



Incident involving radiation injury from gamma NDT source exchange

Description of incident

The incident occurred during the replacement of a used Iridium-192 gamma NDT source (activity 74 GBq (2 Ci)) with a new source of 2.6 TBq (70 Ci). The sequence of events was as follows:

- The source exchange (into a projection-type NDT container) was carried out, with nothing unusual noted.
- After the exchange, the radiographer performed a routine test exposure to validate the exposure time. He does not notice at the time, but the source is not fully extended – it stops short of the exposure position due to a crease in the projection tube.
- After developing the film, he determined a non-exposure, and assumed that the new source had not been correctly loaded during the exchange. This is supported by his dose rate meter that gives no indication near the device.
- Thus, he restarts the source exchange operation manually (from a container provided by another company) and he, unfortunately, loads both the old and new sources into the same container. He then finds that he cannot disconnect the shaft from the container of the old source to the container of the new source (the radiological meter still gives no indication).
- Perplexed, he rewinds the cable and called a radiographer from a different company, who notices with his radiological meter that the new source is fully loaded in the device, and thus the source exchange was, in fact, performed correctly the first time.

After reflection, the radiographer remembers that during the test exposure, the projection tube was a little curved which may have prevented the source from extending fully.

It is actually during the second (failed) source exchange procedures that the radiographer received a high radiation exposure - irradiation of hands and the whole body for about five minutes where he handled the tube-container junction without success. He did not, however, report the error at the time: the exposure was revealed by the examination of his personal film badge.

A subsequent investigation revealed the following facts:

- The radiographer's survey meter was inspected annually. After the incident and inspection by the suppliers of the meter, it was found that it was subject to random failures.
- The radiography facilities and procedures were inspected by an approved body a month before the incident (with the old source) and a month after the incident (with the new source). These inspections did not detect any specific anomalies.
- The verification of the gamma radiography equipment is performed annually (the last review was carried out six months before the incident). In addition, during these reviews, the projection tube is periodically replaced.
- There was no written procedure for the exchange of a radioactive source.

Radiological consequences

The first radiographer was the only person exposed. His whole body dose, as recorded on his film badge, was 200 mSv. Biological dosimetry confirmed the results of film badges (0.4 Gy with a 95% confidence interval of 0.2 – 0.6 Gy).

The irradiation of his left hand was estimated at 20-30 Sv. Three to four weeks after the incident, a very large skin blister of the internal part of the palm of his left hand appeared, evolving into cutaneous fibrosis accompanied by local pain.

Lessons to be learned from the incident

- Survey meters must be subject to careful testing and inspection in order to prevent random or intermittent failures. In this example, if the radiological meter had functioned properly, the operator would have realized that the source replacement operation was successful.
- Care should be taken to avoid excessive bends or curves in the source projection cables and tubes, as these commonly result in blocking the passage of the source.
- For specific operations such as the replacement of a used source by a new source, the company must have written procedures on how to proceed.
- When there is a handling error or even if this is just suspected, it must be reported to the employer as quickly as possible.
- It is necessary to update the radiation protection training of radiographers and supervisors regularly.
- An electronic dosimeter would have alerted the radiographer and prevented the radiation exposure, and these should be mandatory for such work.