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EXPERIENCES WITHIN BRITISH STEEL SINCE 1989

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1 British Steel

British Steel has four sites (Teesside, Scunthorpe, Port Talbot and Llanwern) producing steel using the blast furnace-BOS production route. It also has two sites operated by British Steel Engineering Steels (Rotherham and Stocksbridge), which produce steel by the arc furnace route. Total production at these sites in 1997/98 was more than 15 M tonnes, and more than 4 M tonnes of scrap was used.
British Steel is also the major shareholder in the stainless steel producer Avesta Sheffield, which produced more than 0.4 M tonnes of stainless steel in the UK in 1997/98 and used more than 0.4 M tonnes of scrap. Scrap is bought from a number of suppliers in the UK and other countries, and all suppliers have to meet agreed standards of quality. Most of the scrap arrives at the steelplants by road, in loads weighing ~25 tonne, although some material is delivered by rail. In either case the material is monitored for radioactivity as it arrives at the incoming weighbridge. Scrap arriving by ship is transferred to the steelworks by road, and is monitored along with the other deliveries by road.

2 Monitoring for radioactivity

After reports of problems with radioactivity in scrap in the USA, the monitoring of scrap for radioactivity began in British Steel in 1989. The first system was a trial unit developed by British Steel Swinden Technology Centre. The system was successful, and it soon disclosed some low level radioactivity in the scrap. It was concluded from this work, and continuing finds of radioactivity elsewhere, that the problem of radioactivity in scrap would be a serious and continuing threat. Monitoring systems were therefore installed at all sites of British Steel and associated companies, in a programme which was completed in 1992.
There have been developments of both the hardware and software of the monitoring systems since the original systems were installed. The system currently recommended within the company has four detector heads which form an array around the incoming scrap load. Each of these heads monitors the scrap for gamma radiation. The data on gamma intensity are divided into thirty-two channels, each corresponding to a different gamma energy. This information is digitised within the detector head, before being passed to the central computer. This computer analyses the information, and compares it with current information on background radiation, and so determines
whether radioactivity is present in the load. Some trials of a detector system of this kind are shown in Fig. 1

3 Detections of radioactive material

During the period 1989 to September 1998 the likelihood of detecting radioactive material has gradually increased as more detector systems have been installed, and the sensitivity of the systems has been increased. The number of detections of radioactive material which triggered alarms at the steelworks sites had reached 35 in September 1998. These detections are summarised in Table 1

Seventeen of the alarms have been caused by natural occurring radioactive material (NORM). The most common form of this is a deposit of minerals containing radium 226 in pipework. Such deposits can sometimes be created simply by the mixing of two streams of process water having different chemical properties. The presence of radioactivity in these deposits is sometimes unexpected, and there have been occasions when it had been unknown to the operator of the plant until it was revealed by the detectors at the steelplant.

The other materials have been from various sources. Those which represented a low level of hazard include metal containing thorium, used as a hardening alloy, and scrap marked with luminous paint containing radium.

The more hazardous materials were those which could either have resulted in a radiation dose to people handling them or have created radioactive products if used in the steelmaking process. They have included radioactive sources of strontium 90 , and cobalt 60, metallic uranium (90 kg), pipework containing intense radioactivity from thorium 232 and radium 226, and activated steelwork which was presumably from a nuclear site.

In addition to the finds at the steelworks there have been finds at the yards of those supplying scrap to the steelworks. These finds have included metallic uranium, sealed sources of caesium 137 and americium/beryllium, and enriched uranium which was almost certainly from nuclear re-processing.

4 Origins of radioactive material

The number of finds of radioactive material is insufficient for detailed statistical analysis.

Nonetheless there appear to be some trends. Table 1 shows there have been a similar number of finds of radioactive material in high alloy and stainless steel scrap, as found in low alloy and carbon steel scrap. This is despite the fact that the tonnage of high alloy and stainless steel scrap used is much lower.

Table 2 shows that scrap imported to the UK is more likely to contain high levels of radioactivity than that arising in the UK. The highest levels of radioactivity found have all been in imported scrap. In practice the imported scrap is nearly always high alloy and stainless material. (The UK imports little carbon and low alloy scrap).

It appears from the information that the stainless and high alloy scrap is more likely to contain radioactivity, and that the likelihood is further increased if the material is imported.

Because high alloy and stainless steel scrap have been shown to be a particular source of risk extra precautions are being taken. Suppliers have been asked to install monitors to check for radioactivity, and this programme of installations is almost complete. As a consequence most of this scrap is checked by both the supplier and by the steelplant before it is used. The result of this is becoming evident. The number of detections at the steelplant has decreased, but there have been a number of detections at the sites of the scrap suppliers. The confidence that radioactive material will be detected has been substantially increased as a result.

5 Actions in event of an alarm

The procedures used in dealing with radioactivity in scrap comply with the legal controls on the use and disposal of radioactivity in the UK. See Table 3 .

The Radioactive Substances Act deals with the possession and disposal of radioactive material. Radioactive material is defined as that exceeding 0.4 Bq/g for most radioisotopes, with exemptions up to 15 Bq/g for some naturally-occurring radioisotopes. Under this legislation it is illegal to accept material believing it to be radioactive, unless the appropriate registration already exists defining the type and quantity of radioactivity.

Under the Radioactive Material (road transport) Regulations the movement of the load containing radioactivity on the road must comply with certain standards related to the packaging and documentation of the load.

The Ionising Radiations Regulations are concerned with safe working with radioactive material. Radiation doses must be limited and correct working procedures must be used.

Once there has been alarm, one of the first actions is to check the levels of radiation around the load to discover whether there is any immediate risk to the driver of the vehicle or other people working in the area. This is done using a conventional Geiger counter, or similar dosemeter. It is important to realise that the hand held Geiger counter is not as sensitive as the installed detector systems, so a failure to detect anything with the Geiger counter is not proof that there is nothing present.

If there is no immediate hazard the load may be move to a suitable place for isolation of the radioactive material. If this operation is to be done off-site there is a need to transport the radioactivity by road, and to comply with the transport regulations, there may be need to obtain permission of the government authorities that the load may be moved.

Isolation of the radioactive material from the load is done under the supervision of people trained in radiation safety. Once the material has been isolated it is characterised with respect to the radioisotopes present and their quantity. The material can then be disposed of in an appropriate way agreed with the national authorities. Characterisation and disposal of the material can take weeks, or months, during which time the material has to be stored in a secure place.

The finding of radioactive material in scrap is a problem for the steelplants and scrap suppliers, which is not of their own making, but they have to bear the costs nonetheless. The national authorities have recognised this fact, and have been helpful in facilitating the transport, storage and disposal of such material.

6 Conclusions

The experience of British Steel is that there is a serious and continuing threat of radioactive material being included in scrap delivered to steelworks.

All scrap entering the steelworks is monitored for radioactivity.

The scrap suppliers and the national authorities have recognised the difficulties caused by the presence of radioactivity in scrap, and are working to minimise the problem.

Both domestic and imported scrap has been found to contain radioactivity, but the imported scrap is much more likely to contain radioactivity.

If radioactivity is found the Environment Agency is informed, and established procedures are used to minimise the hazard, and to isolate the radioactivity.

Detecting, and isolating radioactive scrap, and preventing it being re-melted in the steelmaking process, is part of the overall commitment of British Steel to work safely, and to provide a safe, good quality, product.

Table 1 Summary of finds of radioactivity in scrap
(A single find may include several loads from a single origin)

	Total Finds	NORM	Moderate/highly hazardous
In carbon/low alloy scrap	17	9	2
In high alloy/stainless	18	8	4
Total at steelplants 1989 - 98	35	17	6
At suppliers (all high alloy and stainless)	9 (minimum)	3	4

Table 2 Comparison of radioactivity in imported and domestic scrap

	Total Finds	Total moderate/highly hazardous	Imported to UK Moderate/highly hazardous
In carbon/low alloy scrap	17	2	0
In high alloy/stainless	18	4	4
Total at steelplants 1989 - 98	35	6	4
At suppliers (all high alloy and stainless)	9 (minimum)	4	4

Table 3 Legal controls on radioactive material in the UK

	Concerned with:
Radioactive Substances Act	Possession and disposal of radioactive material. Radioactive material <0.4 Bq/g, some exemptions to 15 Bq/g for natural materials
Radioactive Material (road transport) Regulations	Safe transport of radioactive material. If there is not correct packaging and documentation special permission is needed for transport
Ionising Radiations Regulations	Safe working with radioactive material. Requires limitation of radiation dose, correct working methods.

Fig.1 Trial of radiation detector system

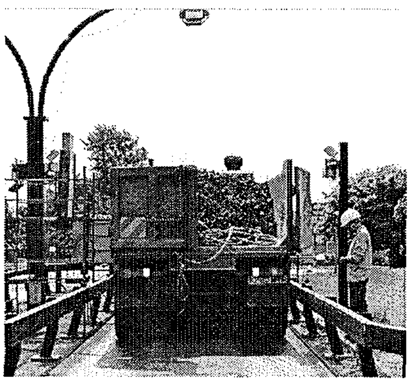
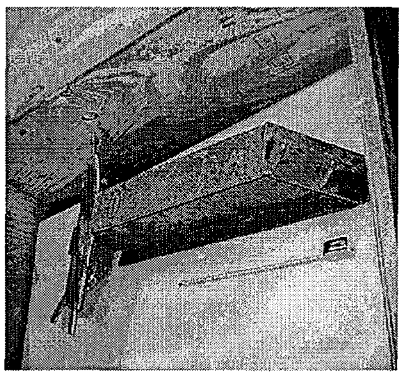


Fig. 2 Example of radioactive scrap:



Activated steelwork.

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