Proceedings of the 15th International Symposium on the Packaging and Transportation of Radioactive Materials
PATRAM 2007
October 21-26, 2007, Miami, Florida, USA

CASKS DEVELOPMENT FOR MOX TRANSPORTATION FROM FRANCE TO JAPAN

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ABSTRACT :

Needing to transport fresh MOX fuel assemblies from France to Japan, TEPCO and TN International worked together to develop new casks:

- A light cask of the MX 6 type (about 20 tons) used for inland transport from the MOX manufacturing plant (AREVA MELOX) to the harbour.
- A heavy cask of the TN12/2 type used for maritime transport to Japan.

The light cask type MX 6 will be also used for maritime transport to Japan Nuclear Power Plant with lower capacity of heavy-duty handling.

New baskets with optimal load capacity have been developed for this use:

- 10 MOX BWR fuel type 8X8 equipped with fuel holder for the light cask
- 21 MOX BWR fuel type 8X8 equipped with fuel holder for the heavy cask.

These new baskets are taking into account a simplified tightening system for fuel assemblies during transport.

INTRODUCTION

In the context of recycling of used fuels, AREVA NC (La Hague plant, France) has reprocessed Japanese fuel. The plutonium extracted from this fuel returned to Japan in the form of fresh MOX fuel assemblies.

The first transport for Japanese BWR power plants was performed by TN International in 1999 and 2000 using the following cask:

- **FS 65 JB** for inland transport in France and Belgium, between Dessel Plant to AREVA NC La Hague plant.

Figure 1: Inland transport

This cask can contain 2 BWR fuel assemblies (The transport of FS 65 JB is made by a group of 4 casks in a container, therefore 8 BWR fuel assemblies can be transported in the same conveyance).

- For maritime transport between France and Japan :

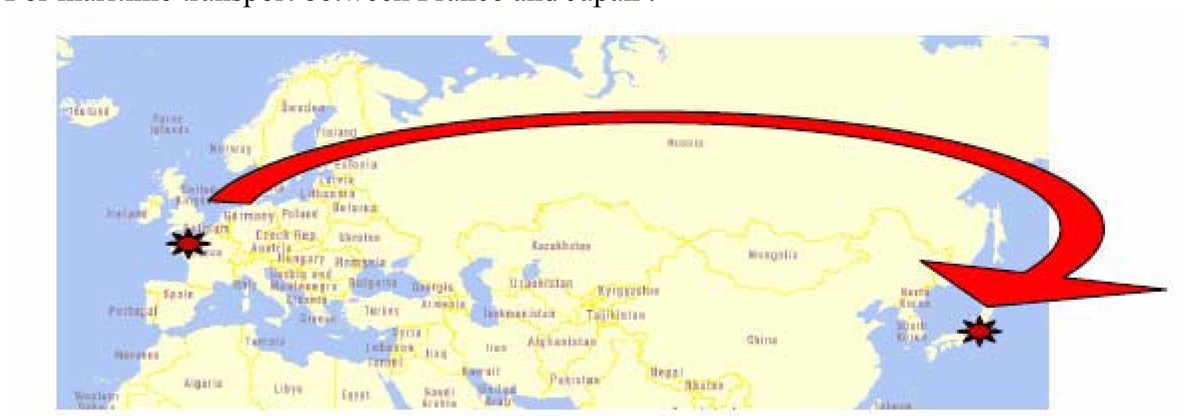

Figure 2: Maritime transport

- **TN 12/2** : which can contain 12 BWR fuel assemblies

- **TN 17/2 :** which can contain 8 BWR fuel assemblies. This smaller cask, which weighs about 80 tons, is necessary for some Japanese plants with lower capacity of heavy-duty handling.

Each MOX fuel assembly is placed into a Fuel Holder, which protects the assembly during handling and transport. The Fuel Holders containing assemblies are transferred from the inland cask to maritime cask in AREVA NC La Hague plant.

After this transport, TEPCO and TN International have worked together to develop new casks so as to increase the transport capacities.

INLAND AND MARITIME TRANSPORT NEW TRANSPORT CASK

For the inland transport from AREVA MELOX manufacturing plant to AREVA NC La Hague plant, a light cask of the MX 6 type (about 20 tons) was adopted as the base for the design of the new cask body.

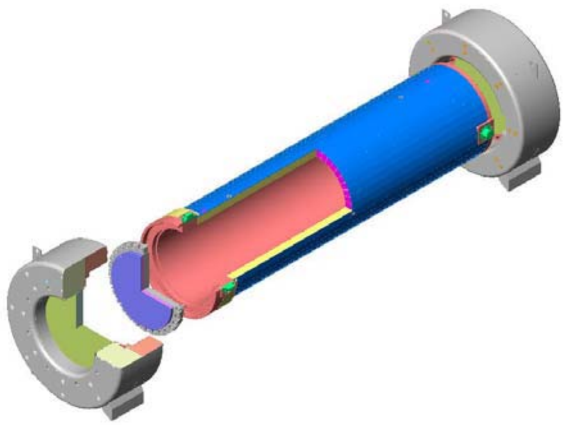

Figure 3: MX 6 cask

This type of cask allows making road transportation without exceeding the maximal mass authorized (40 tons).

For the maritime transport to Japan, a heavy cask type TN 12/2 (about 110 tons) which is designed like conventional maritime transport cask for Japan, was adopted for the body design. The light MX 6 cask is also used for the maritime transport for some Japanese plants with lower capacity of heavy-duty handling.

Figure 4: TN 12/2 cask

For Fresh Fuel, its integrity has to be preserved during the transport. Accelerations and vibrations sustained by the cask must not damage the Fuel. Therefore, the Fuel must be carefully secured in its compartment by tightening. In order to do this, previous tightening system consists in a line of tightening pads, which come to stick radially the fuel against 2 faces of the compartment. From its feedback in MOX Transport, TN International developed new tightening systems (for MX 8 in France, and MX 6 in Europe) consisting in:

- A new transportation position, the assembly orientation has been changed from 0° to 45°. This allows the assembly to remain stable on the 2 inner faces of the compartment and consequently, this stable condition allows the Fuel tightening system to be simpler and smaller.

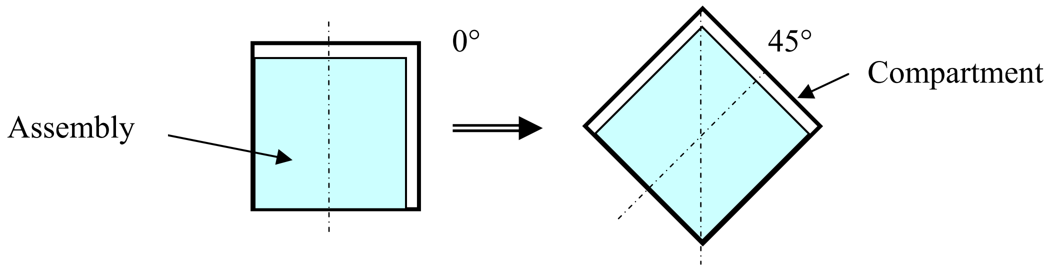

Figure 5: assembly orientation during transport

- Tightening of the Fuel only by its head part.

At the same time, a new type of Fuel Holder which is equipped with a spring system to place itself towards a corner of the basket compartment automatically during loading, has been developed by Japanese utilities including TEPCO.

The principle of this new tightening system adapted to the Fuel Holder, and also the changes in the design of the Fuel Holder conduct to a new clamping system which assures the immobilisation in radial and axial direction by the head part of the Fuel Holder collaborating with the spring system of the new Holder.

Through this design evolution, space is used more efficiently and this allows the loading capacity to increase in the same volume.

Therefore, the new baskets developed have a loading capacity increased to:
- 10 Japanese BWR Fresh MOX Fuel assemblies for MX 6 cask,
- 21 Japanese BWR Fresh MOX Fuel assemblies for TN12/2 Advanced cask,

The increased capacity can be easily seen on figure 6 showing the increase of the transport capacity for the same cask TN12/2

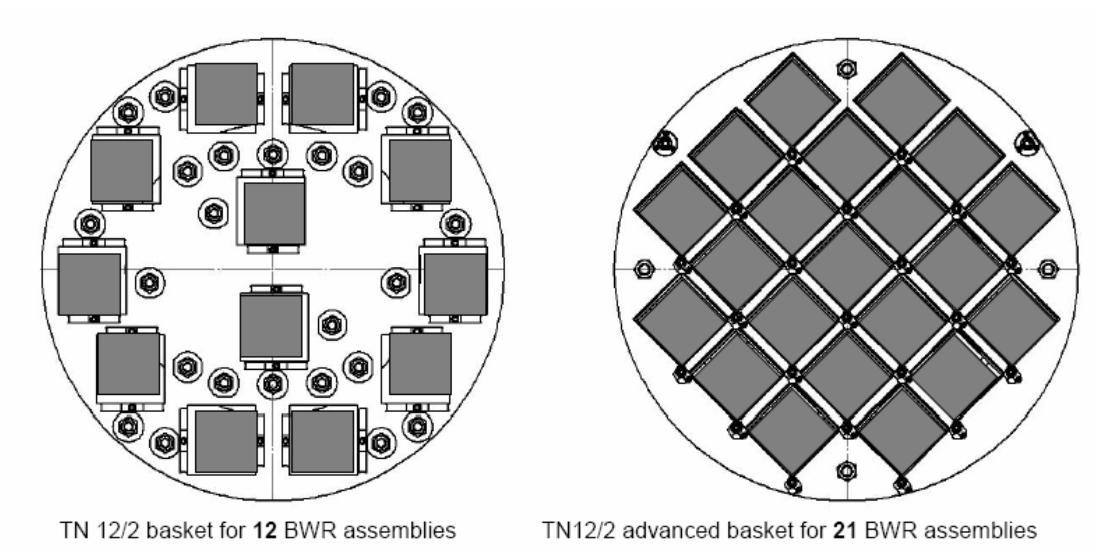

Figure 6: difference between 2 baskets

Indeed, this also increases the weight of fissile materials transported in the same cask. A special attention has been taken in the design of the new baskets in order to comply with criticality requirements.

TRANSPORT CAPACITY BENEFIT

The table below compares the capacities between the former and future transport casks.

	Former transport	Future transport
Inland transport		
Packaging	FS 65 JB	MX 6
Number of fuel/cask	2	10
Number of cask /conveyance	4	1
Total number of fuel/conveyance	**8**	**10**
Maritime transport case 1		
Packaging	TN 12/2	TN 12/2 advanced
Number of fuel/cask	**12**	**21**
Maritime transport case 2		
Packaging	TN 17/2	MX 6
Number of fuel/cask	**8**	**10**

Table 1: Comparison between former and future transport casks

The advantages of the new casks are not only the increased loading capacity but also the rationalized cask operations shown below:

For inland transportation:

- Reduction of operating time (lid closure, leak tightness test, dose rate, measure of the contamination, package handling…) by using one cask (MX 6) instead of 4 casks (FS 65 JB).
- Reduction of the number of transportation to supply the same number of assemblies (for instance to supply 40 assemblies, 5 transports are required with FS 65 JB cask, instead of 4 transportations with MX 6 cask).
- Optimisation of transportation as TN12/2 cask can be loaded with 2 transports of MX 6 package

For maritime transportation:

- The same cask (TN 12/2) can transport 75% more assemblies; for example, in order to supply 60 assemblies, 3 TN 12/2 advanced packages are necessary instead of 5 conventional TN 12/2 packages.
- Also, compared to TN 17/2 cask, the MX 6 cask can transport 25% more assemblies. Furthermore, by using MX 6 package for sea transportation, the assembly transfer operations between casks (from the FS65 JB cask to the TN 17/2) are suppressed.

Cask operation in site:

- The new tightening system, which consists of the new clamping system and the spring system of new the Fuel Holder, facilitates the mounting of the Fuel Holder in the compartment. Indeed, the operation of mounting the Fuel Holder is made by the simple placing of the clamping system on its support in the basket with a tightening torque. No other action is necessary. Times of operation are thus largely reduced, which follows the ALARA principles.

The identical tightening system (the new clamping system and the spring system of the new Fuel Holder) is adopted for both of the TN12 advanced and the MX 6 so that the same tools can be used.

CONCLUSION

Thanks to this new development, TEPCO and TN International contribute to reduce the number of transportation (for the same quantities of nuclear materials to be supplied) and facilitate the operations during loading or unloading in nuclear power plants. These actions follow the ALARA principles and an eco-design approach.