FRESH MOX FUEL TRANSPORT IN GERMANY: EXPERIENCE FOR USING THE MX6

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ABSTRACT

The MX6 packaging developed by COGEMA LOGISTICS replaces the BWR SIEMENS packaging and SIEMENS III packaging for the transport of either BWR or PWR fresh MOX assemblies. It is licensed in France, Germany and Belgium according to TS-R-1 requirements (IAEA 1996). The associated security transport system was developed in co-operation with NCS (Nuclear Cargo + Service GmbH). The MX6 packaging is based on innovative solutions implemented at each step of the design.

In 2004, RWE GUNDREMMINGEN Nuclear Power Plant (NPP) will be the first NPP delivered with the MX6 system and MOX assemblies manufactured by BELGONUCLEAIRE and FBFC in Belgium. Before this first transport, successful cold tests were performed for qualification of the whole system with the participation of all parties involved: NPP, carrier, fuel supplier and local Authorities. These tests were conducted by the NPP's operators in FBFC and GUNDREMMINGEN facilities and lead to the validation of the operating manual. Specific conditions for the return of the empty MX6 were also agreed between all parties. Similar operation will be conducted in each NPP before the first use of the MX 6.

The large payload of the MX6:

- 16 BWR MOX assemblies in one packaging instead of 2
- 6 PWR MOX assemblies in one packaging instead of 3

contributes to the optimisation of the dose uptake during unloading in the NPP.

In this paper, the main contributors to the first MOX transport to Germany with the MX6 will present their involvement and feedback at each step of the transport of this new type of packaging, including loading and unloading operations.

The use of the MX6 will be extended to other German NPP's from the next year. After FBFC in Belgium, MELOX in France will load the MX6 as well as the current MX8 packaging for the delivery to the French NPP's.

I. INTRODUCTION

For the first time, fresh MOX fuel assemblies were delivered at the GUNDREMMINGEN Nuclear Power Plant in Germany with the MX6 from mid-March 2004 to mid-April 2004. The MOX fuel assemblies were manufactured at BELGONUCLEAIRE (BN) and FBFC-I in Belgium. Four transports were then operated by TRANSNUBEL (TNB) and NCS (Nuclear Cargo + Service GmbH) from FBFC-I to GUNDREMMINGEN NPP at a rate of one transport of 16 BWR fuel assemblies per week.

In this paper, the main contributors to these first transports to Germany will present their involvement and feedback at each step of the transport of this new type of packaging, including loading and unloading operations.

II. GENERALITIES AND BACKGROUND

The MX6 packaging developed by COGEMA LOGISTICS replaces the BWR SIEMENS packaging and SIEMENS III packaging for the transport of either BWR or PWR fresh MOX assemblies.

This project was launched in early 2000 for the European market, focusing firstly on MOX PWR 16x16 and 18x18 fuel assemblies and MOX BWR 10x10 fuel assemblies. The design allows transport of a greater number of fuel assemblies with increased Pu characteristics..

1. Packaging characteristics [Ref.1 and 2]

The MX6 packaging was designed for loading and unloading under dry conditions.

The MX6 loaded either with 6 PWR Mox fuel assemblies or with 16 BWR MOX fuel assemblies has a total gross weight of less than 20 t, a total length of 5980 mm, a body diameter of 1340 mm and a shock absorber diameter of 2130 mm (fig.1).

The shielding has been optimised in order to minimise the total dose absorbed by the operators.

The fuel assemblies are transported in a horizontal position. The content restraining system and the basket were designed by COGEMA LOGISTICS and approved by FRAMATOME ANP, the fuel supplier.

The maximum characteristics of the 16x16 or 18x18 fuel assemblies to be transported are as follows: Pu total = 15%, Pu fissile = 6.5% to 8%, with a maximum power per fuel assembly of 1100 W

The maximum characteristics of the 10x10 fuel assemblies to be transported are as follows: Pu total = 15%, Pu fissile. = 8%, with a maximum power per fuel assembly of 415 W.

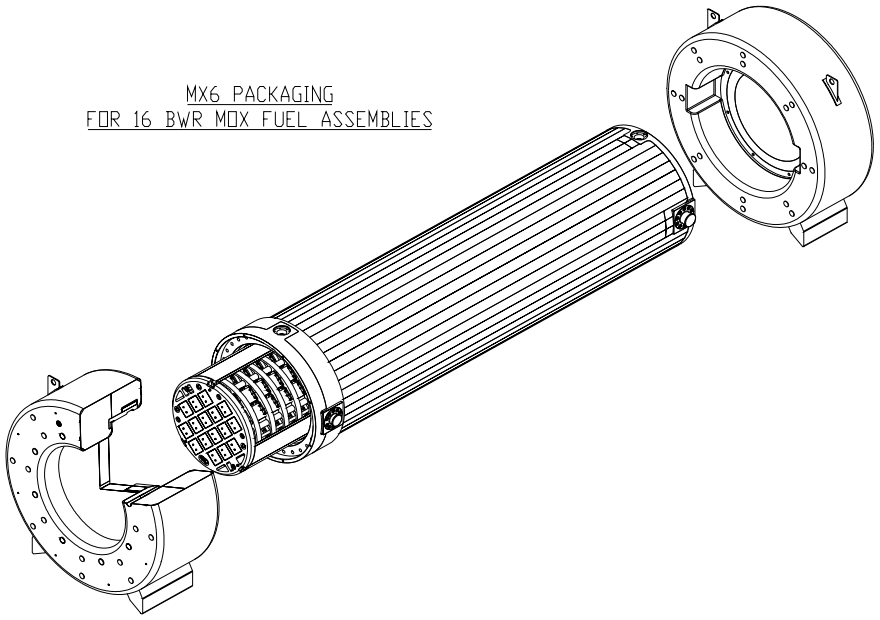

Fig. 1 The MX6 Package with its BWR basket

2. Safety requirements

The package complies with the TS-R-1 requirements as a Type B(U)F package and the corresponding international modal regulations ADR, RID and IMDG-Code.

It has been fully approved in France since December 2002 and in Germany since October 2003.

3. Transport means

A new high-security system adapted to the MX6 has been developed in co-operation between COGEMA LOGISTICS and NCS. This new high security system, called SIFA2/2, complies with international road transport requirements and the German security regulations (fig.2)

Fig. 2: High security system for transporting the MX6

4. Handling

In order to comply with the German requirements, the trunions of the MX6 packaging are designed in accordance with the German KTA standard 3905.

III. COLD TESTS [ref. 3]

Due to its innovative design and its large payload compared with previous packagings:

- 16 BWR MOX assemblies in one single packaging per transport instead of 8 BWR MOX assemblies in one packaging and 2 packagings per transport,

- 6 PWR MOX assemblies in one single packaging instead of 2 PWR MOX assemblies in one packaging and 2 packagings per transport,

New handling operations have been implemented in FBFC-I workshop and in the German NPP.

So, before the first transport, cold tests were successfully performed from November 2003 to December 2003 for qualification of the whole system with the participation of all parties involved: NPP, carrier, fuel supplier and local Authorities. These tests were conducted by the NPP's operators in FBFC and GUNDREMMINGEN facilities with dummy 10x10 fuel assemblies;

For these cold tests in both plants, COGEMA LOGISTICS offered a full range of services from the very beginning: improvements in the plants were decided one year before the cold tests and conducted by the plants leader; within this period.

COGEMA LOGISTICS as well as all parties were involved. First of all, the handling manual was issued for approval by both national and local Authorities (BfS and BAM for the transport licensing, FANC in Belgium as well as TüV-STMUGV in Germany). Then, operating protocols were issued for the tests at FBFC-I and GUNDREMMINGEN NPP. The main target of this preparation was the approval of all handling manuals (general and in plant manual) before proceeding with the test themselves and six months were necessary to reach this goal. The MX6 was finally prepared and transported to both plants. Then, the whole system was tested by each plant with the attendance of all parties: NPP, carrier, fuel supplier, local Authorities as well as COGEMA LOGISTICS. This last one offers its assistance in the cold test operation and in the routine transport operation.

The main feedback of the tests are:

- loading at FBFC and unloading at GUNDREMMINGEN NPP are in accordance with operator's security,

- the fuel assembly integrity is guaranteed during loading and unloading operations,

- heavy equipment and tools are qualified in the plant:

At FBFC-I, the dummy fuel was inserted several times in all lodgements using a funnel device (in order to avoid shock during loading or centring).

Specific conditions for the return of the empty MX6 were also agreed between all parties involving the health physics sections: values and location of the measurement of the non contamination control are so reported in a protocol issued before each return of the empty packaging. So, the packaging is fully controlled externally and internally, top plate, faces and bottom part of the lodgements are controlled. Therefore, the packaging returns to the manufacturing plant within allowed conditions of non contamination agreed by the plant (less than 0.4 Bq/cm2 for beta and gamma, less than 0.04 Bq/cm2 for alpha).

IV. FIRST OPERATIONS OF THE MX6 FROM MID-MARCH TO MID-APRIL 2004

The first transports of 10x10 fresh MOX fuel assemblies in the MX6 transport system from FBFC-I to GUNDREMMINGEN NPP were performed from mid-march 2004 to mid-April 2004 at a rate of one transport per week.

The main differences with the previous consist in the size and the payload of the container. t16 fuel assemblies are unloaded from one packaging instead of two packaging previously: the time period for preparation is longer, but the 16 fuel assemblies are loaded or unloaded during a less longer time period. Therefore, thanks to the resin and the reduced time schedule for loading or unloading, the total dose is minimised.

1. Loading operations at FBFC-I

The main loading operations at DESSEL are described in the sketch hereafter:

- The empty container arrives in a conventional truck at the plant, then is unloaded from the truck.

- Shock absorbers are removed, the flanges of the frame are unlocked and the packaging is transported on its tilting bench

- The fork lift truck tilts the packaging and introduces it in a pit

- The radiological shield is therefore installed, the lid is removed as well as the control orifice plug

- The 16 clamping system are removed, the axial radiological shield is installed and the fuel assemblies are introduced and clamped one by one while removing each corresponding shield plug. The axial radiological shield is removed, the lid screwed with the appropriate torque.

- The leaktightness is controlled and pressure inside the cavity checked

- The handling operations are then performed in the reverse order than previously

- The transport frame is unloaded from the security vehicle. The packaging is locked on the frame, the shock absorber replaced and sealed, the accelerometers switched on.

- The MX6 with the transport frame is installed and secured in the security caisson, the roof is replaced and external contamination controls are recorded before departure.

2. Unloading operations at GUNDREMMINGEN

The main unloading operations at GUNDREMMINGEN NPP are described in the sketch hereafter:

- At the arrival of the security vehicle at the power plant, the control of the external non contamination of the vehicle is recorded, then the roof removed and the transport frame unlocked. The MX6 and the frame, connected with the horizontal lifting beam, are removed from the vehicle.

- The accelerometers are controlled, the seals removed, the flanges of the frame removed. The shock absorbers are removed and stored. Then, the external contamination is controlled and the results recorded, the MX6 is transferred on its airlock bogie before entering the power plant. The transport frame is replaced and locked in the security caisson, so that the security vehicle is ready for departure.

- The packaging is tilted and lifted in a decontamination box, situated at the pool level. The scaffolding are put up, the accelerometers controlled, the internal pressure controlled and the packaging is put at the atmospherical pressure.

- The seals are taken off, the lid unscrewed and removed in a storage rack.

- The 16 clamping systems are unlocked and removed and the MX6 is transferred in the spent fuel cask pit. For that purpose, the pit is dried and a protective plate is placed for avoiding any contamination.

- The refuelling manipulator, protected by a sock for avoiding contamination, transfers the fuel one by one in the cooling system. Concurrently each fuel transfer, the fuel supplier controls the fuels with a camera. After MX6 removal, the spent fuel cask pit is flooded for transferring the fuels in the pool.

- After unloading, the MX6 is replaced in the decontamination box. The internal contamination is controlled and recorded, the clamping systems locked, the lid replaced with the appropriate torque and the handling operations are then performed in the reverse order than previously.

- Then the external contamination is controlled and the results recorded, the MX6 is loaded on its storage frame with its shock absorbers and transported back to FBFC-I on a conventional truck.

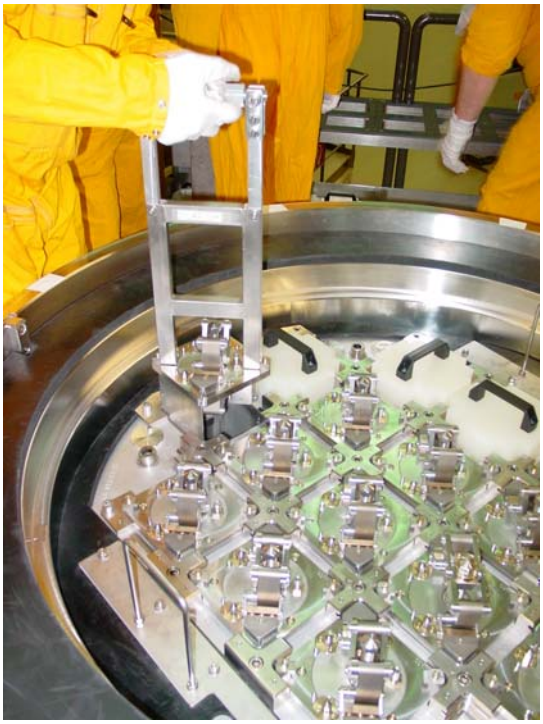

Fig. 3: Unlocking and removal of the clamping system

V. FEEDBACK OF THESE FIRST TRANSPORTS

- All operations were driven in accordance with the operation manuals and the cold test.
- The protocol for the return of the empty packaging was correctly applied to the parties with the checking of all faces of the lodgement
- All operations were proceeded in accordance with operator's security
- The main success of the MX6 operations is the significant decrease of the dose uptake by the operators: The loading of the fuel lasts less than one day and the unloading with the associated fuel integrity control less than 4 hours. This is a consequence of the new sequence of operations, which contributes significantly to the large decrease of the dose. The easiness for using the clamping system contributes already to this decrease.
- GUNDREMMINGEN NPP and FBFC-I operators agreed to conclude that the operations of loading and unloading were proceeded more rapidly than with the old SIEMENS casks: Only one cask is to be operated instead of two for 16 fuel assemblies.
- The transports were performed accordingly to the fuel integrity requirements; the transport frame and the new clamping system are so efficient.
- During all the process of the test and during the current operation, COGEMA LOGISTICS offered a large range of services from the documents issuance and the preparation of the test to the assistance during loading and unloading operations. The co-operation between all parties involved was necessary to reach this success.

VI. CONCLUSION

The first transports of fuel assemblies from FBFC-I to GUNDREMMINGEN in the MX6 were successfully achieved, accordingly to the power plant representatives and the fuel supplier. The good preparation and co-operation between all the contributors guaranteed this success.

The MX6 is a fully TS-R-1 packaging, developed for several types of fuel design with high performance, designed for a high payload. Its new design as well as its sequence for unloading contributes to reduce significantly the level of the dose uptake during the operations.

The use of the MX6 will be extended to other German NPP's from the next year and the feedback of these first transports will contribute to the success of this use.

After FBFC in Belgium, MELOX, in France, will load the MX6 for the delivery to the NPP's.

VII. REFERENCES

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