

# RADIOACTIVE MATERIAL IN SCRAP METAL - THE UK APPROACH

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## ABSTRACT

In common with other industrialised countries, the UK is aware of the risks associated with the accidental incorporation of radioactive material (RAM) into the scrap metal chain of supply. The source of radioactive materials is *likely* to be from redundant sources (e.g. industrial gauging equipment and naturally occurring radioactive materials (e.g. low specific activity scales) from chemical plant. It may also arise from contaminated scrap arising from the nuclear industry outside the UK. Radiological and commercial implications are discussed. The role and scope of detection systems is outlined.

The UK has set up a working group to address the many issues associated with RAM in scrap. The membership and terms of reference of the group are described.

It is predicted that commercial pressures and safety concerns will stimulate an increase in the number of installed monitoring systems in the scrap metal supply chain in the near future.

## INTRODUCTION

The UK steel industry currently produces about 18m tonnes of new steel per year. However, 7m tonnes (about 40%) is produced from secondary metal, of which the scrap industry contributes about 5m tonnes. The UK produces a surplus of low grade steel scrap; approximately 3.5m tonnes are exported world-wide. In addition, scrap is imported into the UK for processing before being exported as fragmented scrap for subsequent smelting. However, there is a shortage of high value scrap for recycling, and so much of this is imported into the UK, especially from the former Soviet block countries and Africa. The non-ferrous metals industry also recycles a lot of material. For example, 39% of UK aluminium is produced from recycled material, and as much as 74% of lead production is from recycled scrap.

The scrap often passes through several operators before it is actually recycled. Typically, a small scrap merchant will buy mixed scrap by the vehicle or container load, and type sort it. Another merchant will buy this sorted scrap from the first merchant, again by the vehicle load. Here, the material may be shredded in preparation for resale to the steel producer, or export by the shipload.

The risk of radioactive material becoming incorporated into new metal is clearly exacerbated by this heavy reliance on recycled materials, where the source and purity of the product is far more uncertain than material from fresh ore. An additional concern is that if contaminated metal gets into the new materials cycle, the high

percentage of recycling means that it would not be a straightforward task to trace and eradicate such metal in the future.

## SOURCES OF RAM CONTAMINATION

There have been many incidents world-wide of radioactive material becoming incorporated into metal products. A common source of such events has been “orphan” sealed radioactive sources, often originating from redundant industrial equipment, such as gauges for process control.

A typical scenario would be initiated by old industrial plant falling into disuse: personnel familiar with the safe use and custody of the source are no longer present on site; remaining management are unaware of their responsibilities. Consequently, proper procedures are abandoned and the plant is eventually demolished without thought being given to the safe custody of the radioactive sources. Gauges are often attached to steel or non-ferrous components which are separated and sent for recycling, and hence the “orphan” source may enter the scrap chain of supply.

The need to control radioactive sources, from acquisition through to their use in the workplace and through to final authorised disposal is subject to legal requirements in the UK. An employer who is prosecuted for losing control of a radioactive source is likely to receive a very severe penalty from the courts.

Steel and other non-ferrous components can become contaminated with “low specific activity” scale (LSA) arising from the handling or processing of naturally occurring radioactive materials. This often arises in the oil and gas extraction industries. Here, formation of scales is well understood, and there are generally rigorous procedures in place to minimise scale production, and to monitor and decontaminate items prior to disposal as scrap material. However, contaminated scales in metal pipework and plant can occur in other industries such as mineral sand processing, where the understanding and management of radioactive contamination is often less well developed.

Items contaminated by artificial radionuclides can also find their way into the scrap metal chain. Most industrialised countries with a nuclear industry have rigorous controls to ensure that all items of scrap metal leaving a nuclear site are screened for radioactive contamination prior to release. However, there have been instances of contaminated scrap originating from the nuclear industry outside the UK being discovered in UK scrapyards. High value scrap, such as stainless steel and copper, seems to be more prone to this source of contamination than low value ferrous scrap.

## WHAT ARE THE HAZARDS?

Prior to smelting, there is the potential for exposure of operatives and members of the public to external radiation, and possibly inhalation or ingestion of radioactive material/dust if loose contamination is present. The risk will depend upon the form and activity of the contaminated object(s). In reality, the probability of significant doses is quite low: material tends to be handled by machinery.

A greater risk is presented if the contaminated article is smelted. Sealed sources will probably rupture at the high temperatures involved in metal production. Radioactive

material/radionuclides will tend to enter a particular phase of the production process, depending upon the physical and chemical nature of the contaminant. For example,  $^{60}\text{Co}$  will tend to associate with the iron itself, whereas  $^{137}\text{Cs}$  is more volatile and will enter the dust and slag from the steel-making process.  $^{210}\text{Po}$  and  $^{210}\text{Pb}$  are extremely volatile relative to the temperature of molten steel, and will very rapidly enter the fume collection system and condense in the dust collection plant. Contamination in any of these phases has the potential for more significant radiation exposure to employees and members of the public. For example, maintenance workers cleaning the dust collection equipment may inhale or ingest dust significantly contaminated by  $^{137}\text{Cs}$ , or steel products contaminated by  $^{60}\text{Co}$  may enter the consumer cycle. The costs of cleaning contaminated plant can be extremely large (£1m+); adverse publicity and loss of customer confidence in a product could easily have far greater financial impact on a company's operations. Another consideration is the political impact; airborne contamination does not respect national boundaries, as was recently demonstrated in a recent incident in Spain when a  $^{137}\text{Cs}$  source was smelted in a steelworks!

## THE UK APPROACH

The awareness of the hazards associated with radioactive contamination of scrap vary throughout the industry. The major metal *producers* are generally aware of the risks to their employees and their company. Some of the companies at the top of the supply chain are also aware of these risks. However, few of the smaller companies are aware of the possibility and implications of contamination in their stock.

Ideally, it would be desirable to detect the presence of radioactive material as early as possible in the supply chain. This can be achieved by the installation of a radiation monitoring system to detect gamma emitting contamination in supply materials. There is a range of such detection systems available in the UK. However, costs are of the order of £10,000 -£20,000, and there are significant costs of ownership: calibration and maintenance costs are usually high. It is possible to monitor incoming material by hand-held monitors, but these are inherently less sensitive and require a greater degree of operator skill if they are to be effective.

The fixed monitoring systems are usually installed at the weigh bridge to the premises and work by measuring gamma activity from the load through the sides of the vehicle. The chance of detecting radioactive material depends upon: the nature of the radionuclide (is it a gamma emitter?) and the ability of the radiation to pass through the load of scrap and the side of the vehicle (how energetic is the radiation?, where is the source? how is it orientated? is it shielded? etc.). Hence, it can be seen that scanning a load of scrap is not guaranteed to detect the presence of radioactive sources or contaminated objects. For this reason, it is necessary to monitor at several stages in the chain of supply, and in particular at the point before the material is crushed, sheared, fragmented or milled, and again before it is smelted.

The UK Health & Safety Executive, in conjunction with the UK Environment Agency (EA) and the UK government department responsible for the regulation of transport of radioactive materials, has worked with the UK scrap metal industry trade associations to promote an awareness of RAM in scrap, the hazards it can present, and the benefits of installation of monitoring systems to help control the health and

financial risks. Working with trade associations is a particularly efficient and effective way of influencing decision-making within the industry. The partnership is undoubtedly synergistic, bringing benefits to all parties which would not otherwise exist. A small group of representatives from the organisations involved has discussed and formulated a policy on issues such as: risk assessment, detection systems, characterisation of contamination, disposal arrangements for contaminated items, compliance with transport regulations, the possibility of insurance schemes to cover the cost of disposals, and the provision of advice on radiation issues from competent organisations.

In addition, posters, leaflets and guidance booklets have been produced, aimed at the operators of scrap yards. These have included pictures and diagrams of some typical radioactive objects likely to be found in scrap yards, so that employees may recognise them in scrap materials.

It is important that UK regulators are aware of the nature and frequency of occurrence of RAM contaminated objects in scrap metal, such that an approach consistent with the risk can be developed. To this end, key members of the industry have agreed to forward (anonymous) details of all RAM in scrap incidents to the HSE, for entry into a database. This will enable the regulators and industry to identify the size of the problem and the origin of sources of RAM contamination in scrap that are likely to arise, and hence target those relevant employers as a priority for action. It also provides useful background information for the UK to feed into the wider European network of countries which are concerned about control of material from a nuclear origin.

However, within the UK, companies are encouraged to advise regulators locally in the event of the discovery of a radioactive contaminated object in scrap. This will help to ensure that orphan radioactive sources are brought under effective control as quickly as possible, and also provide the regulators with the opportunity to investigate the origin of an orphaned source.

## CONCLUSIONS

Awareness of the hazards associated with the incorporation of RAM in scrap metal has increased within the UK metals industry. The working group set up between the industry trade organisations and the UK regulators has contributed to this by means of guidance, information and publicity. The database of RAM in scrap incidents will allow the regulators to estimate the size of the problem and to target those areas of the industry at greater risk. These safety concerns and commercial pressures within the industry will stimulate an increase in the number of installed RAM monitoring systems in the scrap metal supply chain.

The views expressed are those of the author, and not necessarily those of the HSE.