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Target Audience  
FOD inspectors  
Specialist Inspectors (Radiation)

## RADIOACTIVE CONTAMINATED SCRAP IN METAL RECYCLING FACILITIES

This SIM advises inspectors of the potential for radioactive materials to be found in consignments of scrap metal. It indicates the potential hazards and the precautions that can be taken to minimise the associated risks.

### WHAT IS RADIOACTIVE CONTAMINATED SCRAP? WHERE IS IT FROM?

1 There have been many incidents worldwide, and some in the UK, of radioactively contaminated material becoming incorporated into the scrap metal chain. The radioactive material tends to originate from one of 3 sources:

- 1) **‘Orphan’ radioactive sources** - these typically come from redundant industrial equipment, such as process gauges incorporating radioactive sources. They are likely to contain, but are not restricted to, caesium ( $^{137}\text{Cs}$ ), cobalt ( $^{60}\text{Co}$ ) or radium ( $^{226}\text{Ra}$ ) encapsulated in a stainless steel capsule to form a “sealed source”. Industrial radiography sources such as iridium ( $^{192}\text{Ir}$ ), and depleted uranium ( $^{238}\text{U}$ ) source containers may also be encountered. Redundant or waste radioactive sources from medical applications, and old dials and gauges luminised with  $^{226}\text{Ra}$  have also found their way into the scrap metal chain.
- 2) **Naturally occurring radioactive material (or NORM) or low specific activity (LSA) scale** - NORM typically contains uranium ( $^{238}\text{U}$ ), thorium ( $^{232}\text{Th}$ ) and their associated radioactive decay products. They can accumulate as a slightly radioactive scale on the inside of chemical plant which processes certain chemical feed stocks (eg zircon sand, phosphates), oil and gas. Scrap metal from such plant can be contaminated with significant quantities of LSA scale containing  $^{226}\text{Ra}$  and other radionuclides. In addition, natural thorium, which contains  $^{232}\text{Th}$ , is used in various alloys for specialist applications (eg

aerospace) and welding rods. Scrap metal containing enhanced levels of these naturally occurring radionuclides can find their way into the metal supply chain.

- 3) **Nuclear material** - material originating from the nuclear fuel cycle has occasionally been found in the scrap supply chain. Whilst most countries with a nuclear industry have very rigorous controls over the release of potentially contaminated scrap metal for recycling, lack of controls in some countries, especially the former Soviet states, has resulted in high value scrap such as stainless steel or copper contaminated with radioactive material reaching the UK market.

## WHAT ARE THE HAZARDS AND RISKS?

2 Radionuclides decay, giving off ionising radiation which can interact with human cells, causing irreparable damage which may result in the death of a cell, or cancer. Ionising radiation is not detected by the human senses. The nature of the hazard depends upon many factors such as: the radionuclide present, how much is present (the activity), the radiation it gives off when it decays, how that radiation interacts with the human body, whether the radioactive material becomes incorporated into the body, the distance from the source. However the risks can be grouped into 2 categories:

- 1) **External radiation.** Sources such as  $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ ,  $^{226}\text{Ra}$ ,  $^{192}\text{Ir}$  give off powerful gamma rays which can pass through air over great distances (100s metres), and even to a limited extent through steel, lead, concrete etc, to enter the human body. Hence, even though the radioactive material is outside the human body, perhaps several metres away, a person may be exposed to a significant dose of ionising radiation, with the potential to cause harm. Factors affecting the degree of risk include: distance from the source, shielding around the source, and time spent in the vicinity of the source. However, all the above sources have the potential for considerable risks to employees in the scrap metal industry.
- 2) **Internal radiation.** Radionuclides can be incorporated into the body by ingestion, inhalation and through the skin (absorption, cuts and grazes). In particular, LSA scale or NORM contaminated dusts may be generated during handling or processing of scrap and breathed into the body.

## WHERE WILL THE HAZARDS ARISE IN THE WORKPLACE?

3 Sealed radioactive sources are usually housed in an outer casing or container which acts as a shield to the radiation. 'Orphan' sealed sources from redundant

industrial plant can present an **immediate** hazard in the scrap yard if this shielding is missing or damaged on initial receipt. They may present little risk if the container is properly closed and locked. However, as soon as scrap is processed and sorted by fragmenting, shearing, milling, cutting, etc, there is a potential for loss of shielding and subsequent significant exposure of employees to external radiation.

4 There is also the hazard arising from possible rupture of the source encapsulation during processing of the scrap, or subsequent smelting. Loose radioactive material can then contaminate large areas of processing plant including scrap yards. If a source is ruptured during smelting, the linings of furnaces, slag- handling facilities, bag houses and the actual product can all become contaminated, with significant potential for exposure of plant and maintenance operatives to internal radiation by ingestion or inhalation. In addition, shutdown and decontamination of plant can be very expensive (£1m+).

5 The processing of NORM and LSA scale contaminated items and contaminated scrap from the nuclear fuel cycle can also present a contamination hazard and internal radiation risk in the workplace.

#### WHAT CAN BE DONE TO REDUCE THE RISK? - MONITORING, ALARMS

6 Unless the scrap is obtained from known sources which are highly unlikely to be contaminated, there could be a degree of risk of radioactive contamination in the product. The risk can increase if the scrap originates from premises where radioactive materials are, or have been used. It can be further increased where higher value material (eg stainless steel, copper scrap) is imported into the EU from countries where controls of radioactive material are less rigorous (eg ex-Soviet states, Africa).

7 Loads entering the scrap chain can easily be scanned for external gamma radiation by passing vehicles through a portal monitoring system, often installed at the weigh bridge. Systems typically cost £15-20,000. Upon detection of radiation, an alarm will sound to alert the operator. More sophisticated systems are available which will indicate the likely position of the source(s) within the load, or the radionuclides present in the load. It is normal practice to monitor product on both entry into and exit from the premises, since monitoring is not guaranteed to detect the presence of a very well shielded radioactive source or radioactive contamination buried deep inside the load, where the load itself can effectively shield the source from detection.

#### PROCEDURES IN THE EVENT OF AN ALARM

8 The operator should have procedures to be followed in the event of an alarm. Normally the operator should have to:

- 1) re-run the vehicle through the monitor to confirm alarm;
- 2) isolate vehicle in designated position;

- 3) investigate the vehicle using a hand-held gamma dose rate meter to establish if it is safe to approach the vehicle, and cordon off if the dose rate exceeds, say, 7.5 microSv/h;
- 4) characterise the radiation dose rate around the vehicle (consistent with 3 above);
- 5) contact the radiation protection adviser (RPA) to seek further advice re safe handling, isolation, storage and disposal of source(s) or contaminated item(s);
- 6) inform local office of Environment Agency (EA) or help line number, consignor and HSE if activity exceeds notification levels in the Ionising Radiation Regulations 1999 (IRR99).

9 The load should only be allowed to return to the road if the cause of the radiation alarm has been properly characterised, and it is safe to do so under the Radioactive Materials Road Transport (GB) Regulations (enforced by DfT) and IRR99. The vehicle driver and consignor should be made aware of the hazards to himself and other persons. Otherwise, the vehicle should remain isolated at the recipient's premises until it can be made safe by competent persons.

#### WHAT HAS INDUSTRY DONE?

10 The major players in the industry are aware of the potential health and safety, and commercial risks associated with radioactive contaminated scrap. Some have installed monitoring systems, and have supporting procedures in the event of an alarm. The Trade Association ([British Metals Recycling Association](#)) have produced supporting information and guidance (available for members only, though HSE inspectors have access to this information via the HSE Intranet. N.B. BMRA guidance is subject to copyright and is not to be reproduced under any circumstances.) In addition, posters and information booklets have been produced by the association and the EA, primarily aimed at highlighting the risks from radioactive sources - how to recognise them, what to do etc.

11 An additional factor in the provision of monitoring systems has been the requirement of major purchasers of scrap metal for the supplier to declare that the consignment is free from radioactive contamination. In reality, this requires the supplier to monitor prior to shipment. In turn, this is now cascading down the supply chain to the medium-sized suppliers. As a result, there is a trend towards the installation of monitoring systems at various stages in the supply chain.

#### APPLICATION OF HEALTH AND SAFETY LEGISLATION

12 Under normal circumstances, IRR99 would not apply unless the employer intends to store, or already stores sufficient radioactive material on the premises to

trigger the application of the Regulations.

13 If the Management of Health and Safety at Work Regulations apply to an employer such as a medium to large scrap metal dealer/processor, the employer has a duty under reg.3 to carry out a risk assessment covering their work activities. This should include an assessment of the risks associated with the handling of potentially contaminated radioactive material. Unless the material brought onto the premises can be assured to be free from radioactive material, the employer may need to install a portal/weighbridge monitoring system to minimise the risk to his/her employees from exposure to radioactive contamination in scrap metal. The employer will also need to have written action/contingency plans describing what to do in the event of an alarm, source characterisation procedures, and contact details for local EA and RPA advice covering safe storage and source disposal. It is vital that these procedures cover conditions under and arrangements for authorisation for return of contaminated loads to suppliers; this most only be done in accordance with relevant legislation enforced by the EA, HSE and DETR.

### ACTION BY INSPECTORS

14 Inspectors should check:

- 1) if a risk assessment covering the possibility of radioactive contamination has been carried out;
- 2) whether a portal/weigh bridge (or other) monitoring system is appropriate under the risk assessment;
- 3) that there are arrangements for checking and testing of any monitoring system and action plans covering procedures in the event of the discovery of radioactive contamination in scrap metal (including source characterisation, temporary storage arrangements and source disposal); and
- 4) whether return of loads suspected of containing contamination is carried out in full compliance with relevant legislation.

15 Further advice or information may be obtained from:

- 1) HSE Intranet (copyrighted information – do not reproduce) - <http://intranet/technical/bmra-cdrom/HealthAndSafety/Health/RadioactiveScrap.html>
- 2) The Manufacturing Sector in Cardiff or specialist radiation inspectors.

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