Report from a UK incident

Gamma NDT overexposure from non-retracted source

Description of the incident

An NDT company was carrying out gamma radiography inside a shielded enclosure, using a 1 TBq (27 Ci) Iridium-192 source. The source, in a projection-type container, was exposed and retracted by an automated wind-out system.

There were no interlocks fitted to the enclosure door to prevent entry during an exposure, and there was no radiation detector installed inside the enclosure to indicate a source was exposed. Instead the radiographer was using a manual system to generate pre-exposure and exposure warning signals. The radiographer was not wearing a personal alarm dosemeter (although these were available).

The radiographer assumed that the previous exposure had finished, and used a portable gamma dose rate monitor to check for the presence of radiation inside the room. The monitor showed no response, and he entered the room and set up the work for the next exposure. After he left the room and attempted to begin the next exposure, he noticed that the automatic wind-out had failed to initiate the exposure and that the warning and indicator lights on the unit were not working.

The exposure unit's distance counter display indicated that the source was incorrectly positioned (between the collimated exposure position and the shielded container). The dose rate monitor was used to measure radiation levels at the room entrance, and again showed no response. The radiographer then disconnected the automatic exposure system and attempted to manually exposure the source. He then realised that the source had not properly retracted after the previous exposure, ie the source had been exposed while he was in the radiography enclosure.

It was subsequently determined that the dose rate meter used by the radiographer had a flat battery. This was despite the fact that the Local Rules contained instructions directing radiographers to check the "battery status" of their radiation monitors prior to entering the room.

Radiological consequences

The radiographer was wearing a thermo luminescent dosemeter. It was sent for assessment, and gave the following recorded doses:

Effective (whole body) dose	42.9 mSv
Equivalent (skin) dose	50.6 mSv

Shortly after the incident, a blood sample was taken from the radiographer for cytogenetic (chromosome) analysis. The results of the analysis were negative - indicating that the dose received was less than 100 mSv, and it was concluded that the recorded dose was correct.

Lessons learned

- The primary cause of the incident was the failure of the automatic wind-out unit to drive the source back into the shielded position. Automatic wind-out mechanisms should be configured such that when switched off, the source is fully retracted into the container, ie before the power is turned off. It is important that gamma radiography equipment is properly maintained and serviced, and that any faults identified during use are reported and dealt with immediately. Even then, such systems are not "fail-safe" and a check with a working radiation monitor should always be made at the end of every exposure.

- The radiographer should have recognised the initial fault conditions of the unit (ie warning and indicator lights) and deduced from the counter display that the source was incorrectly positioned. Employees should be thoroughly trained in the correct use of the equipment, be familiar with *all* the relevant safety and warning systems, and understand the main equipment failure modes. Radiographers must be aware of (and understand the need for) the safety instructions contained in the local rules.

- The wearing of a personal alarm dosemeter would also have alerted the radiographer to the presence of high dose rates, and such dosemeters are recommended for all industrial gamma radiographers.

- The installation of an independent gamma detector/alarm inside gamma enclosures can add significantly to the level of safety.

- One less obvious lesson from this incident is that automated systems do not necessarily imply a greater level of safety. In this case, there were more ways for the equipment to fail than with a manual exposure system. Although there were fault indicators on the exposure system, they can be (and were) overlooked by the operator. Also, when using a manual exposure system, radiographers develop a "feel" for whether the source is exposing and retracting in the normal manner, and thus can notice developing problems – something that an automated system cannot do.