Challenges of Radioactive Waste Characterisation at ISIS

Some Examples

Ruth McCrohon
SETTING THE SCENE

Part 1 of 3
PROPERTIES: SIZE OF WASTE ITEM

ISIS Metallic and Shielding wastes

- 1090 tonnes RadWaste
- 805 tonnes Potential scrap

48% items 4t or greater
PROPERTIES: Examples of large items

ISIS waste is dominated by big items, such as:

• Magnets each over 9te
• Magnet trolleys each about 9te
• Shutters 7te each for TS1
• Shielding up to 12te per item
• Tanks such as Tank IV is 7te 12m long
PROPERTIES: Activation

NON-UNIFORM SPREAD  Sometimes easy to predict and sometimes not

<table>
<thead>
<tr>
<th>Material Irradiated</th>
<th>Examples of Resulting Radionuclides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>Co-60, Fe-59, Mn-54, Co-57, H-3</td>
</tr>
<tr>
<td>Concrete</td>
<td>Eu-152, Eu-154, H-3, Co-60</td>
</tr>
<tr>
<td>Copper</td>
<td>Ni-63, H-3</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Na-22</td>
</tr>
</tbody>
</table>
Safety-related Requirements

- Minimise worker doses
- No dust releases
- No gas releases
- Minimise secondary waste
- Minimise costs

MINIMAL INTERVENTION!!
So, now you have your waste item

- Complete well documented history
- Correct design drawings
- Material specification known
- Experience of characterising
- Pattern of activation known
Part 2 of 3

EXAMPLES RELATING TO CHARACTERISATION
Shutters: Use
Shutters: Gamma-camera
## Shutters: Sampling

### Dose rates across faces (μSv/h)

- Surveys
- Sampling
- High-resolution gamma-spect and modelling

<table>
<thead>
<tr>
<th>Beam entry face</th>
<th>Side view</th>
<th>Beam exit face</th>
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</thead>
<tbody>
<tr>
<td>100 153 68</td>
<td>100 80 21 7 3.2 1.5 0.5 0.3</td>
<td>0.3 0.5 0.5</td>
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<tr>
<td>180 332 120</td>
<td>180 180 30 9 3 1.2 0.4 0.4</td>
<td>0.4 0.2 0.5</td>
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<tr>
<td>370 700 310</td>
<td>370 170 28 17 5.8 1.4 0.7 0.6</td>
<td>0.6 2.6 0.5</td>
</tr>
<tr>
<td>140 230 90</td>
<td>140 140 22 10 2.5 1 0.3 0.3</td>
<td>0.3 0.2 0.3</td>
</tr>
<tr>
<td>100 138 65</td>
<td>100 110 18 8.5 2.3 0.9 0.1 0.2</td>
<td>0.2 0.1 0.2</td>
</tr>
<tr>
<td>40 58 30</td>
<td>40 34 12 5 1.4 0.7 0.3 0.1</td>
<td>0.1 0.3 0.2</td>
</tr>
</tbody>
</table>
Shutters : conclusions

- Shutters pattern of activation supports consideration of current holdings as LAW not HAW as originally anticipated
- Cast iron half-depth 150mm
- Concrete activation half-depth 300mm
Magnet Trolley
Magnet Trolley - sampling

- Concrete slab depth 165mm
- Steel plate depth 25-30mm
- Concrete infill of steel box frame depth 330mm

Interior to be filled with reinforced concrete
Magnet Trolley

Typical activities found for trolley
(approximately 10 years after activation)

<table>
<thead>
<tr>
<th></th>
<th>3H</th>
<th>55Fe</th>
<th>54Mn</th>
<th>57Co</th>
<th>60Co</th>
<th>152Eu</th>
<th>154Eu</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>227</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>13</td>
<td>33</td>
<td>4</td>
<td>Bq/g</td>
</tr>
<tr>
<td>Steel</td>
<td>-</td>
<td>239</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>-</td>
<td>Bq/g</td>
</tr>
</tbody>
</table>
Magnet Trolley

- Magnet trolley was found not to be HAW as initially designated
- Cost saving as was sent to special landfill rather than the LLWR (National Low Level Waste Repository)
- Use for other trolleys characterisation
  - less samples and quicker
Linac Tank IV

Archive photo of tank on delivery to site late 1950's
Linac Tank IV

- Previous experience with copper
Conclusions re. Linac Tank IV

- Copper pipework sampled for destructive analysis of $^{60}\text{Co}:^{63}\text{Ni}:^{3}\text{H}$
- Steel sampled for destructive analysis of $^{60}\text{Co}:^{55}\text{Fe}:^{59}\text{Fe}:^{3}\text{H}$
- Surveyed & gamma-spec. in low dose rate area
- Intact disposal to landfill currently anticipated.
LOOKING INTO THE (NEAR) FUTURE

Part 3 of 3
Steps in the disposal process

To recent times:
1. Store
2. After a long time, start to think about characterisation
3. Search for history and designs
4. Take samples
5. Consider disposal options (BAT)
6. Process &/or take more measurements
7. Dispose
Improvements

1. Anticipate
2. Plan to measure
3. Store & measure
4. Review data held and form action plan
5. Final review of BAT for disposal
6. Dispose
What benefits will this bring?

• Lower costs due to less sampling, purchase of storage flasks.
• Better data and thus more convincing arguments for increasing some accumulation times.
• Opportunity to dispose of some wastes earlier where longer accumulation times bring no benefits.
QUESTIONS