Management of Waste

IAEA R2D2 Workshop
May 2012
Duncan Kemp
Overview

- Waste Operations at ANSTO
- Radioactive Waste Tracking
- Characterisation and Clearance
- Australian Repository and disposal
- Acceptance Criteria
- Moata Experience
Waste Operations’ Responsibilities

• Radioactive Waste Services
  • Solid and Liquid
  • Low Level and Intermediate Level
• Hazardous (Chemical) Waste Collection and Disposal
• Non-radioactive Waste advice
• Effluent / Trade Waste liquid disposal
• Decontamination Services
• Laundry
Waste Generators Responsibilities

• **Segregate waste at the source**
  – Radioactive or non-radioactive
  – Solid or liquid
  – Chemical; clinical or ordinary waste
  – Soft or hard solid waste

• **Properly package waste**
  – no chance of spill – double containment

• **Label and Document waste**
  – Need to know what it is
  – general waste, recycling, reuse off site options
Laundry

• WO can clean work clothes

• Two clothing streams:
  – Radioactive (lab coats, overshoes)
  – Non-radioactive clothing (work clothes)

• Make sure clothing is labelled
Low Level Liquid Waste

- Three systems on site
  - Sewer
  - Trade waste water (C line)
  - Potentially radioactive waste water (B line)

- List of prescribed substances
- Radioactivity limits
- Higher levels of radioactivity will be picked up
- Treatment options in special building
  - Drum drying liquids
LLS Waste Storage

- No radioactive waste can leave site
- Soft Waste is shredded and compacted into drums
- Non-compactable Waste is directly drummed
- Drums are stored until no longer radioactive
- Special packages for large items can be organised
ILS Waste Storage

- Shielded transport & storage
- Below-ground retrievable pits
- Few stakeholders
- Limited size capacity (72L or 200L drum)
Documentation
### Radioactive Waste Tracking System

#### Browse Process Stages

<table>
<thead>
<tr>
<th>Waste ID</th>
<th>Type</th>
<th>Location</th>
<th>Process Stage</th>
<th>Unit Operation</th>
<th>Date</th>
<th>Nature of Waste</th>
<th>Source Code</th>
<th>Source Bldg</th>
<th>Service Request No</th>
<th>Container</th>
<th>Volume (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 4730-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4731-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4732-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4733-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4734-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4735-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4736-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4737-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4738-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4739-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4740-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4741-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4742-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4743-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4744-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4745-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4746-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4747-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4748-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4749-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4750-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4751-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4752-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4753-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4754-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4755-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>B1</td>
<td>19</td>
<td>57619</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>LS 4756-11</td>
<td>LLW Processing</td>
<td>B57 Solid</td>
<td>B57 PFR Solid Waste Processing</td>
<td>20/12/2011</td>
<td>plastic, paper, gloves</td>
<td>A1</td>
<td>23A</td>
<td>59320</td>
<td>Yellow plastic bin</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>
Clearance Process

Three point check

1. At source
2. In a Low Background area
   – Hand scanning bulky wastes
   – Drum scanning solid wastes
   – Portable spectrometer
   – Assessment against regulations
3. Vehicle Monitoring System
Characterisation process

- Waste is characterised by
  - Physical characteristics
  - Chemical characteristics
  - Process history
  - Radiological parameters

- Fingerprinting for not easily detectable nuclides (β emitters)
## Clearance Document

### Description of Waste

**Drum Identifier**
- FPR 073-12

**Drum Description**
- FPR waste bags

**Date of Analysis**
- 13-Sep-12

**Net Weight**
- 31.42 kg

### Detected Nuclides

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Activity Concentration</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-57</td>
<td>0.0126</td>
<td>395</td>
</tr>
<tr>
<td>Cd-60</td>
<td>0.0617</td>
<td>1130</td>
</tr>
<tr>
<td>Th-232</td>
<td>0.0130</td>
<td>1000</td>
</tr>
<tr>
<td>Na-22</td>
<td>0.0141</td>
<td>750</td>
</tr>
<tr>
<td>As-110m</td>
<td>0.0300</td>
<td>644</td>
</tr>
<tr>
<td>Bi-214</td>
<td>0.0404</td>
<td>1340</td>
</tr>
<tr>
<td>Ba-133</td>
<td>0.0070</td>
<td>221</td>
</tr>
<tr>
<td>Cs-137</td>
<td>0.0203</td>
<td>637</td>
</tr>
<tr>
<td>U-238</td>
<td>0.0098</td>
<td>302</td>
</tr>
<tr>
<td>Sn-90</td>
<td>0.0205</td>
<td>637</td>
</tr>
</tbody>
</table>

### Criteria

- **ANSTO**
  - Below Limits
  - Assessment against the limits given in the ANSTO Waste Operations Procedure 2.5

- **AS/NZS Exempt Dealing**
  - Assessment against the limits given in the Australian Radiation Protection and Nuclear Safety Regulation 1998.

- **NSW**
  - Below Regulatory Concern
  - General
  - Assessment against the limits given in the Radiation Control Regulation 2003 (NSW)

### Radioactivity Classification
- Free Release Waste

### Comments

- Duncan Kemp

- 20-February-2012

### Authorisation

- Name
- Signature
- Date
Vehicle Monitoring System

- All waste leaving site must go through the Vehicle Monitor.
- Final check point for radiation monitoring of wastes/equipment or vehicles leaving site.
- It can also be used by contractors and other private vehicles to check for contamination.
Disposal Options

- Re-use
- Recycling
- Landfill
- Hazardous Waste Treatment Facilities
Waste Definitions

Activity content

- $10^8 - 10^9$ Bq/g
- $400$ Bq/g (α)
- $100x$ Exemption Levels

Exemption Levels

- VSLW
- LLW
- VLLW
- EW

Half-life

- ~100 days
- ~40 years
- Waste with naturally occurring radionuclides
Australian Repository and Waste Acceptance Criteria

- Awaiting Volunteer Site
- Can’t demolish HIFAR without a Repository or storage location
- Waste Acceptance Criteria not defined
- Generic criteria being developed
Moata Wastes

- Existing systems were used
  - Some stages modified
- Some items too large
  - Special packages
- Existing documentation and tracking system used
# Moata Wastes

<table>
<thead>
<tr>
<th></th>
<th>Free Release</th>
<th>Restricted Waste</th>
<th>Low Level Waste</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (Kg)</td>
<td>159,567</td>
<td>49,861</td>
<td>15,628</td>
<td>225,056</td>
</tr>
<tr>
<td>Percentage</td>
<td>70.9%</td>
<td>22.2%</td>
<td>6.9%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
# Moata Wastes

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity (approximate)</th>
<th>Type</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear grade graphite</td>
<td>~12 Tonne</td>
<td>LLSW</td>
<td>24 Bins</td>
</tr>
<tr>
<td>Metal components from core and cavity regions</td>
<td>Lead plate ~750kg, Aluminium ~80kg, Steel ~300kg, Al + Steel ~60kg</td>
<td>LLSW</td>
<td>2 bins</td>
</tr>
<tr>
<td>Metal Helicoil inserts removed from graphite</td>
<td><strong>100 g</strong></td>
<td>ILSW</td>
<td></td>
</tr>
<tr>
<td>Core lower shield blocks</td>
<td>9 T</td>
<td>LLSW</td>
<td>custom sized bins</td>
</tr>
<tr>
<td>Concrete and steel from bioshield blocks</td>
<td>97 T (42m³)</td>
<td>LLSW / Free Release</td>
<td>24 bins each 1.75m³</td>
</tr>
<tr>
<td>Concrete coring slurry</td>
<td>8 T</td>
<td>LLSW</td>
<td>40 x 200L drums, average 150kg each</td>
</tr>
<tr>
<td>Concrete pieces and rubble</td>
<td>5.4 T</td>
<td>LLSW / Free Release</td>
<td>20 x 200L drums, average 270kg.</td>
</tr>
<tr>
<td>Soft wastes</td>
<td>279 containers</td>
<td>LLSW / Free Release</td>
<td>279 x 37 L drums</td>
</tr>
</tbody>
</table>
Questions?