LOADING AND TRASPORT OF IRRADIATED MTR FUEL LOOSE PLATES

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1. Introduction

Sogin, the state company in charge of the decommissioning of the Italian NPPs and nuclear research centers, is currently managing the closure of the nuclear fuel cycle at each site. The strategies chosen are the reprocessing abroad for the irradiated fuel assemblies and alienation for nuclear materials.

In this framework, Sogin has participated to the Global Treat Reduction Initiative of the National Nuclear Security Administration of the United States Department of Energy for the repatriation to USA of US origin nuclear research material.

The scope of this work is the repatriation to USA of a small amount of Spent Nuclear Fuel, with high enriched uranium content. In particular, 10 loose plates, MTR irradiated nuclear fuel type, stored at Deposito Avogadro Site in Saluggia (Vercelli), North of Italy.

2. Operation

The Material Testing Reactor (MTR) fuel, irradiated at the Petten facility in the Netherlands,arrived at the EUREX facility in 1965 following a Testing Agreement signed by CNEN and EURATOM. It consisted of U–AL alloy plates, with high enriched uranium. In 2007 the plates were transferred, together with the other irradiated Garigliano (BWR) and Trino (PWR) fuel assemblies stored in Eurex pool, to Deposito Avogadro pool. Considering the unusual characteristics of the fuel (62.5 cm x 7.33 centimeters with a thickness of 0.127 centimeter) the operations and the activities carried out for loading and transport were unique and original in contrast to the activities for transport and loading of standard Fuel Elements for Nuclear Power Plant like Pressurized Water Reactor or Boiling Water Reactor.

The loose plates were stored inside the Avogadro pool contained into a quiver, encompassed in a capsule, and then inserted into a single fuel bottle.

The first activity was the opening of the single element bottle and the extraction of the capsule. Then also the capsule was opened and the loose Petten plates were transferred from the quiver to an aluminum canister. These activities were performed under water using special devices like tank confinement, pincer, rod and screwdrivers, fabricated for the scope in EUREX workshop, and handled by the operators that could watch a monitor connected to an underwater camera which filmed all the underwater activities.

The package used was the NAC–LWT cask, designed, manufactured and licensed properly for the transport of MTR fuel by the American company NAC International.

Due to specific plant operating requirements, it was decided to not load the cask in the pool following a standard procedure. Moreover, the option of the dry loading of the NAC-LWT cask using the NAC transfer device in vertical position was not feasible without modifying the lifting system of the plant. Therefore, a unique shielded transfer device was properly designed, tested and manufactured, specifically for the loose plates, which allowed the dry horizontal loading of MTR fuel into the cask. In this way, the loading activities of the loose plates were carried out without modifying the current configuration of the 60 ton linear crane of Deposito Avogadro, suitable for the activities with Areva related to the irradiated fuel transports for reprocessing in France. All the onsite activities related to the loose plates were performed in the period between the shipment of the full casks to La Hague and the return of the empty casks to Italy.

Plant constraints, due to the height of the entrance door to the Avogadro reactor building, required that the NAC–LWT package entered upon an “omega” road trailer (very low trailer). The NAC-LWT cask remained in the horizontal position on the road trailer during all the onsite activities.

The special shielded transfer device was submerged in the pool, loaded with the canister containing the loose plates and then raised from the pool. After draining, it was vertically transferred close to the cask and downloaded upon a seat to permit its horizontal tilting. In the horizontal position, the special shielded transfer device was coupled to the NAC–LWT package and with a push rod the canister was inserted inside the empty central position of the basket. After this phase, the special shielded transfer device was removed and the package was closed with its lid, mounted with shock absorbers and ready for shipment.

Fig 1. Coupling of the Shielding Transfer
Device to the NAC – LWT package

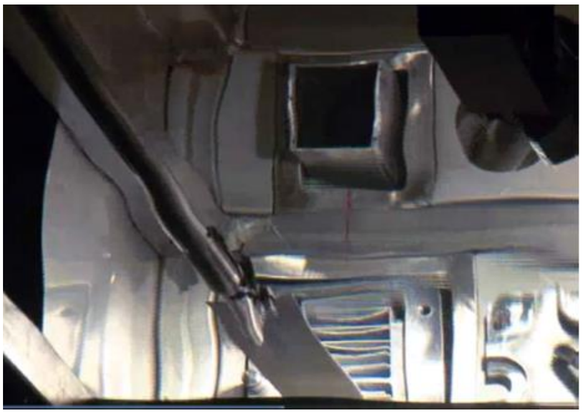

Fig 2. Transferring of the Petten plates to from the storage capsule to the aluminum canister

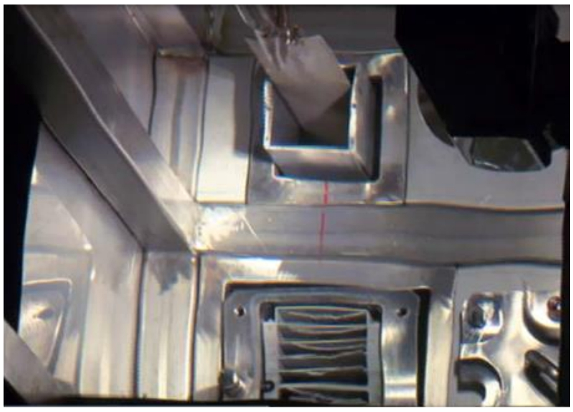

Fig 3. Transferring of the Petten plates from the storage capsule to the aluminum canister

3. Shielding Transfer Device

The “shielded transfer device was designed and manufactured on the base of the following technical requirements:

- General requirements:
  - ➢ The connection systems and the auxiliaries of the shielded transfer device shall comply with the actual configuration of the 60 ton crane. In particular, the measure of free vertical height available was 3300 mm.
  - ➢ The maximum dimensions and weight of the shielded transfer device shall allow all the anticipated operations for loading.
- Mechanical requirements:
  - ➢ The lifting connections of the shielded transfer device shall withstand to a maximum load of 10 times the total weight to be lifted, consisting of the weight of the shielded transfer device, the weight of the canister (3084,5 g), and of the weight of the loose plates (1651,30 g).
- Radiological requirements:
  - ➢ The dose rate limit on the external surface of the shielded transfer device prescript by the Qualified Expert of Deposito Avogadro site was 400 micro Sievert/hour.

4. Auxiliary equipment

To perform the loading of the loose plates in the canister the following were necessary:

• A workstation at the edge of the Deposito Avogadro pool, from which the operators were able to transfer the plates from the current quiver to the canister and then to load the canister in the shielded transfer device.

• A containment tank in order to ensure the recovery of the loose plate in case of loss during its handling from the quiver to the canister.

• Tools like pincers to handle the loose plates, tongs to handle the canister, actions with keys to open and close the lids of the quiver and of the canister and ancillary tools for additional operations.

• Video camera locations to ensure the underwater filming and the recording during all the activities in the pool and during the loading of the canister in the NAC LWT cask.

The design and construction of the above equipment were performed at the Sogin workshops of EUREX and have required the commitment of four men for fifty working days.

Fig 4. Pincer to handle the Petten plates

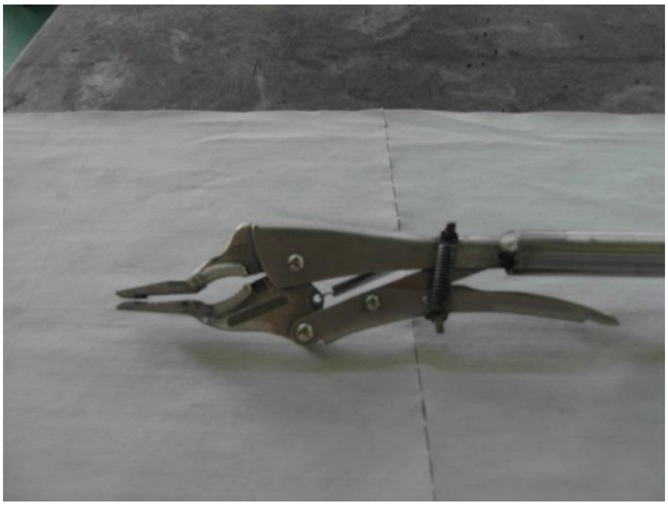

Fig 5. Pincer to handle the Petten plates

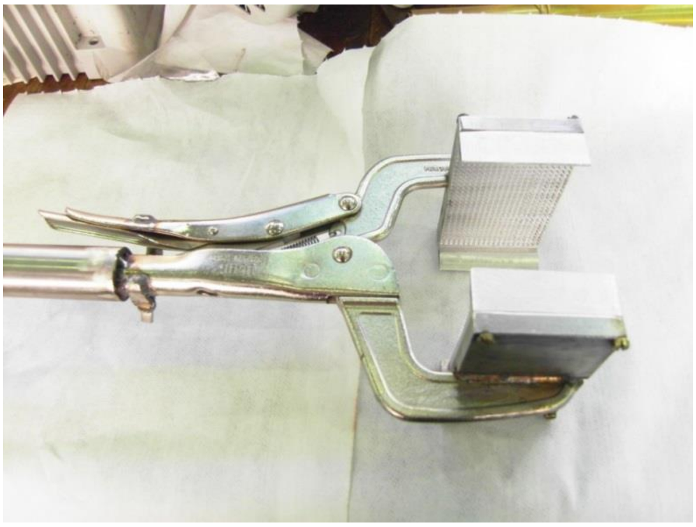

Fig 6. Pincer to handle the DOE canister

5. Timing

The time scale of the activities agreed with DOE, Deposit Avogadro nuclear operator of the plant, NAC International supplier of shielded transfer device, Edlow International Company manager of the international transport and the Italian carrier MIT Nuclear, was developed over a week considering:

• Functional testing of the shielded transfer device from the pool to the cask

• Coupling shielded transfer device to the cask

• Cold tests of the handling, loading and coupling at the witness of the Italian Control Authority

• Opening of the quiver and transfer of the loose plates in the canister at the presence of DoE representatives

• Closing of the canister and its loading into the shielded transfer device

• Transfer of the shielded transfer device from the pool to the position on the ground in the area of the cask

• Tilting of the shielded transfer device and its coupling with the cask

• Pushing of the canister in the center position of the basket inside the cask

• Closure of the cask and leak tightness tests

• Radiological Controls and replacement of the shock absorbers

In fact, the times were drastically compressed with an actual time elapse of 3 days

6. Transport

The multiple-mode international transport for multiple customers was managed by Edlow International Company.

Over the Italian territory, land transport was by specialized truck and trailer followed by loading onto a LO-LO INF-II Vessel. The Italian shipment joined another shipment of spent nuclear fuel already on board the INF-II vessel that was also coordinated by Edlow International Company.

All transport arrangements in Italy were managed by the authorized carrier MIT Nucleare, under subcontract from Edlow International Company which, in addition to obtaininig all relevant transport authorizations, took care of the emergency response plans, both for road and national water, according to the Italian law which involved all Prefecture and local Authorities interested in the transport.

Figure 7. Shipment of the NAC – LWT cask
loaded onto the "omega" road trailer

7. Conclusion

The project was characterized by very stringent schedule. The possibility of repatriation was communicated to Sogin in the spring of 2012 and was completed within the autumn of the same year.

The amount of work to be done was enormous in terms of the authorizations, planning, realization and organizational systems.

All Authorities and agencies involved: DOE / NNSA, Edlow International Company, MIT Nuclear, NAC, ISPRA, Italian Ministries, EURATOM etc. etc. collaborated to assure the achievement of the target.