RADIOACTIVE CONTAMINATION OF RECYCLED METALS

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INTRODUCTION

Radioactive sources commingled with metal scrap have become a major problem for the metals recycling industry worldwide (1). Worldwide there have been 38 confirmed reports of radioactive sources accidentally smelted with recycled metal. In some instances, contaminated metal products were subsequently distributed. The metal mills, their products and byproducts from the metal making process such as slags, drosses and dusts from furnaces can become contaminated. In the U.S., imported ferrous metal products such as reinforcement bars, pipe, flanges, table legs and fencing components have been found contaminated with ^{60}Co. U.S. steel mills have unintentionally smelted radioactive sources on 16 occasions. The resulting cost for decontamination, waste disposal and temporary closure of the steel mill is typically USD 10,000,000 and has been as much as USD 23,000,000. Other metal recycling industries that have been affected by this problem include aluminum, copper, zinc, gold, lead and vanadium.

Exposures to radiation from radioactive sources mixed with metal scrap can be significant, even injurious. In Taiwan, steel reinforcement bars that were contaminated with ^{60}Co were used in building construction and may have resulted in doses of 1 Sv or more to individual members of the public (1). Estimates of whole body external doses received by workers and residents in Cuidad Juarez, Mexico, as a result of a ^{60}Co teletherapy unit disposed as metal scrap in 1983 ranged from 0.13 Gy to 5.5 Gy (1). More recently, in Estonia, a ^{137}Cs source that was mixed with metal scrap was detected by an Estonian scrap metal company and transferred to a waste disposal facility. It was subsequently stolen from the facility. One person who handled the source and stored it in his home died as a result of exposure to radiation and another household member suffered radiation injuries (1).

In the U.S. in 1994, an unshielded 14 GBq ^{137}Cs source was found buried at a scrap metal processing site. It is not known when or how this source entered the plant. It is not known what doses workers at the site may have received. The potential for significant doses from such an unshielded source is, however, clearly evident.

The most prevalent preventative measure that the metal recycling industry has undertaken is radiation surveillance of incoming metal scrap shipments to detect radioactive sources. While such surveillance has resulted in detection of radiation sources that were mixed with metal scrap, even the best surveillance systems cannot provide 100% protection because of the shielding provided by source containers and by surrounding metal scrap. The industry in the U.S. believes that the U.S. Nuclear Regulatory Commission (NRC) and the States should take additional regulatory measures to assure that licensed sources are properly controlled by licensees and, when transferred or disposed of, are done so in an approved manner and, thus, are prevented from entering the scrap metal stream (1).

THE PROBLEM

In the U.S. there are approximately 7,000 persons specifically licensed by the NRC to use radioactive materials. Another 15,000 specific licenses have been issued by 29 States under agreements with the NRC. Most of these licensees are subject to routine inspections by the NRC or the States at intervals up to 5 years between inspections. In the U.S., persons may also possess and use certain devices containing radioactive materials under a "general license". Such devices must meet more stringent standards for design so that they may be used safely by persons without special training in radiation safety. There are about 95,000 general licensees in the U.S. Most general licensees are not subject to routine inspections. Thus, there is a significantly large number of licensees and radioactive sources that are under minimal routine regulatory scrutiny.

One of the most common uses for radioactive sources is in industrial devices for "the purpose of detecting, measuring, gauging, or controlling thickness, density, level, interface location, radiation, leakage, or qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere" (2). Approximately 1,500,000 of these devices have been distributed in the U.S. to general licensees but not all contain radioisotopes in forms and quantities that might concern the metal scrap recycling industry. There are about 86,000 nuclear gauges in the U.S. which contain radioisotopes in forms and quantities that could create radiation and contamination hazards if mixed with metal scrap, e.g., MBq and larger quantities of ^{137}Cs. If warning labels on these devices and gauges become obliterated or knowledgeable personnel at facilities that use them leave employment, the devices may become lost or inadvertently disposed of as ordinary metal scrap. About 200 licensed sources are lost or stolen each year in the U.S. (1). Some have subsequently appeared in metal scrap destined for recycling. In 1991, the NRC proposed a rule that would have required general licensees to inventory their devices periodically and report their inventories to the NRC (3). Resource constraints prevented the NRC from finalizing this proposed rule. Furthermore, resource constraints are tightening: For the fiscal years 1993 through 1996, Congress' appropriations to the NRC fell from USD 540,000,000 to 474,000,000, a 12% reduction. The NRC personnel ceiling in this period fell by 5%. Most State radiation control programs are under similar constraints.

FINDING SOLUTIONS

Given these constraints, the NRC decided to seek alternatives to the 1991 proposed rule and in 1995 formed a joint State - NRC Working Group to review the regulatory program for radioactive devices and develop recommendations for changes, as appropriate. The Working Group conducted two public meetings in 1995 and a public workshop in 1996. A deliberate effort was made by the Working Group to inform and involve persons who could be potentially affected by regulatory changes, e.g., the metal recycling industry, vendors and user of radioactive devices, consultants and service companies, the insurance industry and the public. The Working Group's findings and recommendations will be finalized in May, 1995.

Among the issues that the Working Group is considering are:

- Device design - Currently, design requirements for generally licensed devices are more stringent than for other licensed devices. A different licensing method might require different design criteria.

- Retrofit - Should new requirements be applied to existing devices or be limited to newly manufactured and distributed devices?

- Options for disposal - Disposal options are limited by availability of access to waste disposal sites and costs.

- Device identification - Are there ways of enhancing the ability to identify devices that are improperly transferred or disposed?

- Radiation exposure savings - What savings might result from improved regulatory controls?

- Cost and fees - What options should be considered to pay for the cost of implementing additional regulatory controls?

- NRC and State compatibility - To be effective on a national basis, regulatory changes must be adopted by the States which have agreements with the NRC as well as by the NRC.

Lastly, the Working Group is considering methods to determine the effectiveness of regulatory programs to ensure adequate control and accountability of licensed sources.

INTERNATIONAL IMPLICATIONS

The U.S. has a well developed regulatory infrastructure that dates to the 1950's. Nonetheless, there is concern that the present U.S. regulatory regime does not provide adequate oversight of users of radioactive devices insofar as ensuring that such devices are properly controlled and transferred or disposed of and thus do not pose a radiation exposure hazard to workers, the public and the metal recycling industry. Other national regulatory agencies may also need to review their capabilities in this highly important area. It is important to recognize that recycled metal scrap is an internationally traded commodity and that it may contain unwanted radioactive materials. When recycled metal scrap that contains a radioactive source is smelted, contaminated metal products and by-products can result which could become sources of radiation exposure. These, too, may be introduced into international commerce. Therefore, the problem of radioactive sources commingled with recycled metal scrap requires attention worldwide.

REFERENCES

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2. U.S. NRC, *U.S. Code of Federal Regulations Title 10, Part 31.5(a)* (1985)
3. U.S. NRC, *Federal Register* 56 FR 67011 (26 December 1991).