(From database EAN, www.eu-alara.net)

Description of the incident

Three dry glove boxes, which formed part of a manufacturing line for radioactive sources (smoke detectors) from pulverised 241-AmO, were dismounted for decommissioning and disposal as radioactive waste. The manufacturing company declared the waste activities in the glove boxes to be 150, 180 and 50 MBq of americium-241, respectively. Before transporting the boxes to the decommissioning location (for dismantling and waste processing), the surface contamination was fixed using a lacquer.

The decommissioning took place over a period of 2 months. At the beginning of the operations, the boxes were separated from each other and the external and internal surfaces were monitored. The material was then fragmented, i.e. cut in pieces by hydraulic shears and a mechanical saw. The fragmented radioactive waste was put into steel drums and conditioned by cementing as radioactive waste.

At the start of each day, air samplers were switched on, and the local exhaust venilation system for the decomssissioning area was put into operation. Periodically, the surface contamination was measured using both wipes and direct measurement. The workers were required to waer suitable Personal Protective Equipment, including respirators. In the course of the operation, dust particles contaminated with americium-241 were released. Due to a number of failures (irregular use of PPE, no approved radiation protection procedures) several workers were internally contaminated. Subsequently this contamination spread through the whole building.

Only after the work was finished was the head of the decommissioning unit informed of the air sampling results. These exceeded the pre-determined intervention levels for the facility, and all work in the unit was immediately stopped.

Soon after this, monitoring of respirators used by the workers revealed considerable contamination - in the worst case up to 1 kBq of Am-241 (later revised upwards to 2.7 kBq). The head of the unit declared it as a radiation accident, and the regulatory authorities, and then the media, were informed.

Radiological conséquences

The worker suspected of the highest internal contamination (W1) was directed to the national radiation protection institute where the first *in vivo* investigation was performed, to provide a conservative dose estimate to serve as a guide for possible remedial steps.

From the first two *in vivo* measurements the body burden of Am-241 was estimated to be about 5 kBq, and the committed effective dose estimated to be of the order of 1 Sv. This estimate was based on the assumption that inhalation was the main intake route, and that the deposit was located in lungs only. In addition, Am-241 internal contamination was detected in seven other people.

It was recognised that the first results were overestimated due to contamination which

remained on the body surface (despite thorough showering before measurements, and no positive response from surface contamination monitors).

Stool and urine samples were taken, and further *in vivo* investigations undertaken (whole body, head and knees) - these reduced the estimated maximum committed effective dose to 350 mSv.

The follow-up of the workers with measurable contamination continued. Decreasing *in vivo* measurement results (to below detection limits) over several weeks confirmed the interference of the early findings by surface body contamination. Eighteen other employees were screened by whole body counting. No measurable internal contamination was found in this group.

A final evaluation (6 months later) based on excretion data produced an estimated committed effective dose of 50 mSv to W1, and doses in the range 5 to 185 mSv to other workers. The excretion analysis suggested that in some workers repeated intakes might have occurred, e.g. at different stages of the decommissioning operation. This uncertainty complicated the interpretation of excretion results.

One worker did not fit the patterns typical for subjects presented above. In this case, clearly measurable activity was found in the lungs, and this activity did not significantly decrease over time. The committed effective dose, calculated by combining the *in vivo* (lung) results and the excretion data, was 130 mSv.

On the basis of first results, some workers seemed to qualifiy for treatment by DTPA infusions. The worker W1 was hospitalised and was treated by two doses of 1 g Ca-DTPA. In addition, five other workers were given two doses of Ca-DTPA. The tolerance of the treatment was good; no adverse effects were observed. After the estimated doses were revised downwards, this treatment was discontinued.

Lessons learned

During hazardous operations with open sources it is necessary to enforce rigorous control over the use of PPE, especially respirators. PPE should be monitored and changed/replaced at an appropriate frequency. Workers must be trained to understand the importance of using PPE correctly.

Very important information on contamination in the workplace is provided by the air sampling results, which should be made available quickly, and reviewed before continuing the work.

Contamination of the body surface may considerably interfere with *in vivo* measurements of alpha emitters such as Am-241. The sensitivity of a portable alpha monitor measurement may be too low to detect activity which is later identified by long term whole body measurements. In this respect the early analysis of stool and urine samples is important, as well as other rapid methods to differentiate surface and internal contamination.

The incident was classified as an INES level 2.