TRANSPORT OF IRRADIATED FUELS RODS FOR ANALYSIS EXPERIENCE AND NEW DESIGN TN MIL IN PROGRESS

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The knowledge of the irradiated fuel rods behavior is crucial in order to improve the performance of nuclear power plants. Therefore, it is necessary to transport either the whole spent fuel assemblies or only parts of them like fuel rods from power plant to specialized laboratories for post irradiation examination.

The purpose of this paper is to expose French experience with existing casks (R62, IL 46, IL47), the new package TN 106 under manufacturing and to present a new design called TN MIL, which is being developed according to the IAEA TS-R-1 recommendations.

INTRODUCTION

The Nuclear Power Plant performance depends on those of the fuel elements loaded into the reactor core. Therefore, the increase of performance has to be supported by active research on fuel material.

Consequently, irradiated fuels or fuel rods have to be transported from Power Plant to research laboratories for analysis. This type of transport is performed with specific casks compatible with the loading interface of Power Plants and the unloading interface of research laboratories.

We expose operational experience in France with the existing casks and we present the new design packagings we are developing in compliance with the new IAEA TS-R-1 recommendations.

EXISTING CASKS AND OPERATIONAL EXPERIENCE

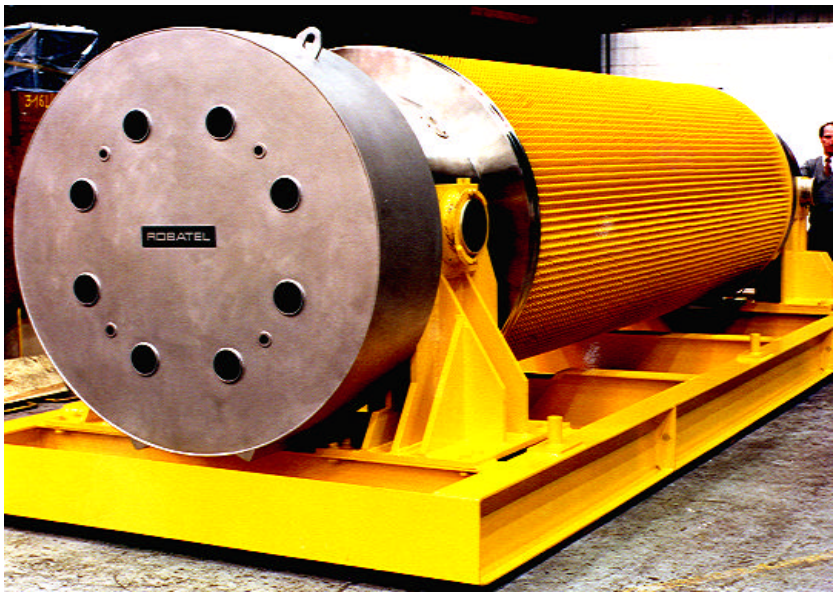
The R62, IL46, IL 47 have been used successfully for many years to transport fuel rods from power plants to laboratories.

R62 cask

The R62 is still under operation for the transport of fuel rods from EDF reactors to CEA research laboratories. This packaging has been initially developed by Robatel EDF to transport a full assembly. Only one cask has been manufactured.

Due to new requirement for the justification on the criticality and radiolysis phenomena, the content of the transport license has been limited to some fuel rods.

This packaging is over designed for such a use and its operational use is quite complicated. Indeed, there are numerous orifices to drain water, to dry and to control the air tightness of the different cavities. Further more its weight, 38,000 kg, is far beyond the conventional transport limit.



Picture 1 – R62

IL 46 and IL 47 casks

These two casks have been design in the sixties by CEA, (Commissariat à l'Energie Atomique), the French Nuclear Research Center for transport of spent fuel and spent fuel rods to research laboratories.

Two IL 46 casks have been manufactured and used up to 1998, but this old design is no more compatible with the new regulations in force.

The main characteristics of the IL46 are the following:

- Overall weight: 7800 Kg
- Useful cavity length: 4705 mm
- Internal diameter: 202 mm

Picture 2 – IL 46

Two casks IL47 have been manufactured and one of them is still in operation for the transport of irradiated Fuel rods in France.

The main characteristics of the IL47 are the following:

- Overall weight: 19 tons
- Useful cavity length: 2400 mm
- Internal diameter: 203 mm

Picture 3 – IL 47

NEW DESIGN TN MIL AND TN 106

- **TN MIL**

Fuel to be transported

As mentioned in the introduction the fuel performances have to be increased, leading to higher initial enrichment and burnup. In order to cover the fuel characteristics to be transported in the coming 15 years, we are considering the following:

- Fuel Type UOX and MOX
- Burn-up < 90 000 MWd/t
- Cooling time = 6 months
- Plutonium content < 11%

Characteristics of the cask

As we have said, the purpose of this new packaging, the TN-MIL, is to allow easy transportation of a few irradiated fuel rods. Therefore it must be as simple as possible, its weight must be kept below the maximal weight of conventional transport (40 tons) and the loading and unloading from the power plant to the research laboratory must be easy.

On this basis, a preliminary concept has been developed and the design has been optimized taking into account all the new IAEA TS-R-1 recommendations. The cask is mainly composed of a body, two lids and two shock absorbers. The overall dimensions are 1,600 mm in diameter and 6,400 mm in length for a weight of about 24,000 kg. The useful dimensions are 220 mm in diameter and the cavity length is 5000 mm.

The mechanical strength is ensured by the exterior and interior stainless steel shell (respectively 30 and 20 mm thick).

A layer of Robatel PNT7 concrete in association with copper flanges provide the neutron and thermal protection. This material has been frequently used in type B packaging since 1988 and has proved his efficiency. A layer of lead completes the radiation shielding.
The body is equipped with trunnions for its handling and with a steel base for its tying down.

The fuel rods are conditioned in a new cylindrical quiver. This quiver is loaded into a canister to allow the safe unloading into the laboratory cells.

This packaging should be able to transport up to 20 spent fuel rods, depending on the criticality calculations.

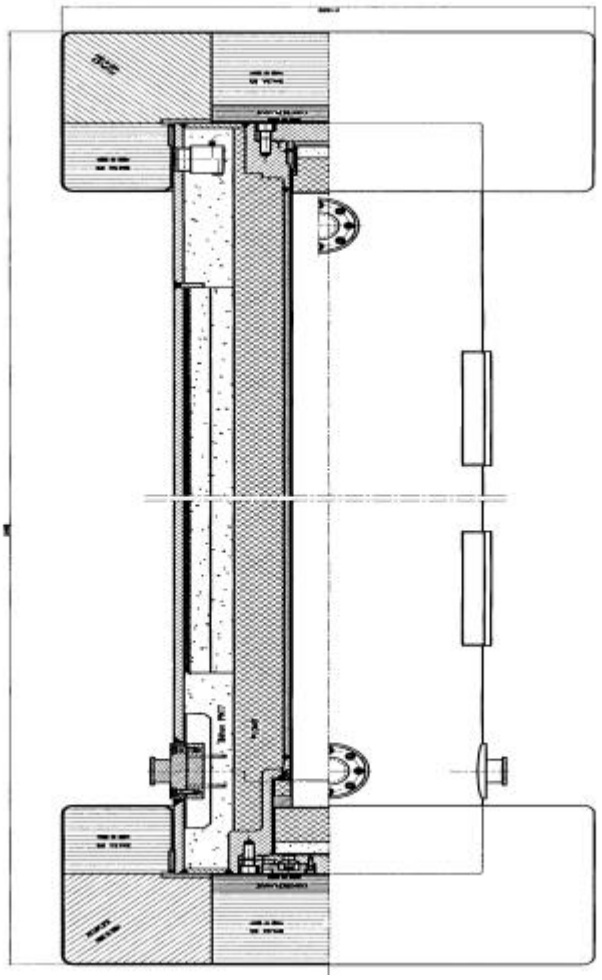


Figure 1 – TN MIL

- **TN 106**

This cask has been developed to replace the TN 6/2 cask developed by Transnucléaire to transport short fuel rods.
The design takes into account all the new IAEA TS-R-1 recommendations.

The main characteristics of the TN 106 are the following:

- Overall weight: 10 tons
- Useful cavity length:2200 mm
- Internal diameter: 203 mm

The application has been sent to the French Competent Authorities early in 2001 and this cask will be in operation by the end of the year.

The Safety Analysis report allows a variable cavity length from 1.5 meter to 3.2.

One cask is under manufacturing with a cavity length of 2.2 meter.

Picture 4 – TN 106

CONCLUSION

In order to support the development of nuclear power plant new high performance fuels, Transnucléaire, with Robatel and EDF, is developing a new generation of casks: TN 106 – TN MIL.