CRITERIA FOR THE TRANSPORT OF REPROCESSING WASTES

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Abstract

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According to contracts concluded between Cogéma and its utility customers, wastes produced at different stages of the reprocessing process at the UP2 and UP3-A La Hague, France, plants will be returned to the respective customers. As there is no packaging currently available for routine transport of these wastes, Cogéma and Transnucléaire have collaborated to determine acceptance criteria for future packagings that will be used to transport the wastes from La Hague. These criteria are intended to simplify package-handling conditions, while at the same time reducing personnel exposures and the risks of equipment contamination.

DESCRIPTION OF THE WASTES

According to contracts concluded between Cogéma and its utility customers, wastes produced at different stages of the reprocessing process, at the UP2 and UP3-A La Hague, France, plants, will be returned to the respective customers (Table I). The wastes take the following forms.

(1) *Vitrified residues.* Fission products which contain over 99 per cent of the irradiated fuel's activity will be solidified with glass in a cylindrical stainless steel container.
(2) *Bituminized residues.* Sludges that issue from the liquid waste treatment station will be embedded in bitumen in a stainless steel drum.
(3) *Hulls and ends.* The metallic structure of the fuel assemblies (mainly bits of chopped Zircaloy tubes), undissolved after reprocessing, will be embedded in concrete in a stainless steel drum.
(4) *Technological residues.* The wastes coming from everyday running of the plants will be shielded in concrete in asbestos–cement containers. They include, as well, miscellaneous contaminated metallic equipment, plastic or protective clothes for operators. They may or may not be in compacted form.

TABLE I. MAIN CHARACTERISTICS OF RESIDUES

		Vitrified residues	Bituminized residues	Cemented residues		
				Hulls and ends	Technological residues	
					Non-α	α
Contents		Fission products, fines	Sludges	Metallic structure of the fuel assembly	Process equipment and materials	Process equipment and materials
Cooling time after discharge from reactor at time of transport (years)		6.5	3	3	3	3
No. of containers per year		1200	4000	800	9000	1600
Container characteristics	External sizes (mm)					
	Diameter	430	600	1130	840	1000
	Height	1335	900	1690	1200	1500
	Average weight (kg)	480	300	4500	1800	3000
	Average activity (Bq)					
	α	1.5×10^{14}	3.7×10^{10}	1.5×10^{11}	7.4×10^{8}	7.4×10^{10}
	B/γ	2.8×10^{16}	9.3×10^{12}	9.8×10^{14}	7.4×10^{10}	2.6×10^{12}
	Maximum heat power (W)	2000	5	130	–	–
	Surface dose rate (Gy/h)	10^{4}	10^{3}	<70	$<2 \times 10^{-3}$	$<5 \times 10^{-3}$

ACCEPTANCE CRITERIA FOR LOADING TRANSPORT PACKAGINGS AT THE LA HAGUE PLANT

Cogéma and Transnucléaire are collaborating to determine the acceptance criteria for future packagings that will be used to transport residues from La Hague. The purpose of these criteria is to simplify package-operating conditions. They are dictated mainly by the interfacing systems operated or managed by Cogéma. These interfaces cover:

- Transport and transfer vehicles, such as railcars, road trucks, sea vessels, etc., and their specific supporting tie-down equipment.
- Handling cranes and beams used for transfers from one vehicle to another, as well as for moving the packagings inside the waste-loading installations.
- All devices, whether remotely handled or not, used for the preparation, opening and loading of the packagings.
- Decontamination and maintenance equipment.
- Removable components.

The need for standardization of the packagings is commensurate with the need to avoid, as far as is practicable, the multiplicity of different operating equipment sizes or the use of numerous adaptors, which represent time and quality losses, as well as higher risks of contamination and personnel irradiation owing to the increased number of manned operations.

TABLE II. OVERALL DIMENSIONS AND WEIGHTS

	Length or height (m)	Maximum diameter (m)	Maximum weight (kg)
Long packaging	Between 2.8 and 7	2.5	110 000
Short packaging	2.8 (max)	2.5	40 000

TABLE III. MINIMUM CAPACITY OF PACKAGINGS

	Vitrified residues	Bituminized residues	Cemented residues	
			Hulls and ends	Technological
Long packaging	20	Not allowed	3	12
Short packaging	5	12	Not allowed	Not allowed

Packaging design features (Tables II and III)

Operating and transport conditions

The packagings are always transported and operated in dry condition. Short packagings (transported in a vertical position) and long packagings (transported in a horizontal position) are usually loaded in a vertical position into hot cells.

Two pairs of trunnions are provided on each long packaging and one pair on each short packaging. Packagings for vitrified residues (short and long) are provided with two pairs of upper trunnions because of the loading mode at La Hague plants. The trunnion sizes are specified by Cogéma.

TRENDS IN PACKAGING DESIGNS (Fig. 1)

Packagings for vitrified residues

This type of packaging is the most complex of the family. Owing to the high level of neutron and gamma radiation, it includes both thick neutron and gamma shieldings, which give it the same properties as spent fuel transport packagings.

Packagings for bituminized residues

This type of packaging provides shielding from gamma radiation only. Its main features are two leaktight baskets which are provided with a central handling device for easy loading and unloading from the cavity. The baskets are filled with six drums each outside the packaging; the spare baskets ensure that packaging operations are not delayed.

Packaging for cemented residues, hulls and ends

Again, this type of packaging provides shielding from gamma radiation only. It is not equipped with any baskets because of the large diameter of the residue containers. A special handling device remains attached to each residue container inside the packaging cavity, allowing easy unloading in the receiving facility.

Packaging for technological residues

This packaging differs from the others in that it has a gamma shielding that is not so thick, and by the rectangular shape of the cross-section, possible because of less severe content characteristics.

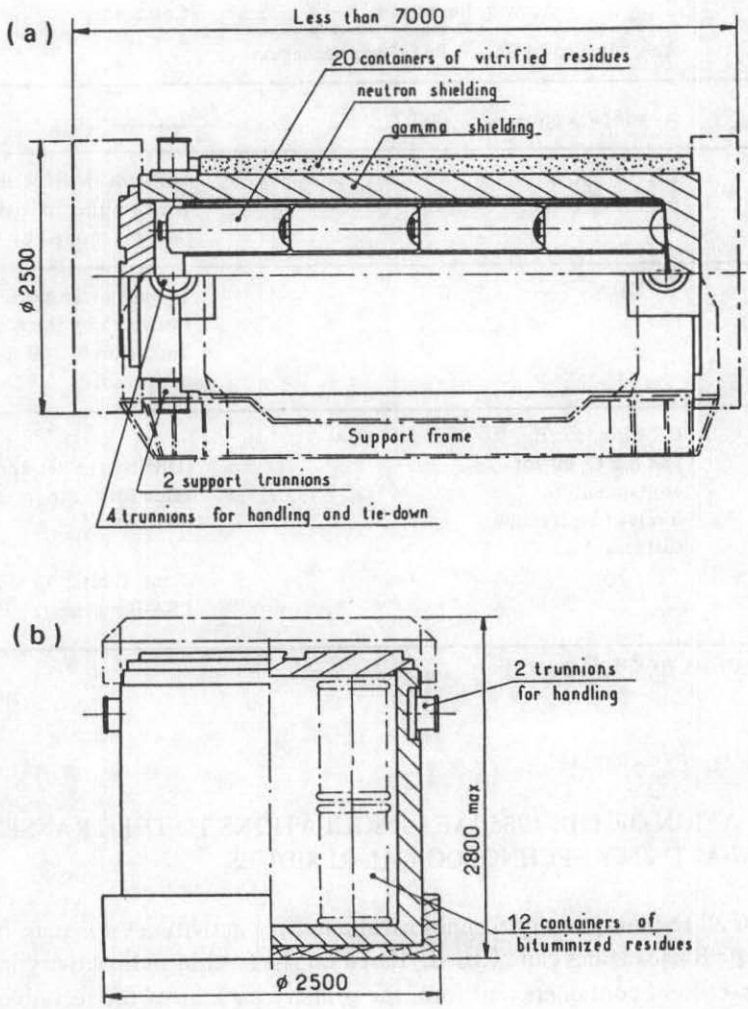

FIG. 1. Packagings for (a) vitrified and (b) bituminized residues (dimensions in mm).

TABLE IV. ACTIVITY LIMITATIONS FOR TECHNOLOGICAL RESIDUES

	Activity limitations		Comments
	According to IAEA	Pu (g) per packaging	
Type A	A_2 per packaging	0.007	Too restrictive
LSA-III	2×10^{-3} A_2/g	4	Difficult to successfully perform the 'lixiviation' test, as required by IAEA
LSA-II	10^{-4} A_2/g	0.2	Quantity transported is restricted by the activity limitation of 100 A_2 per conveyance
SCO-II	0.2 Ci/m^2 for B, and 0.2 Ci/m^2 for contamination levels of inaccessible surfaces	–	– (Difficult to determine a value for the inaccessible surface) – (Same limitation as for LSA-II material)

Note: 1 Ci = 3.70×10^{10} Bq.

APPLICATION OF THE 1985 IAEA REGULATIONS TO THE TRANSPORT OF LOW-ACTIVITY TECHNOLOGICAL RESIDUES

For all residues, except technological ones, the activity level is such that only Type B packagings can be used. Based on the level of radioactivity in the asbestos–cement containers that form the primary packing of the technological residues, these materials may be transported either by using:

(1) A Type B packaging, as described above. This solution is obviously less economical and will preferably be used only for materials which exceed the limits required for the other categories.

(2) Type A or industrial packages which, for instance, could be tied down inside maritime freight containers. This solution is the more attractive as the asbestos–cement containers may be qualified as either Type A or industrial packagings, though restrictive activity limitations have to be applied for each category (Table IV).