SERVING THE FUEL CYCLE: PREPARING TOMORROW'S PACKAGINGS

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1. INTRODUCTION

The main fleet of transport packagings serving today the fuel cycle was born more than 20 years ago. 0r was it they?

The present paper will show that serving the fuel cycle by preparing tomorrow's logistics is actually an on-going process, rather than a rupture.

We shall review the great packagings of the fuel cycle:

In the front end, the major actors are the UF4, UF6, enriched UF6, UO2 powders, fresh fuel packagings.

In the back end of the fuel cycle, we find the dry transport casks of the TN-12, TN-17, TN-13, family and also the Excellox wet flasks.

In the waste management, a whole fleet of containers, culminating in the TN Gemini, are available or being created.

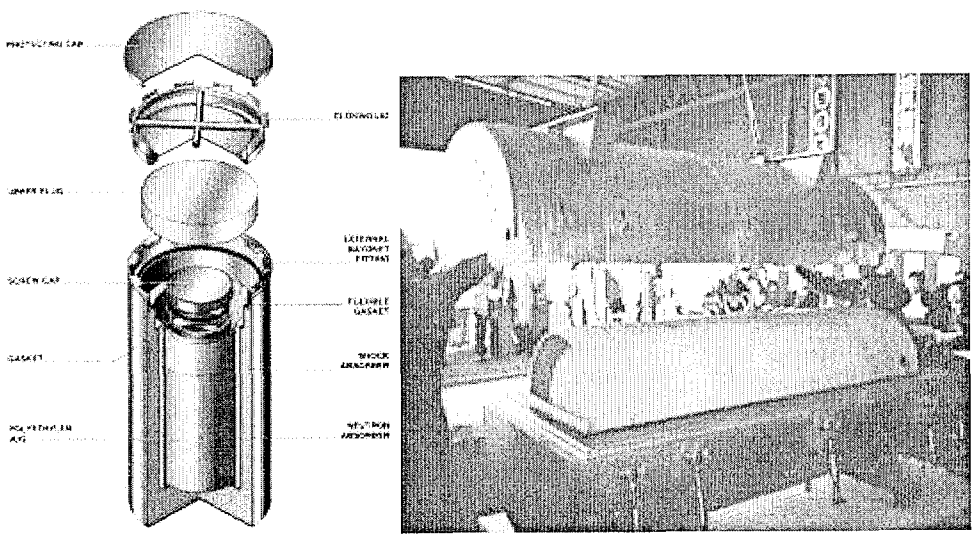
2. EVOLUTION IN THE FRONT END

From the mine, the containers are quite simple ore or ore concentrate containers, stemming from conventional mining industries, and they are today still appropriate.

What progress has been made over the years is the implementation through Quality Assurance of correct follow-up of status and maintenance.

After conversion, the cylinders being used, 48Y and 30B, are derived from the chemical industry, where they were created to handle aggressive gases such as chlorine. The evolution here has been a traceability of cylinders, maintenance, new definition and thorough testing of modern user-friendly 30B overpacks.

The next step will be the new type H packaging created by IAEA 1996, as of July 2001. This type H is meant to give fuller confidence in the behaviour of the 48Y cylinder under a fire accident, because the Teneriffe study indicated, not conclusively, there might be an excessive pressure within the cylinder.



The industry is presently studying and applying for different solutions to their competent authorities. These solutions include intumescent paint, insulation covers, overpacks, etc. The complex thing is the great number of existing cylinders (tens of thousands) that make it paramount not to modify operational interfaces.

Demand for higher enriched fresh fuel (UO2 and MOX) also leads to progressive introduction of higher performance fresh fuel packagings.

The Framatome FCC, with Transnucléaire neutron absorber, benefits from the advances in neutron absorbers implemented in Transnucléaire's fresh MOX packages.

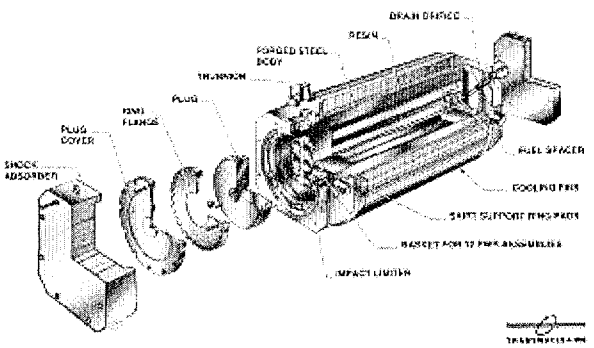
Important steps forward have also been made to guarantee that under normal transport conditions, fresh fuel integrity is extremely well preserved : benefits from extensive measurements campaigns during transport have yielded scores of useful data now being implemented in newer packagings.

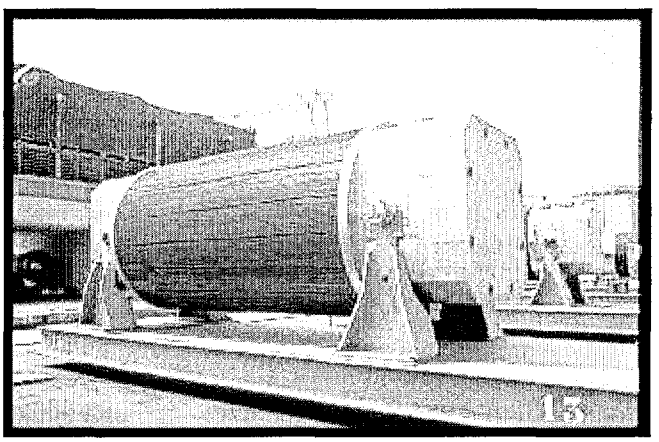
3. EVOLUTION IN THE BACK END

Today, we are still manufacturing casks who were first transported more than 20 years ago, like the TN-12 family casks ! How is this possible?

Basically, the TN-12 concept included from day one a wide margin of safety because it was designed for 8 months cooled fuel at moderate burn-ups. So gamma and heat sources were very high indeed, with a moderate neutron source.

TN 12/2 SPENT FUEL TRANSPORT CASK





So as burn-up and initial enrichments were increasing, the evolution was simple:

- increase a little the cooling time would keep ? and kilowatts at bay,
- the lesser heat exchange surface thus necessary would allow a thicker coat of neutron shielding through which the fins carry heat to the atmosphere.

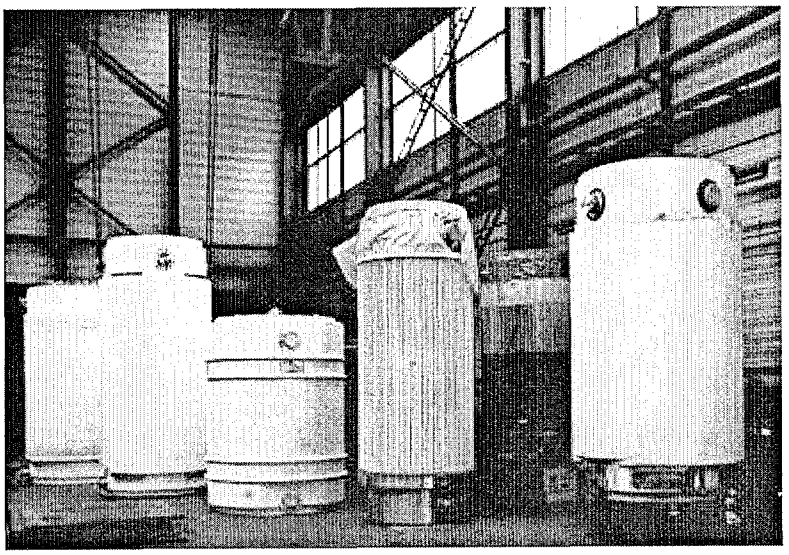
A few years later, two further steps could be taken :

- improve baskets criticality control through very high performance designs involving more neutron poison and shielding,

- use of burn-up credit.

In parallel, as a part of the spent fuel was not directed immediately to reprocessing, dual purpose casks (i.e. interim storage and transport casks) were designed to store much cooler fuel.

The TN-24 cask family was born, and is characterized by a high payload (up to 37 PWR or 97 BWR spent fuel) and a much lower heat power (less than 40kW in most cases). This also gives now way to offering flexibility to the utilities while diminishing their costs.



Recently, the synthesis was conclusively demonstrated by the TN-52L which is a transport cask with (interim) storage capability. It has been well tested in operation and is one of the forefathers of our new developments.

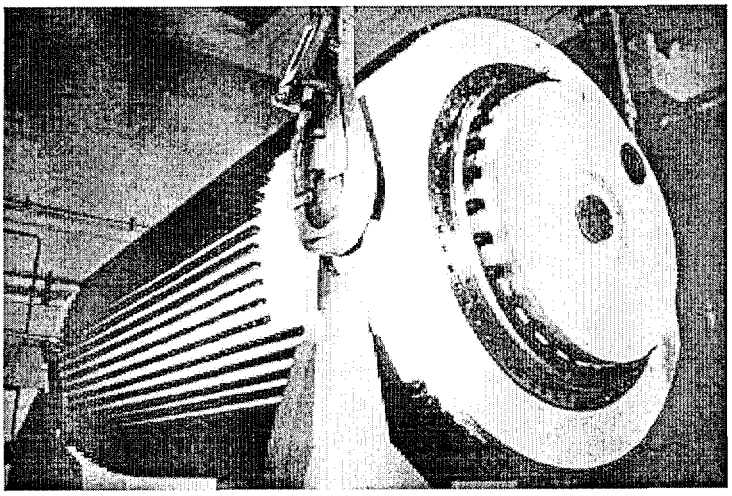
Today's challenges in the back-end are the spent MOX fuel and high burn-up UO2 fuels, with their very large neutron source terms that abate only very slowly with time.

The trend to complete the TN-12 family is represented by the TN-112, that is a synthesis of the design progress made over the several evolutions of the TN-12 family and the TN-24 family.

It integrates optimally :

- high capacity for rather short cooled fuel,
- excellent neutron shielding, including MOX sources,
- enhanced maintainability.

In high activity residues, progress is also moving along the way of the most flexible operation.
A fleet of TN-28 casks is performing well in the delivery of HAW from la Hague to Reprocessing Customers in Europe and Japan, but it is wished to :



- take into account ICRP60 quality factor on these high neutron sources,
- facilitate shipment preparation by accepting all sources from COGEMA without having to sort them, thus saving time end dose to operations.

Thus was created a new cask, the TN-81, to fulfill this upper range demand, with innovative new features.

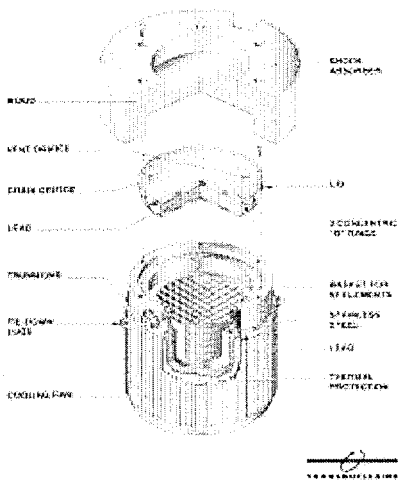
As in different countries, new a waste repositions are being created, such packagings as the TN Gemini, that allow large batches of a bearing wastes, also become a new reference for that purpose.

4. EVOLUTION IN RESEARCH

Corresponding to the need of power generating stations, demand for higher performance and newer designs for the research reactors and laboratories has ripened.

The other design packagings like the widely known IU04 (Pegase) are being replaced by the new TN MTR spent fuel package.

TN-MTR CASK



The need of post irradiation examination of fuel rods and the trend towards higher burnup also progressively make the TN-6 series obsolete. The new TN-106 and TN-1000 cater to the current needs of laboratories.

The changes are less in basic design than in changes to improve operation, maintenance, and also in analysis of behaviour corresponding to the state-of-the-art.

5. CONCLUSION

Continuity is the rule and well designed older concepts have a good lifetime of safe operation before them.

But we shall see progressively along with the current packaging models new ones, integrating new and also well-proven ideas, to keep on transporting safely radioactive material to serve the industry and its own progress towards getting full value out of the available resources.

The main objective was and still is tomorrow the perfect record of the industry.