Management of Materials from the Decommissioning of Nuclear Reactors

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Symposium on Recycling of Metals arising from Operation and Decommissioning of Nuclear Facilities
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World Nuclear Association

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Strategic Overview

Nuclear Industry Cooperation

Joint positioning in economic, safety and environmental issues

Nuclear Energy Communication

Wider understanding among public, politicians and decision makers

Nuclear Information Management

Trustworthy, comprehensive and easily accessible information

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Representation in key international forums

- **International Atomic Energy Agency (IAEA)**
- **Nuclear Energy Agency of the OECD (NEA)**
- **UN Framework Convention on Climate Change (UNFCCC)**
- **International Commission on Radiological Protection (ICRP)**
Decommissioning Prospects Worldwide

- More than 400 reactors in operation worldwide
- By 2060, most of them will reach end of operation
- Within controlled area each reactor provides:
  - 200,000t concrete
  - 20,000t steel
  - 2,000t copper
- Only 4,000t are activated (i.e. must go to final disposal)
## Total Mass of Materials to be Managed

<table>
<thead>
<tr>
<th>Material</th>
<th>Total mass from reactors worldwide (Mio t)</th>
<th>Annually recycled mass (Mio t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>80</td>
<td>2,000</td>
</tr>
<tr>
<td>Steel</td>
<td>8</td>
<td>400</td>
</tr>
<tr>
<td>Copper</td>
<td>0.8</td>
<td>8</td>
</tr>
</tbody>
</table>

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Why Recycling?

Reasons:

• Saving resources
• Reducing use of disposal sites
• Economic arguments

<table>
<thead>
<tr>
<th>Material</th>
<th>Value (MEUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>800 Mio</td>
</tr>
<tr>
<td>Steel</td>
<td>1 Bln</td>
</tr>
<tr>
<td>Copper</td>
<td>4 Bln</td>
</tr>
</tbody>
</table>

• Legal obligation in several countries (not for radioactive materials)
Two Recycling Routes

Inside nuclear industry
- Higher level of radioactivity
- Concrete: not possible
- Steel: limited masses for shielding & disposal containers

Outside nuclear industry
- Lower level of radioactivity
- Unlimited mass
Full Recycling - what does it need?

- Legal basis
- Public acceptance
- Recipient
- Decontamination technologies
- Free release measurement
- Logistics
Legal Basis

- Availability of clearance values
- Good feedback from operating countries
- Different by country

-> Revised EC Directive may help
Public Acceptance

The toughest challenge...
Recipients

Concrete:
- Road construction
- Backfill of underground mines

Steel
- Foundry

Copper
- Refining
Any contamination (not activated) can be removed

- Decontamination prior to cutting
- Measurement prior to cutting
- Chirurgical cutting (to keep activated material separate)
- Dry, wet, laser, etc decontamination of cut pieces
- Melting for further decontamination

[not Co-60! But interesting half-life (5 - 7yr) allows other possibilities, e.g. temporary storage,...]
Free Release

- Measurement of significant mass at low activities
- Continuous measurement
- Qualification & acceptance by authorities and recipient
- Melting to increase share of free release material
Logistics

• No long distance transport for bulk/low value material (concrete) -> expensive
• Preparedness for blockage of nuclear transports (local treatment?)
• Intermediate/buffer storage capacities
• Transport of huge metallic components for decay and centralized treatment
Messages

• Huge amounts of materials from D&D
  **BUT:** recycling market is much bigger, hence no disturbance

• Recycling is most believable/affordable process to minimize environmental impact (preservation of natural resources, reduced storage capacities, waste management...)

• Legal, technical basis to be set
  - Common analysis of environmental & human impact among nuclear operating countries could reinforce nuclear industry credibility

• **ACCEPTANCE** is the **MOST** important/challenging issue
NUKEM Technologies – Expert in Waste Management and Decommissioning

Dr. Georg Braehler, CTO

Presentation on behalf of WNA
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