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Report on materials inventory and transportation from Germany to France

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RAPHAEL (ReActor for Process heat, Hydrogen And ELectricity generation)





ReActor for Process heat, Hydrogen And ELelectricity generation (RAPHAEL)		
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Document title

Report on materials inventory and transportation from Germany to France

Abstract

Considering first the low enriched uranium oxide kernels but also UCO and (U,Th)O₂ kernels, irradiated samples have been identified in Juelich (pebbles, compacts and particles). The samples choice has been done. The main characteristics are indicated in this document which includes also considerations about the transport of the samples to Atalante facility.

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1 Introduction

The generation of waste from the operation of nuclear power plants, and specifically the VHTR one is an issue of major importance with regard to sustainable development, and receives much more attention than in the past when the main emphasis was on the technological development of the reactor systems and high conversion fuel cycles. In this field, an ambitious characterization programme is scheduled in Atalante facility with HTR samples provided by FZJ.

The objective of the RAPHAEL sub project on the back end of the fuel cycle is to study the characteristics and performance of HTR fuel with regard to behaviour in direct geological disposal conditions and is restricted to the once-through fuel cycle. Existing characterization data from past investigations, in particular in France, Germany and UK, have to be completed. In this field, FZJ samples will be transported to Atalante facility.

2 Samples choice

Physical-chemical and radiochemical characteristics have to be known for interpreting the results of the studies on the long term behaviour of the spent fuel and the performances of the treatments for the separation of graphite from TRISO particles. It is necessary to get information about the localization and the distribution of the contamination. Analysis will be performed, in the Atalante facility, with equipment implemented in gloves boxes and hot cells.

The samples choice is based on the knowledge about the main particles characteristics (kernel, coating, irradiation conditions) and depends also of the samples accessibility at FZJ (place that can be reached easily).

Table 1 shows samples details. According to the R&D needs in the back end fuel cycle subproject, the main samples characteristics are :

- Nature : coated particles (mainly TRISO), pebbles and compacts,
- Kernels
 - o UO_2 , UCO and $(\text{U,Th})\text{O}_2$
 - o diameters from 200 to 500 μm
 - o reference coatings thickness
- Irradiation conditions
 - o Low and high burn up values (7 to 56 FIMA)
 - o Temperature in a range from 800 to 1600°C

In complement, It will be investigated the possibility to get additional samples stored at ITU.

3 Transport

According to the European Agreement concerning the International Carriage of Dangerous Goods by Roads (ADR), two kinds of transport are under consideration :

- low activity samples (only coated particles in small quantities) which can be carried out using a type A package,
- high activity samples (pebbles and so on) which can be performed in a type B package like the TN106 or the RD15IIB (Padirac) one (see photos 1 et 2) that can be used in Atalante facility.



Photo 1 : TN106 cask



Photo 2 : RD15IIB cask

The RD15IIB cask is more suitable for FZJ facility. A specific licence is needed to be used for the samples shipment. This point is under investigation but the cask licence will not be available before 2007.

4 Miscellaneous

Due to the specificity of HTR samples (kernel, graphite matrix and so on), a safety file is needed to handle these materials in Atalante facility. The examination is under way and the the authorization is waited for the end of this year.

5 Conclusion

The selected samples will be transported to Atalante facility in two times :

- First, the low activity ones in a type A package at the beginning of year 2007,
- After, the high activity samples in a RD15IIB cask when the licence will be obtained (expected date, second semester of year 2007).


Table 1 : FZJ samples characteristics.

Coated Particles			Data before irradiation								Irradiation conditions			
			Kernel				Coating Thickness (µm)				Irradiation time (efpd)	Center temperature (°C)	Burn up (% FIMA)	Date of End of irradiation
Fuel Type	Lot Number	Particle Batch	U5/Utot (%)	U/Th (%)	Utot (g)	Diameter (µm)	Buffer	Ipyc	SiC	Opyc				
UO2 TRISO	HFR-P3/O2: Harwel capsule with particles from Coupon 8/17, BS03A817	EUO 1551	90.34	—	0.00428 in 100 cp	205	111	35	38	39	123.3	1400	47.4	Jul 1, 1979
UCO TRISO	HFR-P3/Z: Harwel capsule with particles from Coupon 2/14, BS03C214	ECO 1541 UCO/1,4	93.19	—	0.00400 in 100 cp	196	109	35	35	37	123.3	1400	55.7	Jul 1, 1979
	HFR-P3/O1: Harwel capsule with particles from Coupon 3/4, BS03D304	HT 129-149 UCO/1,1	92.97	—	0.00419 in 100 cp	197	104	35	34	36	123.3	1400	53.1	Jul 1, 1979
	HFR-P3/Z: Harwel capsule with particles from Coupon 3/7, BS03D307	HT 129-149 UCO/1,1	92.97	—	0.00419 in 100 cp	197	104	35	34	36	123.3	1400	55.7	Jul 1, 1979
(Th,U)O2 TRISO	FRJ2-K11/19/D1: Compact box with ca. 400-500 particles, AA1119D1	HT 150-160, 162-167	92.47	21,89	0,052	500	90	43	34	41	260.2	1168	10	Jun 27, 1980

Pebbles			Data before irradiation								Irradiation conditions			
			Kernel				Coating Thickness (µm)				Irradiation time (efpd)	Center temperature (°C)	Burn up (% FIMA)	Date of End of irradiation
Type	Lot-Nr.	Fuel Type	U5/Utot (%)	U/Th (%)	Utot (g)	Diameter (µm)	Buffer	Ipyc	SiC	Opyc				
HEU (Th,U)O2 LTI TRISO	FRJ2-K11: Pebble 3, AA110300	HT 150-160, 162-167	92.47	21,89	1.081 in 10,390 cp	500	90	43	34	41	260.2	1156	9.6	Jun 27, 1980
LEU UO2	FRJ2-KA1: Pebble 2 (Kugel abgedreht wie BE24), AAA10200	HT 354-383	16.76	—	6 in 9500 cp	501	92	38	33	41	25	< 500	0.35	Apr 2, 1989

Compacts			Data before irradiation								Irradiation conditions			
			Kernel				Coating Thickness (µm)				Irradiation time (efpd)	Center temperature (°C)	Burn up (% FIMA)	Date of End of irradiation
Type	Lot-Nr.	Fuel Type	U5/Utot (%)	U/Th (%)	Utot (g)	Diameter (µm)	Buffer	Ipyc	SiC	Opyc				
MEU UCO LTI TRISO	FRJ2-P24/3: Compact 16, AJ241600	HT 174/176	20.08	—	0.55951 in 3822 cp	302	73	40	35	34	298	850-1050	22.2	Apr 19, 1982
HEU (Th,U)O2 HTI BISO	FRJ2-P22: Capsule 3, Compact 2-18, AJ22C018	EO 1232-34	91.84	N=5	1.47 HM in 1647 cp	407	180 total BISO		—		182	1620-1110	10.7	Apr 22, 1979
	FRJ2-P22: Capsule 4, Compact 2-30, AJ22D030	EO 1232-34	91.84	N=5	0.2619 in compact	407	180 total BISO		—		182	1400-1000	10.3	Apr 22, 1979
LEU UO2 LTI TRISO	FRJ2-P27/2, Coupon 8/3, AJ27C400	EUO 2308	9.82	—	0.02126 in 34 cp	497	94	41	36	40	232.34	1220-1320	9	Feb 10, 1985
	FRJ2-P27/1, Coupon 8/1, AJ27C200	EUO 2308	9.82	—	0.02126 in 34 cp	497	94	41	36	40	232.34	880-1080	8.4	Feb 10, 1985
	FRJ2-P27/1, Coupon 9/2, AJ27C100	EUO 2309	9.82	—	0.02126 in 34 cp	497	93	37	51	38	232.34	880-1080	7.8	Feb 10, 1985
	FRJ2-P27/3, Coupon 8/4, AJ27C500	EUO 2308	9.82	—	0.02126 in 34 cp	497	94	41	36	40	232.34	1080-1130	8.1	Feb 10, 1985