Shipments of Irradiated DIDO Fuel from Risoe National Laboratory to the Savannah River Site - Challenges and Achievements

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Abstract

On September 28, 2000, the Board of Governors of Risoe National Laboratory decided to shut down the Danish research reactor DR3 due to technical problems (corrosion on the reactor aluminum tank). Shortly thereafter, the Danish Government asked the National Laboratory to empty the reactor and its storage pools containing a total of 255 DIDO irradiated elements and ship them to Savannah River Site in the USA as soon as possible. Risoe National Laboratory had previously contracted with Cogema Logistics to ship DR3 DIDO fuel elements to SRS through the end of the return program. The quantity of fuel was less than originally intended but the schedule was significantly shorter. It was agreed in June 2001 that a combination of Cogema Logistics' and NAC casks would be preferable, as it would allow Risoe to ship all the irradiated fuel in two shipments and complete the shipments by June 2002. Risoe National Laboratory, Cogema Logistics and NAC International had twelve months to perform the shipments including licensing, basket fabrication for the NAC-LWT casks and actual transport. The paper describes the challenging work that was accomplished to meet the date of June 2002.

Introduction

The NAC-LWT cask was introduced by NAC International in 1989 as a replacement for its older vintage PWR and BWR assembly truck transportable casks. However, its first use and most frequent successive use have been for the transport of various research reactor fuel forms. The cask's small diameter and long cavity length has proven very accommodating for various research reactor fuel forms due to their attractive criticality characteristics and adaptability to different basket configurations. Nevertheless, the introduction of a new fuel form requires design work, analysis, certification and validation efforts that can be time consuming and costly unless they are managed very carefully.

The DR-3 reactor, owned and operated by the Danish National Laboratory, was built in the late 1950's and initiated operation in January 1960. At that time the DR-1 and DR-2 reactors were already in operation. The main purpose of the Danish DR-3 research reactor was material and fuel testing. Until 1989 the reactor utilized HEU fuel elements. Conversion to the LEU fuel cycle was accomplished in 1990.

DR-3 fuel, in the past, had been transported by Cogema Logistics (ACL - formerly known as Transnucleaire) using the IU-04 cask. Risoe had placed a long term contract with ACL for transport of the remaining fuel to be shipped to the U.S. under the foreign research reactor returns program through 2009. However, on September 28, 2000, the Board of Governors of Risoe National Laboratory decided to shut down the Danish research reactor of DR3 due to technical problems (corrosion on the aluminum reactor tank) and anticipated increasing operational expenses. Shortly thereafter, the Danish Government asked the National Laboratory to empty the reactor and its storage pools as soon as possible, to minimize further costs. A total of 255 DIDO irradiated fuel elements required shipment to Savannah River Site. After some discussion between Risoe and ACL in early 2001, the decision was reached to ship all of the DR-3 fuel no later than June 2002. At that time, ACL was in the process of licensing the new TN-MTR package in the USA. The early shut down of the DR-3 reactor and resultant accelerated shipping schedule was not compatible with ACL's equipment and licensing schedule for the cask. Since ACL had teamed with NAC on several very successful transportation projects (i.e. Portugal, Italy, Taiwan, and Austria shipments), NAC was contacted to discuss of the best way to optimize both companies' resources to achieve Risoe's goal of June 2002 shipment.

Shipment Preparations

Following discussions regarding the work necessary to prepare, certify, and validate the NAC-LWT and the TN-MTR for DIDO shipment, ACL and NAC proposed to perform the shipment in two phases:

- A first shipment of 2 NAC-LWT casks containing 84 fuel elements during the second half of 2001.
- A second (and last) shipment of 3 NAC-LWT casks and 1 TN-MTR cask containing a total of 171 fuel elements during the second quarter of 2002.

To meet this schedule ACL and NAC needed to perform a number of design, certification and fabrication activities in a time frame of less than 12 months:

- ACL needed to revise the design of the TN-MTR52 basket, obtain the French license, obtain the Danish and US validations for this new design, and then modify the TN-MTR52 basket to comply with this new design (consisting of adding aluminum sleeves in the lodgment of the basket.)
- NAC needed to design a new basket and license the NAC-LWT cask and baskets for DIDO fuel in the US, obtain the license validation in Denmark, and then fabricate and test the new DIDO baskets prior to mobilizing for the first shipment in the fall of 2001.

In order to meet the anticipated Risoe needs, NAC took several "at risk" steps to accelerate the schedule. First, NAC initiated its expedited project planning and engineering effort in November, 2000, prior to contract authority, permitting receipt of the amended US certificate of compliance for DIDO fuel elements contents in September 2001 and the Danish validation one month later. Second, NAC fabricated the two sets of DIDO baskets in parallel with the licensing effort, a risk normally avoided when the schedule permits. The fabrication effort was completed within 3 months of contract signing – a few days after the license had been received from the NRC. NAC's dry transfer equipment was proof tested with the new baskets shortly thereafter, and the NAC team was mobilized to the Risoe facility just in time to perform the first shipment. Subsequently, a third set of DIDO baskets was fabricated to support the second shipment.

ACL received the French license for their newly designed basket, the TN 52 S, on 12 April 2001. The corresponding Danish validation was received on January 24, 2002 and the US validation on March 25, 2002.

The First Shipment

Shipment preparations faced equal challenges as a result of the accelerated schedule and first time application of personnel and transportation resources. While NAC and ACL were making cask preparations to support the shipments, Risoe was making final preparations to receive and load the NAC-LWT cask. Since the NAC-LWT had never been used at DR-3, great care was taken to insure the cask and transportation operations at Risoe went safely and smoothly. Additionally, the Transportation Manager at Risoe was new and had not had the opportunity to experience a similar transportation project. In order to facilitate the teamwork necessary for success, weekly conference calls were held between NAC, ACL and Risoe technical and transportation team members to discuss and coordinate all of the actions to be accomplished by each of the parties.

Once all operational procedures and transportation protocols were in place, the NAC team mobilized to the Risoe site. A team consisting of two NAC field engineers was dispatched to Denmark. After unpacking the ancillary cask equipment and NAC's dry fuel transfer system, the first cask was placed into the pool. To insure proper cask loading, a complete dry run was performed using an empty DIDO fuel basket. This test was successfully completed and actual fuel loading operations were initiated. Over the next two weeks, a total of twelve fuel baskets, each containing seven DIDO fuel elements, were transferred into two NAC-LWT casks.

Once loading was completed and the casks had been prepared for shipment, the transport operations were started. Risoe was responsible for transportation of the loaded casks from the site to the port of Esbjerg located on the west coast of Denmark. The port of Esbjerg had been utilized in the past for irradiated MTR fuel shipments from Denmark and Germany. A representative of the Danish Competent Authority was present at the Risoe site to ensure the adequacy of transport documents and compliance of cask radiological levels with the regulations. As was the case for the entire shipment, the transportation operations in Denmark were successfully completed on schedule. The ocean portion of this shipment was performed using a two year INF-2 old vessel, the *Fret Moselle*, operated under contract to ACL. This was the first spent fuel shipment performed by the *Fret Moselle*. Special attention was paid to coordination with both Danish and US officials to insure the acceptability and approval of this vessel for spent shipment. The ocean transportation, as well as the US land transportation operations performed by NAC, were carried out in very successful manner.

The Second Shipment

While the first shipment was being conducted, the NAC/ACL team was making preparations for the second one. A third set of DIDO fuel baskets was fabricated and tested by NAC. ACL received the validations for the TN-MTR cask in both the US and in Denmark. ACL also worked closely with Risoe to insure the cask loading operations would be performed flawlessly. The *Sea Bird*, an INF-2 certified vessel, was selected for the second ocean shipment. As the *Sea Bird* had already performed INF-2 spent fuel shipments from Denmark and to the Charleston Naval Weapons Station, vessel certification and acceptability was not an issue.

The second series of cask loading operations using three NAC-LWT casks was performed as originally scheduled without problem. The loading of the TN-MTR was performed in a conventional manner, in the DR-3 pool underwater. TN-MTR cask operations at Risoe included the loading of 51 fuel elements and were completed in 5 days with the assistance of one ACL representative supporting Risoe personnel. This effort was also completed on schedule without incident.

One of the goals of the Foreign Research Reactor Fuel Return Program is to minimize the total number of shipments of SNF to the US by maximizing the number of casks in each shipment. Consequently, agreement was reached between two German research reactors (Garching and Julich), Studsvik, Risoe and the US Department of Energy to add five additional casks to the shipment. A one-month delay was instituted to make the necessary coordination and transportation arrangements. This minor schedule perturbation was still compatible with Risoe National Laboratory's schedule commitment to the Danish government.

The final spent fuel shipment from Risoe National Laboratory departed the site at 1 PM on June 3, 2002. Just before departure, a dozen DR-3 employees came out to the parking lot to watch the convoy leaving the site. A bit of history was accompanying this shipment. Despite the satisfaction of having safely accomplished the operations to de-fuel the reactor, it was an emotional day for the Risoe staff.

Prior to arriving in Denmark, the *Sea Bird* had already picked up one cask from Sweden.. The complex European transportation logistics effort culminated at the Port of Esbjerg with the on-schedule arrival the vessel from Sweden, three casks from Germany which were shipped by truck to Esbjerg and the casks from Risoe. With all eight casks safely on board, the Sea Bird departed Denmark and arrived safely at the CNWS on June 18, 2002. The casks were off-loaded at the dock and then transported to SRS by train on the same day.

Summary

The adaptation of a transportation cask to accommodate a new fuel form is always an intensive engineering and licensing efforts, normally requiring several years advanced planning. The Risoe shipments presented unique difficulties due to expedited schedule and first time application of personnel, equipment, and ships. The dedicated NAC and ACL efforts, competent technical performance, and precision in project management supported accomplishment of secure and safe spent fuel transport operations as originally scheduled by Risoe. This required the close cooperation and teamwork between Risoe National Laboratory, ACL, NAC, the US Department of Energy, Westinghouse Savannah River Company and Competent Authorities of several countries. The ACL and NAC International personnel worked closely with the Risoe team over a twelve-month period during of the project. Successful completion of the work and the delivery of the second shipment ended the weekly conversations, but certainly did not end the relationships between the people on the team, or the satisfaction in achieving a truly demanding project goal.