AREVA BU Logistics presentation
Current issues in international/intercontinental transport from transporter’s point of view

Tcherkoff & Victorin – 05-03-2010 – AIEA, Vienna
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Areva Logistics Business Unit

Shipping research reactors materials

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AREVA BU Logistics profile
The Logistics BU is present at all stages of the nuclear fuel cycle. With its expertise, it oversees all the AREVA group transports all around the world.
BU Logistics positioning inside AREVA group

BU Logistics

A global offer which includes:
- Design and manufacturing of casks for the transport and storage of radioactive materials
- Realization of logistic services and transports in the best conditions of safety and security

- Recycling Logistics
- Site management
- Clean up
Internationalization of the BU Logistics network

Logistics

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Strengths and opportunities

Our strengths

◆ A unique experience and an international recognition
◆ A capacity to manage major logistic projects
◆ The highest level of safety and security in the world for the transport of radioactive materials
◆ An international network, narrow relations with the customers and the competent Authorities

Our main opportunities

◆ The global Renaissance of the nuclear power
◆ Nuclear plants to be maintained
◆ The recycling, the key constituent of a sustainable energy
◆ Growing demand for a secure supply chain

An international network and a 45 years knowhow for the biggest profit of our customers
Shipping research reactors materials

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- Regulations
- Necessary tests for type B and C packages
- Developing a new cask
- A typical transport breakdown
## Regulations

<table>
<thead>
<tr>
<th>Country</th>
<th>Regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>10 CFR 71 – Packaging and transportation of radioactive material</td>
</tr>
<tr>
<td>Canada</td>
<td>SOR/2000-208 – Packaging and transport of Nuclear Substances Regulations</td>
</tr>
<tr>
<td>Sea</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Code IMDG (Amrd 34-08) – International Maritime Dangerous Goods Code</td>
</tr>
<tr>
<td>Air</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>IATA – Dangerous Goods Regulations – 51st Edition</td>
</tr>
</tbody>
</table>

- Regulations are mostly based on IAEA Recommendations
  - But differences exist
- To transport small quantities of irradiated material
  - Every Content by road and sea
  - Content < 3000 A$_2$ in every country (except USA) by air
  - Content < A$_2$ of plutonium in USA by air
  - Content > 3000 A$_2$ in every country (except USA) by air
  - Content > A$_2$ of plutonium in USA by air

**Logistics**

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### Necessary tests for type B and C packages

<table>
<thead>
<tr>
<th>Condition of Transport</th>
<th>Test</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal conditions</strong></td>
<td>• Water spray test&lt;br&gt;• Free drop test (1,2 m or 0,9 m)&lt;br&gt;• Stacking test (5 x mass)&lt;br&gt;• Bar penetration test</td>
<td>Increase in radiation level (&lt; 20 %)&lt;br&gt;Loss of radioactive contents &lt; $10^{-6}$ A$_2$/hours</td>
</tr>
<tr>
<td><strong>Accident conditions</strong></td>
<td>• 9 m free drop&lt;br&gt;• 1 m puncture test&lt;br&gt;• Thermal test : 800°C Fire for a period of 30 min&lt;br&gt;• Water immersion test : 15 m for a period of 8 hours</td>
<td></td>
</tr>
<tr>
<td><strong>TYPE B</strong></td>
<td>Radiation level &lt; 10 mSv/h at 1 m&lt;br&gt;Loss of radioactive contents &lt; 1 A$_2$ in a period of one week</td>
<td></td>
</tr>
<tr>
<td><strong>Water immersion test</strong></td>
<td>• Immersion at 200 m deep for one hour</td>
<td>No rupture of the containment system</td>
</tr>
<tr>
<td><strong>Burial</strong></td>
<td>• Environment thermal conductivity 0,33 W/(m.K))&lt;br&gt;• Temperature of 38°C</td>
<td>Radiation level &lt; 10 mSv/h at 1 m&lt;br&gt;Loss of radioactive contents &lt; 1 A$_2$ in a period of one week</td>
</tr>
<tr>
<td><strong>Accident conditions</strong></td>
<td>• 9 m free drop&lt;br&gt;• 9 m drop of a 500 kg plate&lt;br&gt;• 3 m puncture test on conic probe&lt;br&gt;• Thermal test : 800°C Fire for a period of 60 min&lt;br&gt;• Impact test at a velocity of 90 m/s (orientation causing maximum damages)</td>
<td></td>
</tr>
<tr>
<td><strong>TYPE C</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Developing a new cask

- **Design**
  - Pre concept
  - Qualifying tests
  - Safety report drafting

- **Licensing**
  - Safety report transmitted to Competent Authorities
  - Authorities assessment
  - Licensing approval

- **Fabrication**
A typical transport breakdown

- **Bid period**
  - Content analysis, cask choice, cask booking, transportability study, offer

- **Customer approval**

- **Transport preparation**
  - Validation in all crossed countries, content classifications in all crossed countries, agreement from all crossed countries
  - Planning validation with Hotlabs including reception and starting periods
  - Technical assistance before transport

- **Transport**
  - Sending of empty cask to Hotlab consignor
  - Technical assistance on site
  - Loading, controls
  - Reception at consignee facility
  - Unloading, controls
  - Cask return to base
Short description of available casks on the market
# Available casks

<table>
<thead>
<tr>
<th>Agreement</th>
<th>AECL-CRL</th>
<th>Beatrice</th>
<th>Agnès</th>
<th>SAFSHIELD</th>
<th>IR100</th>
<th>TN106 – Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Varied</td>
<td>Varied isotopes (Mo, I, Ir)</td>
<td>Uranium</td>
<td>Varied isotopes (Co, Cs, Ir)</td>
<td>Varied</td>
<td>Varied</td>
</tr>
<tr>
<td>Cavity (mm)</td>
<td>Ø320 x 1168</td>
<td>Ø50 x 103</td>
<td>Ø22 x 160</td>
<td>Ø161 x 342</td>
<td>Ø150 x 1020</td>
<td>Ø203 x 1000</td>
</tr>
<tr>
<td>Overall (mm)</td>
<td>Ø1220 x 1930</td>
<td>Ø286 x 374</td>
<td>Ø1650 x 1705</td>
<td>Ø1040 x 1360</td>
<td>Ø1200 x 2272</td>
<td>Ø1458 x 2424</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>5500</td>
<td>150</td>
<td>5404</td>
<td>3830</td>
<td>6875</td>
<td>7284</td>
</tr>
<tr>
<td>Designer</td>
<td>AECL</td>
<td>South Africa Nuclear Energy Corporation</td>
<td>La Calhene</td>
<td>Croft</td>
<td>CEA</td>
<td>TN International</td>
</tr>
<tr>
<td>Restrictions</td>
<td>AIEA 85</td>
<td>Limited content (U, A, B)</td>
<td>Limited content (B, U, A)</td>
<td>Limited content (A, B, C)</td>
<td>Dimensions</td>
<td>Dimensions</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Small cavity</td>
<td>Dimensions</td>
<td>Docking</td>
<td>Limited power</td>
<td>Licensed but not fabricated</td>
<td></td>
</tr>
</tbody>
</table>
Options for new cask development
Option for new cask development

- Differences between TYPE B / TYPE C
  - Tests of type C are heavier than type B
  - Type B is a well known design / Few designs of type C have been authorized*
  - Material for type C cask will be technically challenging
  - Design period will be longer for type C Cask

« TYPE C » - Patent 2 610 907 - CEA

TYPE B – TN106

* : According to the IAEA Agreement list – TECDOC – 1377 – October 2003 – Only one design have been authorized in Russia
Cost efficiency approach
Cost effective new cask development

A cost effective new cask?

Simplify the design by
- Reducing the dimensions of the cavity
- Reducing the weight of irradiated content (to reduce gamma protection)
- Fixing the loading mode (top or horizontal loading)
- Defining requirements for the new cask (overall dimension, docking,…)
- Defining the preferred transport mode

Simplify the safety analysis report by
- Defining all irradiated materials to transport
- Reducing number of contents to “most needed” contents
- Reducing number of conditioning box or develop a “standard” box

Simplify licensing procedures by
- Defining the countries where the cask has to travel through (and reduce countries number)
How to reach cost efficiency?

Main spending categories

1) Rental
2) Transport
3) Follow-up
   • Project management follow-up
   • Commissioning supervision
4) Technical assistance on site

Impacting rental

- Rental rate is our only way of recouping the investment of the cask development
- It is a direct function of the number of transports per year
- The less those numbers are, the highest the rental will be

the only way of guaranteeing a competitive rental price is to maximize the use of the cask => efficient cooperation between hotlabs

In order for us to guaranty no price variations from one year to the other, we must have a minimum of transports guarantied by the hotlabs
Conclusion

- No existing cask able to feed the expressed needs (ref letter of NMS/AL/2009-37)

- To develop the expected cask:
  - Type B or C choice is decisive for the project
  - Large number of countries = large number of package approval validations
  - Cost efficiency is highly dependent on market’s size = number of transport per year

AREVA is committed to participate to this project and has extensive experience in design, fabrication and operation of casks

Project’s funding mechanism is crucial for AREVA: various alternative should be discussed