for collecting, transporting and processing scrap metal should be provided with on-going training on the procedures in place to monitor for radiation and check for radio-active materials. Training should include how to recognize radiation symbols.

In the event suspicious material is found

Call for help

Should suspicious materials be found, immediately contact emergency personnel or the responsible regulatory authority. Protect those in the vicinity from being exposed to radiation. There are three important things to remember to reduce risk from radiation:

- time,
- distance,
- and shielding

Limit time near a source of radiation

Limiting the time spent near any radioactive material, will reduce the amount of radiation exposure.

Keep well away from radioactive materials

The intensity of radiation and its effects drop off sharply with distance from the source, so always maximize your distance.

Shielding reduces radiation exposure

Shielding materials, like cement blocks, lead, steel, and other metals, will block the radiation produced by radioactive materials. Properly trained personnel use shielding to reduce the amount of radiation to which they are exposed.

Contact your regulatory authority for more information.

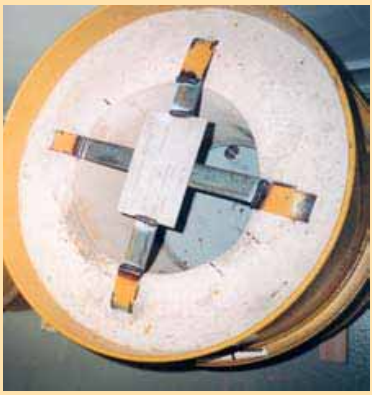


Photo Credit: M. Al-Mughrabi, Waste Technology Section (IAEA).

In Conclusion

The most effective means to prevent accidents with sealed radioactive sources is to adopt work habits that reduce the likelihood of a source becoming lost in the first place. However, if they should become lost, those working in the scrap metal industry must be able to detect a source in order to prevent it from being used as scrap and contaminating other metal.

Cover photo: Cutting up contaminated items for removal from the warehouse of a junkyard. Credit: CNEN/Brazil.

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