A Radiation Protection Perspective - Decommissioning of the Moata Reactor

Preliminary Dismantling

Australian Nuclear Science & Technology Organisation

IAEA Workshop (R2D2) – Sydney Australia
7th-11th May 2012
A History of Moata

- Constructed at ANSTO in 1961
- ARGONAUT type reactor
- Built as a 10kW reactor, but modified in 1972 to 100kW
- Graphite moderator / reflector
- Cooled by light water
- Shielding - high density and low density concrete
The Moata Reactor

From 1961 to 1995:
- Neutron radiography
- Soil analysis
- Cancer treatment research
- Quality Control for HIFAR
Two phases of dismantling:

- Preliminary Dismantling – the removal of the internal components of the reactor, including the steel core structures, graphite moderator and beam line facilities

- Structural Dismantling – the cutting and removal of the concrete shielding and the floor area below the shielding.
Preliminary Dismantling
Getting There…

The steps involved in planning, completing and evaluating the success of the Preliminary Dismantling:

- Radiation Protection Plan
  - Characterisation
  - Dose Estimation & Constraints
  - Radiation Management & Monitoring
  - Personal Protective Equipment
- Outcomes & Lessons Learnt
Characterisation – Radioactive Inventory

- In 1999 a Radioactive Materials Inventory Assessment was completed which estimated the specific activities of Co-60, Eu-152, Eu-154 in various reactor components
- In 2008 this Inventory was revised to take into account radioactive decay

<table>
<thead>
<tr>
<th>Item</th>
<th>Specific Activity (Bq/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1999</td>
</tr>
<tr>
<td>Graphite</td>
<td>3.7x10^5</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>4.0x10^8</td>
</tr>
<tr>
<td>Mild Steel</td>
<td>5.0x10^7</td>
</tr>
<tr>
<td>Lead/Bismuth</td>
<td>2.8x10^6</td>
</tr>
<tr>
<td>Aluminium</td>
<td>7.9x10^6</td>
</tr>
</tbody>
</table>
Characterisation – Graphite Survey

Graphite dose rates:
- Estimated to range from $10\mu\text{Sv/h}$ to $1,000\mu\text{Sv/h}$
- Measured to be $10\mu\text{Sv/h}$ to $1,500\mu\text{Sv/h}$
Dose Estimation & Constraints

**Dose Estimates:**
- Collective – 1,680 man-\(\mu\)Sv
- Av. Individual – 210\(\mu\)Sv (assuming 8 workers)
- Max. Individual – 381\(\mu\)Sv

**Dose Constraints:**
- Individual – 500\(\mu\)Sv
- Daily – 50\(\mu\)Sv
Radiation Management & Monitoring

Controlling exposure using distance
Radiation Management & Monitoring

Controlling exposure using shielding

The estimated dose reduction by using the steel shielding plates was by a factor of 36 i.e. from 360 $\mu$Sv/hr to 10 $\mu$Sv/hr.
Radiation Management & Monitoring

Controlling exposure using shielding
Radiation Management & Monitoring

Controlling exposure using shielding

Shielded containers for activated waste:

- Lead pots for helicoils
- Specially designed 50mm steel boxes for core components
- 3mm steel boxes for graphite storage
Radiation Management & Monitoring

Dose Management:
- Radiological surveys

Dose Monitoring:
- EPD System
- TLDs
- Whole Body Monitoring
Personal Protective Equipment

• Since there was a lot of shearing and cutting it was decided to start from the highest level of PPE

• This would then be downgraded at the discretion of the Radiation Protection Advisor and OHSE staff
Outcomes & Lessons Learnt

• A Preliminary Dismantling Health Physics Report was written following the completion of this phase of dismantling.
• This report found that from a radiation protection perspective the Preliminary Dismantling was completed safely and without incident.
  – Dose rates on the majority of core components were found to be lower than those estimated.
  – No surface or airborne contamination was detected throughout the project.
  – There were no personal contamination events.
Outcomes & Lessons Learnt

- Estimated doses vs. actual doses:

<table>
<thead>
<tr>
<th>Dose</th>
<th>Estimated</th>
<th>Actual</th>
<th>Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collective</td>
<td>1,680 man-(\mu)Sv</td>
<td>1,590 man-(\mu)Sv</td>
<td>-</td>
</tr>
<tr>
<td>Av. Individual</td>
<td>210(\mu)Sv*</td>
<td>159(\mu)Sv**</td>
<td>-</td>
</tr>
<tr>
<td>Max. Individual</td>
<td>381(\mu)Sv</td>
<td>261(\mu)Sv</td>
<td>500(\mu)Sv</td>
</tr>
<tr>
<td>Daily</td>
<td>-</td>
<td>46(\mu)Sv (max)</td>
<td>50(\mu)Sv</td>
</tr>
</tbody>
</table>

* Estimated - 8 workers  ** Actual - 10 workers

This just goes to show that planning was essential in the success of the Preliminary Dismantling