Report from a UK incident

Contamination of an engineering facility due to damaged Tm-170 radiography source

Description of the incident

A purpose-built source holder containing a 20 GBq thulium-170 source (in the form of thulium oxide inside a sealed metal capsule) was being used to inspect tube welds on a steam generator being constructed inside a very large clean room engineering facility. Work was undertaken continuously in this facility, in three shifts.

At the end of one shift, the source was inadvertently left in a tube (possibly as a result of pressure of work) whilst the radiographs were processed. The radiographs indicated that this tube had a faulty weld. Not realising that the source was still in the tube, two workers were told to drill out the faulty weld. During this procedure the source capsule was accidentally destroyed, releasing a substantial fraction of the thulium-170 into the tube and working environment.

The situation was made far worse by the lack of knowledge of the Radiation Protection Supervisors on the nature of the source and of techniques to prevent contamination from spreading. The driller recognised that there had been an obstruction in the tube, removed the source holder and showed the damaged source to the shift RPS. The latter's training had led him to believe that sealed sources could not be damaged. Also there were no contingency plans to deal with the situation. The matter was left to the RPS on the next shift.

Dose rate measurements identified the presence of numerous fragments of the source. The RPS decided to use an industrial vacuum cleaner, which was not fitted with a fine particulate filter, to clean up the area. This had the effect of further dispersing the activity over the whole facility. It was not until 24 hours after the accident that a senior RPS was informed and expert advice sought.

In the interim some 200 workers had been in and out of the facility. Most had contamination on their skin and clothes. The contaminated staff and paperwork from the facility, together with the ventilation system, provided routes for the activity to spread throughout the factory.

Although isolated contamination was found in some cars and homes there was no significant spread outside the factory. It took eight persons three months (twelve hours per day) to clean up the contamination. This, together with lost production, resulted in a significant economic penalty to the company.

Radiological consequences

External whole body doses were negligible. Extremity/skin doses were calculated from the level of fixed contamination and duration:

Number of staff	Extremity (equivalent) doses (mSv)
1	3800
1	150
2	80-100
1	60-80
5	40-60
20	10-40

Intakes of radioactive material, and hence internal doses, were assessed by whole body monitoring:

Number of staff	Estimated Intake (Bq)	Committed effective dose (mSv)
1	4.5×10^4	0.200
1	6.0×10^3	0.025
1	4.5×10^3	0.020
5	3.0×10^3	0.015

Lessons learned

1. Sources must not be left unattended and always be removed to a safe location when not in use.

2. The failure to plan for contingencies and to train staff adequately, especially RPSs, can turn a significant incident into one which has very serious consequences.

3. Whilst there were failings of individuals to follow written procedures, these need to be seen against a background of the overall management of the work and the inherent safety culture. There is a clear lesson of the need to give appropriate priority to the management of health and safety at work.

4. In addition to radiation hazards, accidents can be very costly, in both financial terms and public image terms.