



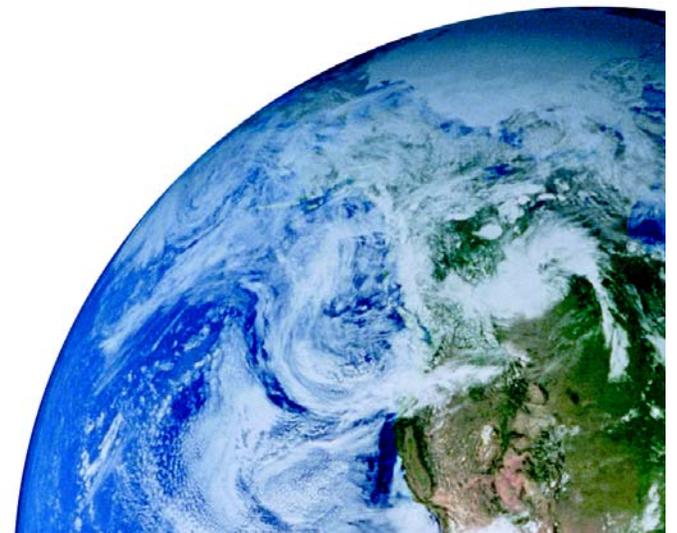
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The Transport of 'Spent Fuel' Samples

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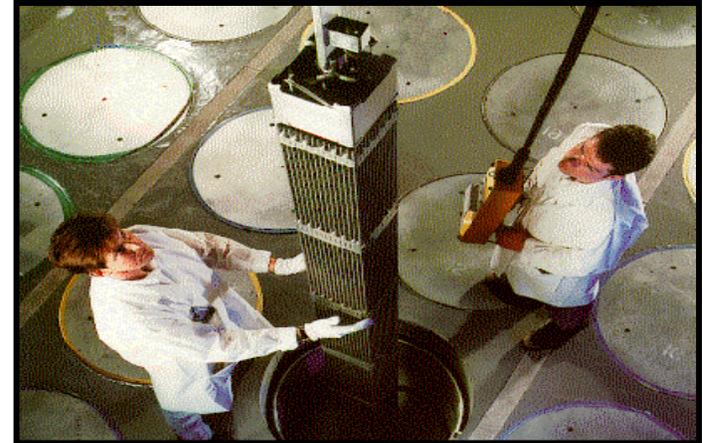
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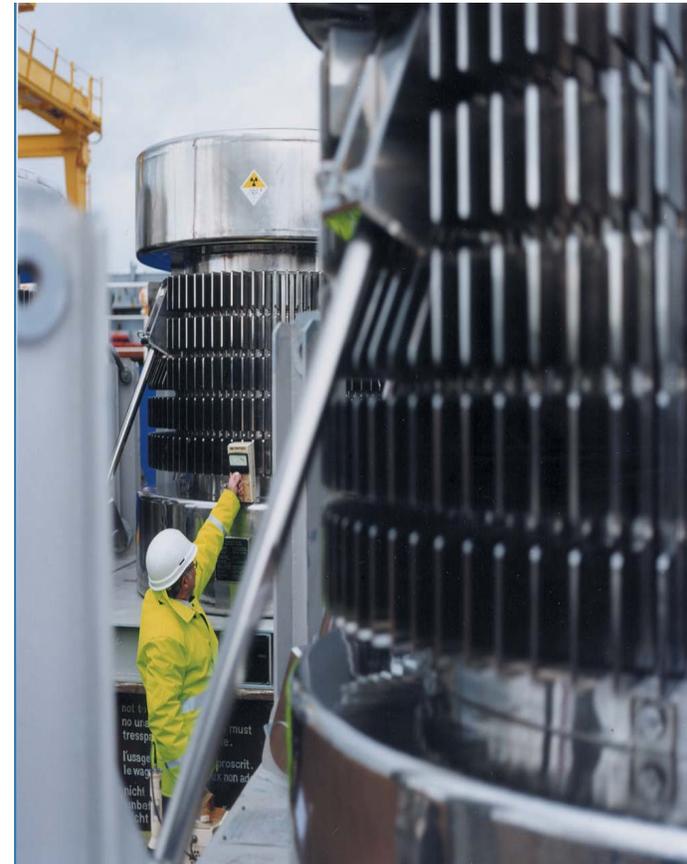
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- Established in 1998
- Founder members Areva, FEPC Japan, BNFL
- 46 Members - drawn from all sectors of the radioactive transport industry
- Several members involved in transport of SF, HLW, and Storage Technology



Unique Issues for Transport

- Public Domain
- Uncontrolled environment
- Multi-modal
- International
- Multi-agency, multi-regulator



Basis for Transport

- Transport must be safe, secure and cost effective
- Safety is vested in the Package
 - risk based packaging approach
 - high hazards are protected with ‘accident proof’ packaging
 - excellent safety record
 - no reported transport accidents resulting in serious radiological consequences



Safety Principles

Safety Principles for radioactive transport;

- Flask 'contents' drives the safety approach.
 - ▶ Accurate radionuclide inventory,
 - ▶ Heat generation, radiation protection, leaktightness, chemical form
 - Regulations provide controls for
 - ▶ Activity, criticality, shielding and heat.
 - ▶ Withstanding normal transport
 - ▶ Safely withstanding 'credible' accident scenarios.
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Packaging options for 'spent fuel samples'



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Transport controls apply hazard values to each nuclide - A2 Values

- Unirradiated uranium has < 1 A2
 - Typically 'spent fuel' has a relatively high hazard (100's, 1000's of A2's)
 - Package types suitable for 'irradiated' spent fuel are limited to
 - ▶ Type B(M)F
 - ▶ Type B(U)F
 - ▶ Type CF
 - Fissile criteria will apply if there is >15 g of fissile nuclides.
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Comparing the Package Types

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Package Type / Criteria	Type B(M)F	Type B(U)F	Type CF
Mode of transport Road, Rail, Sea & Air	All With restrictions for air	All With restrictions for air	All
Hazard Rating (No's of A2)	Unlimited subject to safety case	Unlimited subject to safety case	Unlimited subject to safety case
Air Restrictions	< 3000 A2 < 3000 A1	< 3000 A2 < 3000 A1	No Limit
Type of Approval	Multilateral	Multilateral (unless fissile excepted)	Multilateral (unless fissile excepted)
Testing	Standard Accident	Standard Accident	Enhanced Accident
Testing - Approx Cost	High 10's to 100's of thousands of euros	High 10's to 100's of thousands of euros	Very High 100's to 1000's of thousands of euros
Testing Experience	High	High	Very Low
Project Risk	Low-Medium	Low-Medium	Medium to High

Differences 'Bulk' vs 'Samples'

Criteria	Spent Fuel (Bulk)	Spent Fuel (Samples)
Volume	High	Very Low
Frequency basis	Campaign	Sporadic
Contract	Higher value contract	Lower value contract
Dedicated flasks	Fleet of flasks	Ad-hoc arrangements
Dedicated infrastructure	Dedicated	Hire, as required
Risk of denial	Very Low	Medium to high
Mode preference	Road rail and sea	Air?

Transport Challenges

In order of difficulty (easiest first):

- Irradiated/MOX samples upto 3000 A2 in a Type B flask, all modes.
 - May require a dedicated new 'Type B' flask design, INF 1 vessel for sea transport
 - Irradiated/MOX samples >3000 A2 by road rail & sea
 - May require a dedicated new 'Type B' flask design, INF 1 vessel for sea transport
 - Irradiated/MOX samples >3000 A1/A2 by all modes
 - Requires a new 'Type C' flask design
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Denial Issues

- Transport routes are 'strategic' and 'closely guarded'.
 - Routes are very fragile and easily lost.
 - Radioactives may be seen as an 'unattractive business proposition' particularly for low volumes and limited shipments.
 - Many airlines opt out. Many shippers opt out!
 - 'Captain' has the ultimate authority to carry or not.
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Other Issues

- Securing reliable transport partners will help avoid 'denial and delay'
 - Security considerations
 - Safeguard considerations
 - 'Transfrontier shipment of radioactive waste and spent fuel' directive
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Key Objectives for me!

To better understand the problem!

- How many 'Hot Labs'? 10-15
 - How many transports? 2 per lab
 - Geographical locations, modes of transport required?
 - Quantity of samples?
 - What is the budget for a 'small inexpensive flask'?
 - No's of A2's or A1's in the samples?
 - Other uses for the flask design?
 - Interface issues?
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Thankyou
