

TRANSPORT OF HANA-6 LEAD TEST RODS FROM SOUTH KOREA TO SWEDEN

In December 2021 the INF vessel Pacific Grebe arrived in the Port of Norrköping in Sweden after a long sail from South Korea. On board on the ship were several KEPCO Nuclear Fuel (KNF) irradiated fuel rods intended for qualification testing in the Studsvik hot cell laboratories. This was the first transport of spent nuclear fuel from South Korean territory ever performed and was the result of a successful collaboration between multiple organizations coordinated by Studsvik Nuclear.

In the licensing process of the KNF developed HANA-6 cladding, HIPER fuel lead test assemblies have been irradiated at Hanul nuclear power plant since the early 2010's. To verify the HANA-6 cladding mid and end of life properties, post irradiation examinations including non-destructive and destructive methods are required.

“No export of irradiated fuel had ever been done from Korea before”

KNF became a member of the Studsvik Cladding Integrity Project (SCIP) in 2008, and through this international collaboration they are familiar with Studsvik's advanced testing techniques suitable for fuel qualification. At an early stage of the discussions, it was concluded that to allow a qualification test program in Studsvik facilities in Sweden, the first critical step was a marine transport of the spent nuclear fuel rods.

Given that no export of irradiated fuel had ever been done from Korea, a feasibility study was performed to identify the prerequisites and actions for a successful transport. For example, these actions included regulatory requirements, cask handling and related operations at the power plant.



“I can confirm Studsvik's high technology from several visits to the facility and participation in the SCIP program. I am very impressed with Studsvik's openness and cooperation to fully satisfy the customer's requirements.”

Jaeik KIM
*HANA Project Manager
 KEPCO Nuclear Fuel*



Orano's TN-LC cask was chosen for the transport and to enable shipping of the HANA-6 rods to Sweden. The cask license had to be extended requiring approval by the US NRC, South Korean NSSC and KINS followed by the application for getting the Swedish validation of certificate by SSM.

In September 2021, the TN-LC cask was successfully loaded with the fuel inventory and all regulatory permits for the transport were finalized without any delays. Around two months later and according to time schedule, the Pacific Grebe was greeted at the Port of Norrköping in Sweden where the cargo was safely unloaded from the ship and carried by truck to the Studsvik site.

“About two weeks after arrival of the rods in Sweden, the first results from the post irradiation examinations could be delivered to KNF”



Before the fuel qualification test program could commence the rods had to be unloaded from the cask and moved into the hot cell. This was the first time the TN-LC was handled in horizontal configuration which required the development of several new tools and special procedures to ensure safe and successful lifting and handling operation of the cask.

Together with an Orano cask engineer, the Studsvik team finished the unloading operations within two days under the supervision of KHNP and KNF representatives present at Studsvik. Around two weeks after arrival of the rods in Sweden, the first results from the post irradiation examinations could be delivered to KNF.

Given the complexity of this transport and the fact that several activities were performed for the first time ever, many stakeholders have been involved and strongly contributed to this shipment. The high degree of cooperation between all involved parties should be emphasized as the key success factor for the HIPER fuel transport project completion.

Summary

- KNF had a requirement for advanced fuel tests in the licensing of the HANA-6 cladding
- No domestic hot cell resource currently available for irradiated fuel, international transport required
- A secure transport route from South Korea to Sweden was developed, including regulatory approvals and permits
- First time loading at nuclear power station and first time unloading at hot cell facility of the TN-LC cask
- Collaboration with shipping companies for development of cost-efficient transport solution
- High degree of cooperation between all involved organizations the key success factor

Word list

- HANA - High performance Alloy for Nuclear Application
- HIPER - High Performance with Efficiency and Reliability
- INF code - Code for the safe carriage of Irradiated Nuclear Fuel, plutonium and high-level radioactive wastes in flasks on board ship
- TN-LC - TN Long Cask (Orano design)