SUCCESSFUL REMOVAL OF MORE THAN 200 SPENT HEU FUEL ASSEMBLIES FROM THE HIGH FLUX REACTOR AT PETTEN

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ABSTRACT

Earlier this year, a shipment of 210 spent Highly Enriched Uranium (HEU) Material Test Reactor (MTR) fuel assemblies representing more than 100kg of HEU (pre-irradiation) were shipped from the High Flux Reactor (HFR) in Petten, Netherlands to the US Department of Energy's Savannah River Site. The HFR is owned by the European Commission, Joint Research Centre (JRC) while the Nuclear Research and consultancy Group (NRG) is the reactor operator and license holder. Since the start of the Foreign Research Reactor Program in 1996, this was the largest shipment of MTR fuel elements originating from a single facility. A total of five NAC-LWT casks were used to support this shipment. Multiple technical, licensing, interface and scheduling challenges needed to be overcome to meet the project objectives. During the five months of project planning and execution, the project team (JRC, NRG, Transrad, NAC, DOE and Westinghouse) has been working in close cooperation and good spirit to achieve a safe and successful shipment.
The paper presents how the team completed this important shipment for the future of the HFR.

Introduction/background

In 1999, the decision was made to convert the HFR to LEU fuel. In January 2000 diplomatic notes were exchanged between the European Commission and the US Government concerning conversion of the HFR to LEU fuel, interim supply of HEU fuel from the US and shipment of spent fuel from the HFR to the US.

The conversion to LEU required a new HFR operating license. The application for a new license was submitted to the Dutch authorities by the end of 2003. In early 2005 a new HFR license was issued according to the nuclear act. In February 2005 this license took effect including the transfer of license holder ship from JRC to NRG. The conversion to LEU fuel started in October 2005 with the loading of the first LEU fuel elements and control rod in the HFR core.

Concerning the back end of the HFR fuel cycle JRC has utilized for dry storage of spent fuel in the Netherlands since the 1990s. However, existing contracts with the Dutch central organization for radioactive waste (COVRA) do not cover all HFR spent fuel generated beyond 2015. For this reason the option to return spent fuel to the US was also pursued. In early 2001 a contract was concluded with US DOE and a shipment of HFR spent fuel to Savannah River Site was performed in spring 2001 with financial support from the Dutch Government.

After a call for tender procedure for more HFR spent fuel shipments to the US, JRC awarded a framework contract to NAC. The first order for the removal of 210 fuel elements (equivalent of 5 NAC-LWT casks) was placed in December 2004. NAC selected the Belgian company, Transrad, for all transport coordination in Europe including trucking services, coordination with Competent Authorities and port coordination. Transrad is very experienced with transportation of nuclear material in the Netherlands and also with the NRG Petten site's personnel, handling and shipping protocols.

Shipment coordination and communication

The project involved numerous technical and scheduling challenges with the logistics associated with the use of five NAC-LWT casks from a single shipping facility. Also, the need to obtain several licenses for transportation, cask validation, loading process and unloading at the receiving facility presented further challenges. In addition, communication was more complex as the contract was placed by JRC, which owned the fuel assemblies, while the reactor is operated by NRG who is the shipper of record. A project kick-off meeting took place in early January with the following team players:

- JRC
- NRG
- NAC
- Transrad

A preliminary schedule and list of tasks identifying the responsibilities of each party were discussed. Numerous actions were listed and assigned in connection with the shipment. These include licensing, transport permits, export formalities, cask operating procedures, cask preparation, logistics, port coordination, site preparation, insurance, etc.

At the same time, an initial meeting also took also place with the Dutch Competent Authority in order to present the project and associated schedule.

Then, weekly communications were organized among the team to discuss the status of actions and identify the main coming milestones. DOE and Westinghouse participated in many of these conference calls to discuss receiving facility interfaces, including cask unloading procedure as a specific criticality analysis needed to be performed to ensure the feasibility of unloading a fully loaded basket and cask as described below.

Transport Licensing

Issuance of all transport permits and cask validation in time to support the shipment were key milestones. The schedule was mainly determined by the timing of the reactor maintenance shutdown. Loading operations for five casks implies significant site logistics, including manpower resources. The only viable schedule window for performing such an operation was at the time of the shutdown which had already been scheduled the previous year for mid-April to mid-May.

In regard to cask licensing, the existing NAC-LWT certificate of compliance was based on an amendment performed in 2001 and covered the fuel assembly characteristics but was to expire on February 28, 2005. A new certificate USA/9925/B(U)F-96, valid until February 28, 2010 was issued by the US NRC at the end of January 2005 and by the US DOT in early February 2005. Application for validation in the Netherlands was performed immediately afterwards.

In the Netherlands, the licensing process for spent nuclear fuel shipments consists of issuance of the following documents:

- Cask validation
- Transport permit

The standard review time for the transport permit and cask validation is eight weeks. However, in addition, the Dutch law requires official publication of the transport permit for another period of six weeks during which a potential contest can be made. After expiration of the 6-week period, if not appealed, the permit comes in force.

To support the cask loading schedule during the shutdown of the reactor, the team had agreed to proceed with shipment of empty casks, for which corresponding permits had been received.

In parallel, a radiological protocol was executed between the Dutch authorities and NRG. The purpose of this protocol was to track radiological surveys of the cask during the shipment cycle (prior departure of empty casks, at the time of delivery of empty casks, prior departure of loaded casks, at the time of delivery of empty casks).

Cask Loading

NRG personnel were familiar with the NAC-LWT cask and its operational support equipment as a result of a successful fuel loading campaign conducted in 2001. However, lessons learned from that three (3) cask shipment identified an alternate NAC dry loading method that could be used

to simplify the work process, decrease the time span and reduce personnel exposure.

Based on the 2001 experience and the Petten facility specifications, NAC designed and fabricated a set of steel rail extensions, which permitted the use of existing NAC Pool Adapter technology. Fuel baskets were able to be pre-loaded and directly lifted through the adapter into the NAC Dry Transfer Cask. The transfer cask was then moved to the reactor hall, where two NAC-LWT casks were previously erected. The transfer cask was mated to the LWT cask and the fuel transfer was completed. This fuel transfer sequence was repeated six times per cask until a single cask was loaded. The operation then shifted to the second cask, allowing parallel closure and testing activities to continue on the loaded cask.

When both casks were loaded and tested, a portable crane unit was moved into the reactor hall. The casks were moved outside for leak testing and final packaging, while two other casks were moved into the hall and the process repeated until all five casks had been loaded.

Cask operations, including set-up and packing for the return shipment lasted approximately four weeks. During this time, public holidays and most weekends were reserved as days not worked.

Transportation

In spite of the fact that a similar shipment from Petten back to the United States had been performed in spring 2001, the 2005 shipment was facing a new environment:

- Security concerns after 9/11
- The Dutch government financially supported the 2001 shipment and consequently managed the interfaces with the Dutch military port of departure

With the support of JRC and NRG, Transrad played a key role for coordination with Dutch authorities including local authorities, police, port authorities, etc. After numerous meetings, it was agreed to use the same route and military port as the previous shipment. The departure date was imposed by Dutch government with a request to have an empty vessel at the Dutch Port. Also, the time period the ship remained in the harbor should be minimized as much as possible. Another shipper in Europe made a late decision to join the shipment with two additional casks but the chartered INF2 ship was first loaded in the Netherlands, followed by the loading of the other casks in another European country, and then sailed to Charleston, South Carolina, USA. The seven casks were safely transported by train from Charleston to the Savannah River site.

Cask unloading

As mentioned above, additional criticality analysis was required for the safe unloading of a fully loaded NAC-LWT basket. The HFR Petten fuel presents a reactivity which could not rule out a criticality issue should all fuel elements be released from an NAC-LWT basket during unloading operations at L-Basin facility. Additional analysis based on fuel characteristics and fuel history was performed to confirm the feasibility of unloading a fully loaded basket with safety margin. Numerous communications took place between JRC, NRG, DOE and Westinghouse for exchanging detailed fuel data. The results of the

additional analysis confirmed the feasibility of unloading fully loaded baskets within the safety margin.
The five NAC-LWT casks were all unloaded within a period of five weeks and returned to NAC's storage and maintenance facility in early July.

Conclusions

This project faced several challenges:

- Capability of obtaining the necessary permits and licenses to support the cask loading operations during the reactor shutdown
- Supporting the logistics of five casks at the loading site
- Performing the additional criticality analysis at DOE-SRS to confirm the feasibility of unloading fully loaded basket and casks.

The key components for overcoming these challenges have been the project communication, the project organization and the excellent cooperation between NAC's engineers and NRG's personnel during cask loading operations, as well as with Transrad during the transport preparations.
Typically, a cask and transportation project is the result of the contribution of the different parties in the process (shipper, carriers, forwarding agents, competent authorities, receiving facilities, etc.). Each of the project players: JRC, NRG, DOE, Transrad and Westinghouse have been contributing to the success of the project and are looking forward to working on a similar shipment in 2006. A few improvements have been identified and will be implemented for the coming shipment.