DESIGN FEATURES TO FACILITATE HOT ISOSTATIC PRESSING IN REMOTE SHIELDED FACILITIES

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ANSTO
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LEGACY WASTES:

- Poorly Characterised
- Contain Radionuclides Mobile in the Environment
- Possibly Volatile
- Low Solubility Constituents in Glass
- Heterogeneous
ADVANTAGES OF HOT ISOSTATIC PRESSING

• Accommodates heterogeneous waste

• Resultant Ceramic, or Glass Ceramic composite form tailored to the waste.

• Higher Waste Loading

• Enhanced Chemical Durability

• Greater Processing Flexibility
HIP INDUSTRIAL MATURITY

Operating History Summary of US Industrial HIPs

<table>
<thead>
<tr>
<th>Company</th>
<th>HIP Units diameter &gt; 0.6 m</th>
<th>Operating Temperature &gt;1150°C</th>
<th>Operating Pressure &gt;50 MPa</th>
<th>Service life &gt;12 years</th>
<th>Oldest HIP in use (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodycote (USA)</td>
<td>13</td>
<td>12</td>
<td>12</td>
<td>8</td>
<td>&gt;20</td>
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<tr>
<td>Bodycote (international)</td>
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<td>12</td>
<td>12</td>
<td>6</td>
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<tr>
<td>Alcoa</td>
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<td>5</td>
<td>3</td>
<td>&gt;30</td>
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<tr>
<td>Crucible Materials</td>
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<td>2</td>
<td>1</td>
<td>&gt;30</td>
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<td>KittyHawk Products</td>
<td>3</td>
<td>3</td>
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<td>&gt;25</td>
</tr>
</tbody>
</table>

Nuclear Operations

• Diffusion Bonding of Nuclear Fuel Rods – 30 years
• Small Facilities in Hot Cells
  • US DOE National Laboratories (3)
  • United Kingdom
• New facility proposed for ANSTO waste from Moly-99 Production
• Under evaluation for disposition of INL calcined waste inventory.
HIP ANATOMY

VESSEL

• ASME B & PV Code Design
• Rigorous Material Requirements
• Ultrasonic and Magnetic Particle Inspections
• 110 to 125% Hydrostatic Testing (Design Margin is still 2.5 times)
• Code Stamping by Independent Inspector
HIP ANATOMY

CLOSURE STYLES
- Theaded
- Breech Lock
- Yoke

LOADING STYLE
- Top Loading
- Bottom Loading
HIP ANATOMY

- HIP CONTAINER
- END PLUGS (2)
- HEATER SECTION
- COOLANT SUPPLY & RETURN
- COOLING JACKET
- POWER SUPPLY TO HEATER SECTION
- INSTRUMENTATION FEED THROUGH
- PRESSURE VESSEL
- VACUUM LINE
- HIGH PRESSURE ARGON SUPPLY
HIP SAFETY SYSTEMS
Incorporating multiple layers of protection including redundant safety features.

ACTIVE SYSTEMS

• Temperature Monitoring and Control
• Pressure Monitoring and Control

PASSIVE SYSTEMS

• Pressure Relief Valves
• Burst Discs
IN CELL MAINTENANCE

- Primarily a mechanical system with few moving parts in cell, thus in cell maintenance requirements are minimised.
- Run to failure and replace for MOST components.
- Contamination control allows manned maintenance providing sources are isolated.
- Remote capability can be provided if desirable.
HIP PROCESS ADVANTAGES

- Minimises equipment and facility contamination.
- Reduces waste volume.
- Minimises Remote Handling Requirements.
SUMMARY

• Large scale production HIPs have operated reliably in commercial applications for decades.

• Safety is a primary consideration in the design of the equipment. System design feature can be tailored to address specific concerns or requirements.

• HIP tailored waste form technology provides the opportunity to lower the risk and life cycle cost to disposition legacy wastes difficult to incorporate in glass.

• Contamination control features afforded by the technology make it well suited for addressing multiple clean-up missions.

• The technology is readily scalable, allowing the size and cost of the unit to be appropriate for the waste feed steam(s).

• Elaborate, complicated, or costly remote maintenance schemes are not required for HIP installations into Hot Cells.