When I heard the words ‘contamination’ and ‘instruments’ this is not what I had in mind

Introduction

On 17 March 2011 at 12:45 a shipment of airfreight from Hong Kong which originated in Tokyo, Japan caused a Project Cyclamen alert at a major UK airport. Project Cyclamen is designed to pick up any radioactive material entering the UK, in line with the arrangements for Project ALERG followed by the fallout movement risk of the Fukushima nuclear power plant. The load was spread over six air freight pallets and the manifest described it as 'musical instruments'. These belonged to an orchestra who had returned early from their tour of Japan on 15 March

As the appointed radiation protection professionals for the government department responsible for homeland security, two Nuvia Limited Radiation Protection Advisors (RPAs) duly jumped into a car and drove to the airport's freight terminal. Local security officers had determined the presence of caesium-137 and caesium-134, with dose rates approximately ten times background levels.

What followed was a week’s intensive work to try and determine the reason for the alarm, the source of the radioactive material entering the UK at the various sea ports and airports around the UK. The load was spread over six air freight pallets and the manifest described it as 'musical instruments'. These belonged to an orchestra who had returned early from their tour of Japan on 15 March.

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The Alarm – 17 March 2011

Upon arrival at the airport in the late afternoon of the 17th, the four pallets had already been isolated for investigation. The pallets were made up of a number of layers of plastic sheet covering the bulk of the cargo underneath. At this stage it was not possible to determine exactly how the pallets had been put together. The initial investigations performed by the RPA on arrival at the site yielded the following information:

Direct probe contamination measurements:

<table>
<thead>
<tr>
<th>Pallet</th>
<th>Position</th>
<th>Average dose rates (Sv/h)</th>
<th>Maximum dose rates (Sv/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom</td>
<td>135</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>2 Bottom</td>
<td>180</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>3 Bottom</td>
<td>140</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>4 Bottom</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>

The direct readings were made using an Electra DK+ double phosphor contamination probe.

Snab-wipe probe analysis

"The snab-wipe analysis was made using six wipes of the surface which was then presented to the Electra DK+. Each wipe was estimated to be 0.3 m2 (300 cm2)."

Table shows the highest values. Detectable contamination was found on all sides. No detectable alpha contamination was found either by direct probe or snab-wipe to prove.

A low resolution handheld spectrometer (Experimantor GR-15) was used to obtain an energy spectrum from the loads to identify the nuclides present. An initial report had identified stron-133 and caesium-137, however, due to the library on the GR-135 the isotopes were not identified by that instrument. The spectrum from the GR-165 has been reproduced in image 1. This image shows peaks at 225 keV, 368 keV, 662 keV and 796 keV.

The Investigation – 18 March 2011

Followings the week of work had established that the estimated level of contamination was present, the following day one of the pallets was chosen to investigate which items exactly were contaminated within the package and a better understanding of the levels of that contamination.

Prior to the unsealing of one of the pallets, the area for the investigation was prepared - an area of 4 to 5 feet square. A metal detector and the RPA's doing the work were donned PPE (Face suits, gloves and overgloves). The work began very reassuringly, as the value of the shipment had been estimated at £15 million due to being made up of the instruments used by the orchestra during their tour of Japan.

The pallet was made up of an undersheet which was laid on the aluminium flight pallet. The flight cases were then loaded on to this with wooden blocks used as wheel chocks, and polythene pieces used as a packing material and finally the cases were secured using ratchet straps. A number of clear plastic sheets and an opaque plastic woven tarpaulin were then placed on top to cover the load. Finally a cargo net was placed over the top of all of these to secure the load.

All of the plastic sheets were found to have similar levels of contamination on them with levels found to be 1-1.5 Bq/cm2. The flight cases were then loaded on to the pallets with welded edge cases and other airmovers which were fixed to the pallets. The external contamination on the cases was removed, and the interior of the flight cases were found to have no contamination in them. Further the aluminium pallet used to support the load had no detectable contamination in the area monitored.

The wheels of the flight cases were also found to have low levels of fixed contamination where the wheel had been in contact with base sheet. In these cases the only part of the wheel to show fixed detectable activity was the part of the wheel in contact during the flight. No additional detectable contamination was picked up from rolling the flight cases across the pallet so they could be lifted off with a fork lift truck.

This work was completed on the afternoon of Friday 18 March.

The results of the contamination measurements of the flight cases which were picked up on a maximum activity on one wheel were 150 Bq/cm2 with typical values less than 100 Bq/cm2. All of the wheel flight cases that were placed on the base sheets had different levels of activity on the wheels.

Using the dose coefficient of 18 x 10-7 Sv/Bq for sodi-131 the most restrictive isotope present for a baby taken from ICRP publication 72, applying a gut transfer factor of 0.6 all the iodine is absorbed through the gut and using the public dose limit of 1 millisievert gives a conservative annual limit of 1 millisievert. Assuming probe efficiency of 20% an instrument reading of 1000 cps.

Conservative assessment a clearance level of 100 cps chosen which corresponds to an activity of 1000 Bq and therefore a dose of 0.0001 millisievert (50 microcuries) should the total activity of a wheel be committed to a baby (very unlikely event).

The Clearance – 24 & 25 March 2011

Following the characterization of pallet 2 so far as possible, the remaining pallets were unloaded with the 'emergency response' nature of the work there was not the required man-power or capability to arrange a full clearance of the air freight pallets.

Further as this was no longer a threat under Project Cyclamen the costs for clean up and disposal fell to the airline that transported the consignment. The need now existed for a commercial contract between the RPA and the airline. The need for expediency was becoming more apparent for the orchestra to whom the instruments belonged were due to play a concert on Friday 25 March 2011. Over the following 5 days discussions took place with enforcement agencies in the UK (Health and Safety Executive and Environment Agency) to understand their enforcement position and ensure we were in a situation to complete the work legally.

Following commercial negotiations, engagement with the enforcement agencies (the final agreement coming from the enforcement agencies at around 5pm on Wednesday 23 March), and the completion of the required paperwork to ensure the work was carried out safely, the RPA and a team of 2 X-ray aircrews met at the Airport on the Wednesday evening to start work on Thursday morning.

Over the next day and a half all six air freight pallets were unloaded and radiological scans carried out and bagged up for disposal. Any contamination found on the flight cases was easily removed. The wheels of the flight cases were found to be fixed, despite repeated efforts to remove them. On the evening of the 24th the orchestra plc agreed to allow the flight cases to be unloaded. Following discussions concluded, all radiological instruments were collected at lunchtime on the 25th March.

The highest value for contamination measured on the flight cases which were brought down a maximum level on one wheel was 150 Bq/cm2 with typical values less than 100 Bq/cm2. All of the wheel flight cases that were placed on the base sheets had different levels of activity on the wheels.

The clearance of the flight cases was expected to take around 24 hours. Following discussions with the airline the clearance time was reduced to 24 hours, which was achieved with the clearance of all pallets on the evening of the 25th March. The pianos, which were permanently attached to the air freight pallets, would also have been loaded on the tarmac while the pallets were waiting to be loaded, hence the cargo nets being contaminated also.

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