ITALIAN-FRENCH EXPERIENCE IN THE TRANSPORTATION OF INF FOR REPROCESSING

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ABSTRACT

SOGIN the state Company founded in 1999 to manage the closure of the nuclear fuel cycle and the decommissioning of the Italian NPPs and nuclear research centers, signed, in April 2007, a contract with AREVA for transport and reprocessing of approximately 235 tons of INF stored at Caorso, Trino and Deposito Avogadro sites.

One hundred ninety tons was stored in the pool of Caorso site located in northern of Italy.

The international transport activities, coordination and cask provision were entrusted to TN International (AREVA group). The multimodal transport in the Italian territory, the preparation activities, the coordination and execution of transports were subcontracted by TN International to the Italian authorized carrier MITNucleare.

The execution of the transport required a significant preparation efforts both for the consignor site and the carriers with an interesting feedback to learn from.

In December 2007, just seven months after the signature of the contract, two TN17/2 casks containing 17 BWR fuel-elements each left Caorso.

The loaded casks, moving by road from Caorso up to the new road-rail transfer site, were transshipped on special 8 axes wagons, transported up to Valognes (F) rail terminal and then transferred by road to the AREVA La Hague reprocessing plant.

During preparation activities, adaptation of the plant for receiving and loading TN17/2 casks and transport infrastructure were performed. In addition an area of 4,000 m^2 disused area, close to the Caorso rail station, was purchased by Sogin to realize a private rail terminal with a 120 tons capacity frame crane.

The emergency plan for transport was developed with the local Governmental Authorities while the Physical Protection System was designed, implemented and authorized by Authorities involved and the Ministry of Home Affairs.

Some of the activities, such as frame crane and road vehicles, were made significantly in advance, while other activities, such as procurement of cask loading equipment and the transfer site design and construction, were accomplished on a very tight time schedule. Such an ambitious goal was reached only thanks to the joint efforts of all the actors involved.

1. DESCRIPTION OF CAORSO NUCLEAR POWER PLANT

The Caorso nuclear power plant was built by Ansaldo Nucleare between the years 1970 and 1976 and its start up tests were performed between 1976 and 1980.
The reactor is a BWR 4 type developed by General Electric with 2651 MWt and 875 MWe. The core is made up of 560 fuel elements and each element is made up of a 8x8 UO2 pin lattice.
The transport described here involved all the fuel that was irradiated into the core starting from the startup tests to the final shut down in 1989. The fuel elements amount to 1032 with an average burn-up of around 19130 MWd/t and a total weight of 160tHM of pre-irradiated fuel.
The power plant is located in the north of Italy, near the town of Caorso on the right side of the Po river and a few kilometers from the city of Piacenza. The Cremona – Piacenza railway crosses the town of Caorso and the railway station is located diametrically opposite the nuclear power plant.

Figure 1. Caorso Nuclear Power Plant

2. GENERAL DESCRIPTION OF THE TRANSPORT PROJECT

Transport of used fuel had never been performed from CAORSO NPP since its entry into service. All the used fuel from the activity of the plant had been stored in the reactor pond until this transport campaign.
The transports have been performed by means of the TN17/2 cask in which 17 BWR fuel elements can be transported. Therefore 61 cask movements, for a total of 16 shipments of 4 casks simultaneously, have been necessary to empty the pond over a period of about 2 years of work. In average the operations required 5 days to prepare one cask for transport.
Thanks to a logistics based on a dedicated fleet of 8 casks, the loading operations at the NPP have been planned on a continuous flow based on the following reference scenario:

- arrival of 1 cask at the NPP at the departure of 4 loaded casks for immediate restarting of the loading activities;
- arrival of 3 casks during the following week to give continuity to operations until the shipment of 4 casks and arrival of the next empty cask.

The transport arrangement in Italy, under the coordination of TN International (TNI), involved:

- Trenitalia as authorized rail carrier (swapping its responsibility at the Italian/French border with SNCF);
- MITNucleare (MIT)as authorized road carrier and responsible for transhipment operation and cask handling at the NPP.

Due to a particular law framework in Italy, the road carrier, duly authorized, also handled the specific transport authorizations (including the rail authorization) and was involved in the process for the setup of the transport emergency response plan (according to the procedure of a recent Italian law D.P.C.M. 10/02/2006).

This transport campaign represents a unique experience for Italy, for :

- complexity of the logistics;
- need for the construction a new multimodal transfer point and lifting equipments;
- study and test on the transport infrastructure;
- proximity of the population to the road transport and multimodal transport.

3. DESCRIPTION OF TN17/2 CASK AND RAIL WAGONS

The TN17/2 is a type B package with the following features:

- Weight empty: 74 tons
- Weight loaded: 79,5 tons
- Overall length: 6,15 meters
- Diameter: 1,90 meters
- Payload: 17 BWR used fuel, 3.145 tHM

The rail transport of TN17/2 is performed with the Q70 wagons having the following features:

- Overall length: 20,70 meters
- Width: 3,06 meters
- Weight empty: 47 tons
- Weight loaded: 160 tons

4. WORKS PERFORMED AT CAORSO SITE

The following constraints:

1) physical dimensions of the TN17/2 cask (length of the body around 5200 mm),
2) specific interface tools supplied by TNI,
3) spaces available for the handling inside the reactor building at the refueling floor,

required to define and to implement a set of structural and procedural modifications in the plant. These modifications were designed, approved and realized between June 2005 and December 2007.

4.a Setup tool pool and path of the cask on the refueling floor

Due to the particular manufacturing of the external surface of TN17/2, TNI decided to fit a metallic skirt on the cask before immersing it into the used fuel pool.

Due to the length of the cask and the metallic skirt, Sogin chose to use the tool pool at the refueling floor as the place to put the cask TN17/2 and where to fit the metallic skirt over it. It wasn't possible to perform this operation with the cask positioned in the decontamination cell because there wasn't enough free space available on the top of the cask to operate with the polar crane.
Before moving the casks into the tools pool, Sogin had to request an authorization to changed the path of the cask on the refueling floor. Sogin had to provide several technical notes and documentation to the control Authority before receiving a formal approval of this new path. A scaffolding was placed inside the tools pool in order to allow the operators to move and work on the cask under safety rules.

4.b Modification of the fuel bridge and the decontamination cell

To load the used fuel into the TN17/2 cask, Sogin had to modify the fuel bridge.
This system was designed to move the fuel in the pool from the refueling racks to the core of the reactor or for moving the fuel from the refueling racks into the cask.
The original elevation available didn't ensure enough free space for loading the Caorso fuel into the TN17/2 cask. Sogin chose to modify only the top beam of the fuel bridge, because the entire system of hooking and lifting of the fuel was linked to this beam only.
At the end of the modification of the fuel bridge 13 cm of free space were available between the bottom of the used fuel lifted and the upper part of the TN17/2 cask. To project, develop and realize this mechanical modification approximately 12 months were necessary.
Sogin also had to adapt the decontamination cell to the cask TN17/2.
To prepare the cask for shipment, it was necessary to dry the cask using specific tools provided by TNI that required some interface with the decontamination cell. It was easy to arrange these interfaces on the decontamination cell because its walls and doors are made of metal. On account of the height of the TN17/2 cask, it was still necessary to lower the cask support plate of the decontamination cell. This was necessary to guarantee a safety margin during the handling of the cask by the polar crane.

4.c Upgrade of the polar crane to NUREG criteria

In order to guarantee maximum safety during the handling of the cask, both empty and loaded, the polar crane of the reactor building was upgraded to the NUREG n. 0612 appendix "C".
The upgrade covers the following parts of the crane: the wires, the barrel, the hook and the brakes. Taking into account the mechanical characteristics of the crane's structural materials, the control Authority ISPRA obligates the use of the crane when the temperature of the structural materials is higher than the temperature that was recorded during the final test of the crane (11,5 Celsius degree).

4.d Loading bay of the turbine building

On account of the restricted area in the reactor building, for the tilting of the transport cask and the axle weight limits allowed on public roads, MIT Nucleare planned to use one road trailer made up of a six axle trailer for the tilting and four road semi-trailers made up of eight axle semitrailers for the transport from the Caorso nuclear power plant to the road-rail transfer point near the Caorso railway station.
Consequently, it was necessary to transfer each cask from the 8 axles semi-trailer to the 6 axles trailer - and vice versa - in a dedicated area in the Caorso power plant.

To perform these operations, Sogin placed the loading bay area, inside the turbine building, at MIT Nucleare's disposal; in this area a 190 ton crane was used to perform the transfer of the casks.
Before using this area, Sogin made a check of the mechanical static of the floor to guarantee that it could sustain the weight of the trailer and the cask. The transfer of the cask from the 6 axles trailer to the 8 axles semi-trailer - or vice versa - was made by lifting the cask the minimum height necessary to free it from its road frame, while the 6 axles trailer and 8 axles semi-trailer were moved simultaneously below the cask.
A procedure was developed to safeguard the load of the cask if the crane were to fail during the lifting or the lowering of the cask. This procedure demonstrates the capability of the trailers to lift or to lower their flatcar thanks to their hydraulic system suspension and the insertion of wooden blocks between the flatcar and the transport frame structure.

4.e. Definition of the area where to store the casks in standby

In order to optimize the transport activities and maintain the maintenance cycles for cask and equipments, TNI proposed to use a fleet of TN17/2 casks from a minimum of 4 casks to a maximum of 8. During the loading of the casks at Caorso power plant, 4 casks were parked. To park these casks, Sogin, in cooperation with the control Authority, located a particular area.
In order to guarantee safety and security, Sogin realized a segregated area with fencing and limited access.

4.f. Design and procurement of cask loading equipments with related procedures

All the specific equipments needed at Caorso plant to load TN17/2 casks was designed and supplied by AREVA.
This equipments consisted in:

- cask handling and lifting equipments such as horizontal lifting beam, vertical lifting beam and lid lifting devices fulfilling NUREG requirements;
- cask preparation system for cavity flooding, draining, drying and leak tightness tests orifice tools;
- contamination protection devices such as metallic skirt, lid and cask bottom protection plates.

All the tools were delivered with related procedures and correct performance was validated by cold trials.

5. BUILD THE NEW INTERMODAL TRANSFER SITE NEAR THE CAORSO RAILWAY STATION (AUTHORIZATIONS, THE TRAIN, THE TRACKS)

In order to transport the fuel by train, Sogin purchased an unused railway area near the Caorso railway station from the Rete Ferroviaria Italiana SpA and modernized the superstructures adding a 120 ton fixed frame crane.
The works started in September 2007 and finished in June 2008, but the area was available for the first transport from Caorso in the first week of December 2007.

Figure 1. Caorso multimodal transfer point

The main works performed for the multimodal site setup were:

- installation of a new rail line and connection to public line;
- geological inspection and site characterization;
- design, manufacture and installation of a fixed frame crane;
- setup of new services and backup services;
- installation of fence and systems for physical protection.

5.a. Rail line

The private rail line has been designed by Sogin and MIT Nucleare in order to achieve the following criteria:

- optimize distance from site borders (for radioprotection purposes);
- maintain the straightness of the train under the crane;
- allow operations without interference between train and road vehicle.

The rail line has been operated by Trenitalia by means of diesel engine.

5.b. Geological inspection and site characterization

The frame crane has been installed on two concrete basements. This basement was designed after a geological inspection down to 15 m in depth.
Due to the nature of the ground in Caorso area (not compacted ground), the basements has been placed over concrete pillars.
During the operations with the crane, the basement level was regularly controlled.
Site characterization also took into account:

- risk due to Earthquake risk;
- risk due to Strong winds;
- risk due to atmospheric strike;
- risk due to low temperature.

5.c. Design, manufacture and installation of a fixed frame crane

A 120 tons capacity frame crane has been chosen for the multimodal transfer operation between road vehicle and rail wagon.
Other than capacity (redundant in respect of the maximum foreseen load), the crane has been designed with some special features in order to reduce the probability of fault during the transfer operation:

- double ropes each suitable to sustain the lifted load;
- back-up electric engine in case of failure of the main electric engine;
- manual recovery system of the load in case of complete failure of the engines;
- double supply system for the electric main engine (one system to be activated as back-up);
- power supplied by public line or by electric generator in case of blackout.

Positioning of the crane allows the handling of the cask with the means of transport positioned simultaneously under the crane frame.
Positioning along the rail line has been designed to allow handling up to 5 casks without need of intermediate train composition.

5.d. Setup of new services and backup services

Completely new services (like connection to electricity public line and rain water collection system) have been installed.
With particular reference to the power supply to the crane and physical protection system, a diesel back up system for electricity has been installed. This system allows termination of all transfer operations even in case of uninterrupted blackout.

5.e. Installation of fence and systems for physical protection

All physical protection features of the transfer site have been designed by Sogin and approved by the competent Authorities. The protection system is based on both passive and active systems.
The passive system is characterized by:

- 3m height metallic fence with barbed wire;
- blinding tissue to prevent direct view;
- microwave alarm system for site border and frame crane;
- full coverage with video system.

The active system is based on 24h surveillance on site.

6. SECURITY ASPECTS

During the loading of the casks and while they were parked in the “storage area”, Sogin increased the level of the security in the Caorso NPP.
For the transport itself, even by road or rail, the security aspects were under the coordination of the departure point “Prefettura di Piacenza” (which is called “Capomaglia”). Under the coordination of the Prefettura di Piacenza and the public security committee, the transport was subject to active and passive physical protection.

7. PROGRESS OF SOGIN FUELS RECYCLING AT AREVA LA HAGUE PLANT (AREVA)

The 61 casks delivered at AREVA La Hague recycling plant, through the 16 shipments of 4 casks amount to 190 tons of used UOX BWR fuel to be recycled in the AREVA La Hague plant situated

in the North – West of France, about 20 km from Cherbourg (which counts 92 000 inhabitants). The plant is located at 180 meters of altitude and covers a total surface of 300 hectares.

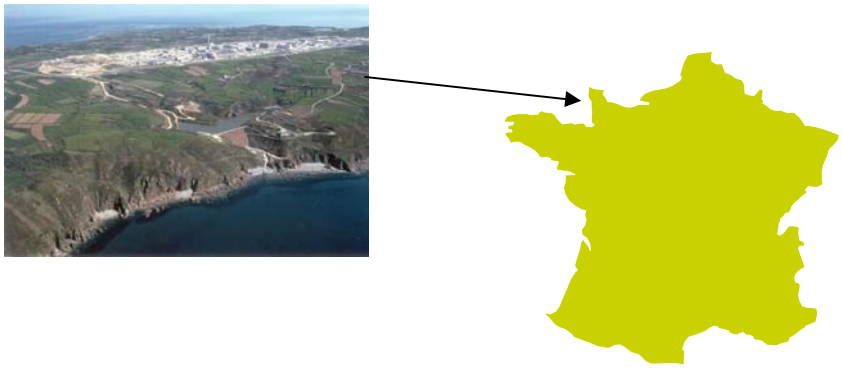

Figure 2. La Hague recycling plant

This used fuel, already cooled after several years of interim storage in Caorso pools, have already been treated in 3 campaigns:

- 82 tons treated in 2008;
- 78 tons treated in 2009;
- 30 tons treated in 2010.

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