

Working Group Hot laboratories and remote handling

Ann Leenaers



New cask characteristics :

Purpose : International transport of small quantities of *irradiated* material

Contents : multi purpose

- UO_2
- MOX (commercial up to weapon grade)
- MTR fuel (LEU up to HEU)
- Thorium fuels
- Various mixtures of Si, Zr, Al, Carbides ...



New cask characteristics :

Physical form :

- cladded and uncladded fuel
- powder or solid, liquids?
- mounted pellets
- pin segments
- sealed source?

Quantities

- content below the 15 gr fissile content limit → COST REDUCING

Radionuclides defined as fissile materials (DGR) :

- U-233
- U-235
- Pu-239
- Pu-240

Origin Calculations

Grams fissile material per ton fuel

commercial MOX		20MW	30MW	40MW	50MW	60MW	70MW		
10 MW									
U235	3.31E+03	U235	2.88E+03	U235	2.05E+03	U235	1.68E+03	U235	1.06E+03
PU239	3.51E+04	PU239	2.79E+04	PU239	1.73E+04	PU239	1.41E+04	PU239	1.06E+04
PU241	6.82E+03	PU241	7.73E+03	PU241	8.51E+03	PU241	8.33E+03	PU241	7.18E+03
total	4.52E+04		3.85E+04	3.28E+04	2.79E+04	2.41E+04	2.11E+04		1.88E+04
commercial UO2		20MW	30MW	40MW	50MW	60MW	70MW	80MW	
10 MW									
U235	2.49E+04	U235	1.72E+04	U235	6.77E+03	U235	3.69E+03	U235	1.91E+03
PU239	3.71E+03	PU239	5.04E+03	PU239	5.81E+03	PU239	5.99E+03	NP237	6.08E+03
		PU241	1.33E+03	PU241	1.72E+03	PU241	1.90E+03	PU241	1.98E+03
total	2.86E+04		2.23E+04	1.82E+04	1.43E+04	1.16E+04	9.97E+03		5.05E+03
Th_Pu_O2									
10 MW									
U233	3.90E+03	U233	7.62E+03	U233	1.10E+04	U233	1.66E+04	U233	1.87E+04
PU239	5.75E+04	PU239	4.40E+04	PU239	3.23E+04	PU239	2.28E+04	PU239	1.54E+04
PU241	1.01E+03	PU241	2.25E+03	PU241	3.59E+03	PU241	4.79E+03	PU241	5.68E+03
total	6.24E+04		5.38E+04	4.69E+04	4.15E+04	3.76E+04	3.49E+04		3.45E+04
MTR fuels		20MW	30MW	40MW	50MW	60MW	70MW	80MW	100MW
U235	1.50E+05	U235	1.04E+05	U235	6.30E+04	U235	3.08E+04	U235	1.05E+04
PU239	2.80E+03	PU239	4.25E+03	PU239	4.89E+03	PU239	5.22E+03	PU239	5.54E+03
		PU241	9.41E+02	PU241	1.45E+03	PU241	1.75E+03	PU241	1.75E+03
total	1.53E+05		1.08E+05	6.88E+04	3.74E+04	1.78E+04			
weapon grade MOX		20MW	30MW	40MW	50MW	60MW	70MW		
10 MW									
U235	3.35E+03	U235	2.86E+03	U235	2.36E+03	U235	1.89E+03	U235	1.47E+03
PU239	3.84E+04	PU239	2.93E+04	PU239	2.19E+04	PU239	1.65E+04	PU239	1.30E+04
		PU241	1.84E+03	PU241	3.19E+03	PU241	4.31E+03	PU241	4.97E+03
total	4.17E+04		3.40E+04	2.75E+04	2.27E+04	1.95E+04	1.73E+04		1.50E+04



Percentage fissile material per amount of fuel

Commercial MOX : 4,5 % → limit to 300 gr material (total)

Commercial UO₂ : 2,9 % → limit to 500 gr material (total)

ThPuO₂ : 6.2% → limit to 240 gr material (total)

MTR fuels : **15.3%** → limit to 90 gr material (total)

Weapon grade MOX : 4.2% → limit to 350 gr material (total)

→ ***stay below the 15g fissile material per package***



New cask characteristics :

Activity limits of content (origin calculations)

➤ Commercial MOX : 300 g -70 MW : $1.02 \cdot 10^{14}$ Bq

➤ Commercial UO₂ : 500 g - 80 MW : $1.63 \cdot 10^{14}$ Bq

➤ ThPuO₂ : 240 g -70 MW : $7.39 \cdot 10^{13}$ Bq

➤ MTR fuels : 90 g – 100%²³⁵U : $6.03 \cdot 10^{13}$ Bq

➤ Weapon grade MOX : 350 g -70 MW : $1.11 \cdot 10^{14}$ Bq

→ ***stay below $2 \cdot 10^{14}$ Bq total activity per package***



New cask characteristics :

Activity limits of content (origin calculations)

- Commercial MOX : 100 g -70 MW : $3.41 \cdot 10^{13}$ Bq
- Commercial UO₂ : 100 g - 80 MW : $3.26 \cdot 10^{13}$ Bq
- ThPuO₂ : 100 g -70 MW : $3.08 \cdot 10^{13}$ Bq
- MTR fuels : 90 g – 100%²³⁵U : $6.03 \cdot 10^{13}$ Bq
- Weapon grade MOX : 100 g -70 MW : $3.16 \cdot 10^{13}$ Bq

→ ***if we limit total weight to 100g we stay below $7 \cdot 10^{13}$ Bq total activity per package***



New cask characteristics :

Package dimensions

Cavity : height 300 mm – internal diameter 200 mm

300 mm SS shielding required (TN106 → ~310 mm)

Cask outer dimensions : height 900 mm – diameter 800 mm

Total weight (approx) : below 5 ton

→ COST REDUCING

→ unloading in hotcell possible (vertical or/and horizontal position) ?



New cask characteristics :

Loading mode

- Only dry loading and unloading

Transportation mode

- Air
- Road
- Railways
- Maritime



New cask characteristics :

Licencing

- Worldwide validation
(enormous interest in intercontinental transport!
which implies Air transport)
- Unilateral approval → COST REDUCING

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Studiecentrum voor Kernenergie
Centre d'Etude de l'Energie Nucléaire

Stichting van Openbaar Nut
Fondation d'Utilité Publique
Foundation of Public Utility

Registered Office: Avenue Herrmann-Debrouxlaan 40 – BE-1160 BRUSSEL
Operational Office: Boeretang 200 – BE-2400 MOL