



## Report from a French incident

**Incident during the retraction of a gamma NDT source****Description of the incident**

The incident involved a 0.85 TBq (23 Ci) Iridium-192 source, and took place at night (between midnight and 2 am), on a construction site. The sequence of events was as follows:

- During radiography using a projection container, during a source retraction, the cable separated from the source holder.
- Radiographer A, without checking with a survey meter that the source was in the projection container, locked the container, uncoupled the projection tube and returned all the equipment to his assistant, B.
- The assistant uncoupled the control mechanism and then noticed, during this operation, that the source holder was not connected to the cable (it was then 2 a.m.). Radiographer A then performs a radiological check which confirms that the source is not in the container.
- A thinks he lost the source and leaves the premises with B; they seek help from C (also a trained radiographer) who was also working that night in another building and who had returned to the workshop where films were developed.
- After getting a container and remote handling tongs, all three persons returned to the premises. Using a survey radiological meter, C locates the source in the tube. Then, with the end of the tube in his hand, he shakes it to slide the source out. Given the length of the shaft (about 3 meters) he must climb on a ladder. The source then released, falls on the ground. With remote tongs, it is placed in the spare container, but the lid cannot be closed because of the 10 cm of cable.
- They then notify the qualified person in charge of radiation protection, D. The three operators proceed to the control room and describe the situation. The qualified person, believing that the three persons could have received high doses, collects their dosimeter badges and goes to the premises with them.
- Upon their arrival, the source was still in the container with the end of the cable sticking out. After a discussion, it was decided to cut the cable. In fact, this operation proved to be impossible, the cable was bent, and then inserted into the container and the lid could then be closed. The container and the source were then placed in a shielded enclosure.

A review of all the films exposed that night revealed that the accident began one hour and forty-five minutes prior to its detection. The review indicated films correctly exposed, followed by over-exposed films, which suggests that the source had alternated between the ends of the projection tube without ever being able to return to the container.

A subsequent technical investigation revealed the following facts:

- The threaded part at the end of the wind-out cable originally measured 18 mm in length. It had been broken and was now not more than 4 mm. The missing part of the threaded rod was not attached to the source holder.
- In fact, the broken end of the cable had been previously reset without a locking nut because of a lack of space to insert it. The movement of the source holder in the projection tube was enough for the cable end to unscrew i.e. because there were only 5 turns of the thread without a locking nut.

An incident of this type is normally first detected by the inability to lock the container, because it is the rear part of the source holder which, when retracted, releases the breech bolt of the cylinder and allows its rotation. The source holder not having returned, the cylinder should have been blocked. After examination of the container, it was revealed that by exerting pressure on the cylinder, it was possible to lock it without the source, however, after 4 or 5 manipulations on empty, the breech bolt functioned normally and the barrel was impossible to lock. It is clear then that during the accident, the system malfunctioned and that the breech bolt had not operated correctly. Because of this, radiographer A was not alerted to the source holder having become detached.

It was also discovered that radiographer A disconnected his personal alarm dosimeter during the gammagraphic controls.

### **Radiological consequences**

Three people were exposed during this incident. The urgent development of the dosimeters gave the following results:

- A: Whole body dose of 155 mSv (if the source had been in contact with his body, this value would be multiplied by at least three)
- B: Whole body dose of 4.65 mSv (at the time, he was wearing a dosimeter that was assigned to another person of the company)
- C: Whole body dose of 4.30 mSv

Biological dosimetry, by chromosome aberration analysis, was also performed on A, which indicated a whole body exposure of approximately 200 mSv.

A was the only person to present deterministic effects as a result of this incident. He has had a lymphopenia (abnormally low level of lymphocytes in the blood).

### **Lessons to be learned from the incident**

- During the radiography, the operators must leave their personal alarm dosimeter connected. They allow for the immediate detection of high dose rates and, therefore, help to prevent high doses being received in the event of an incident. In this example, the radioactive source had problems returning to its container before the operators identified a technical problem. It is likely that if A had left his alarm on, he would have been alerted right away that there was an incident.
- At the end of a radiography, operators must monitor the proper retraction of the source into its container using a radiation survey meter.
- When a device is defective or in poor condition, operators must report it to their employer (who must then send it to their supplier for a review) and not try to repair it themselves. Furthermore, the faulty cable should not have been used because a new cable was available.
- The film badges allocated to operators must be registered to ensure they are worn by the right individuals.
- The operators must be made aware of the risks of radiation injuries from extremity exposures. In this incident, despite the training received by the radiography staff, they appeared unaware of the radiation risks involved.
- The purchase of a gamma alarm is recommended.