Offgas Management in the Australian Nuclear Medicine (ANM) Mo99 Facility

June 2016
Late 1970’s
operated MEK extraction of Tc-99m from n-activated Mo-99

1980
commenced fission product Mo-99 from 1.8% enriched UO₂ target

1984
increased fp Mo-99 production with development of sterile Tc-99m generator

1990
Ceased n-activated Mo-99 production due to cessation of demand

1994
UO₂ enrichment increased to 2.2% to meet Australian demand for Tc-99m generators

2008
New fp Mo-99 installed utilising 19.97% enriched UAl₂ targets. Increased Mo-99 production four times

2010
Mo-99 capacity doubled. Capacity now 1000 6d Ci per week. Significant export commenced

2012
Commenced Planning for ANM plant - 3500 6d Ci Mo-99 per week

2014
Commenced construction of ANM plant

Australian Focus
International Focus
ANSTO Global Mo-99 Supply

Bulk Mo-99
- Japan
- USA
- South Korea
- South Africa
- Turkey
- Russia
- Brazil

Tc-99m Generator
- Singapore
- Hong Kong
- Taiwan
- Vietnam
- New Zealand
- Philippines
- Myanmar
- Indonesia

Mo-99 & Tc-99m Generator
- China
- Thailand
Current Mo-99 Production

OPAL Reactor | Processing Plant
---|---
LEU $^{235}\text{U}$ targets irradiated in OPAL | LEU Mo-99 separated and purified

Increasing production
Current Mo-99 Production

<table>
<thead>
<tr>
<th>OPAL Reactor</th>
<th>Processing Plant</th>
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<tr>
<td>LEU $^{235}\text{U}$ targets</td>
<td>LEU Mo-99 separated and purified</td>
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</table>

- 7-10 days
- 1 day

**Average Yield Per Run (Ci)**

- **2009**: 628 Ci
- **2010**: 708 Ci
- **2011**: 840 Ci
- **2012**: 921 Ci
- **2013**: 1031 Ci
- **2014**: 1044 Ci
- **YTD 2015**: 1117 Ci

*Increasing yield*
ANM Mo99 Emission Control

ANM Ventilation Configuration
Emission Design Criteria
The emission limits design criteria for the ANM Mo-99 off-gas system are as follows:

1. **Essential**: Anm-Moly99 URS Section 6.2.6: “The facility shall incorporate an off-gas management system so that gaseous emissions from the plant shall not exceed 2012 levels.”

<table>
<thead>
<tr>
<th>Daily B54 ASERMS data</th>
<th>Xe-133</th>
<th>Kr-85m</th>
<th>Kr-88</th>
<th>Xe-135</th>
<th>Kr-87</th>
<th>Xe-135m</th>
<th>I-131</th>
<th>I-132</th>
<th>I-133</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
</tr>
<tr>
<td>2012 Total</td>
<td>668,100</td>
<td>15.3</td>
<td>0</td>
<td>160,203</td>
<td>10.2</td>
<td>16,800</td>
<td>2.79</td>
<td>1.08</td>
<td>0.165</td>
</tr>
<tr>
<td>Daily Mean</td>
<td>1,825</td>
<td>-</td>
<td>-</td>
<td>438</td>
<td>-</td>
<td>54</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Daily Median</td>
<td>1,634</td>
<td>-</td>
<td>-</td>
<td>254</td>
<td>-</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Daily maximum</td>
<td>33,942</td>
<td>11</td>
<td>-</td>
<td>2,528</td>
<td>-</td>
<td>2418</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

2. **Essential**: The plant shall operate within the current licenced ARPANSA notification levels for B54.

<table>
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<th>B54 Notification Levels</th>
<th>Xe-133</th>
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<th>I-133</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
<td>GBq</td>
</tr>
<tr>
<td>Current levels</td>
<td>280,000</td>
<td>65,000</td>
<td>6,000</td>
<td>400,000</td>
<td>350</td>
<td>400,000</td>
<td>28</td>
<td>240</td>
<td>15</td>
</tr>
</tbody>
</table>

The dominant design criteria for the ANM off-gas treatment system is the requirement for limiting the Xe-133 annual emissions to below the current notification level of 280,000 GBq. This translates to an average minimum of **622 GBq** per run based on 450 production runs per annum.
ANM Mo99 Emission Control

Estimate of Xe133 emission for ANM (GBq)
Carbon Columns
Carbon Columns
Carbon Columns
Carbon Columns