Inside Repair of a Type-B (U) Cask in Operation

P. Dybeck
Swedish Nuclear Fuel and Waste Management Co, SKB

INTRODUCTION

For more than 10 years, SKB, Swedish Nuclear Fuel and Waste Management Co has been operating a transport system which today comprises the ship M/S Sigyn, 10 transport casks for spent fuel, 2 transport casks for core components, 27 steel containers for low- and intermediate level waste, and 5 transport vehicles. More than 800 casks corresponding to 2,300 tonnes of spent fuel and about 800 heavy steel containers, corresponding to 17,000 m^3 of radioactive waste, have been transported to the Central interim storage for spent fuel, CLAB, and the final repository for radioactive waste, SFR, respectively.

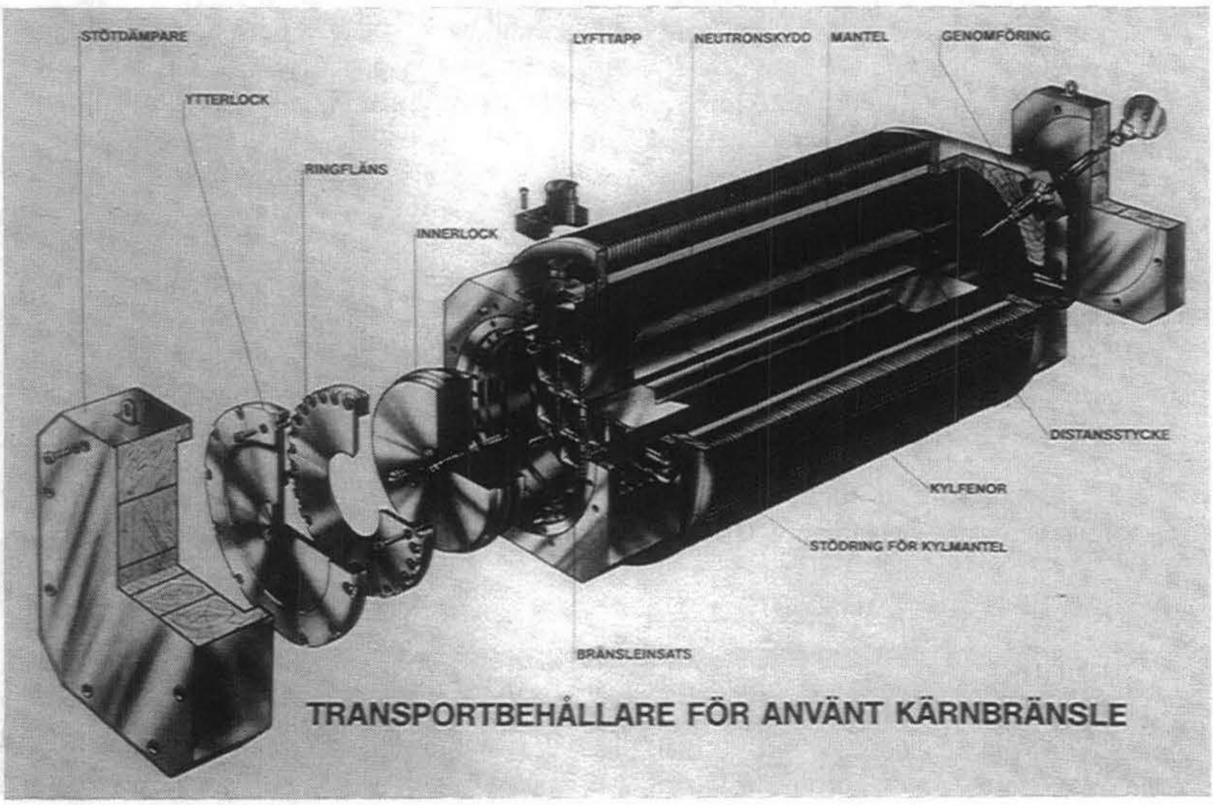
During a routine change of basket of one of the transport casks for spent fuel in autumn 1993, problems occurred when the new basket was loaded into the cask. The basket got stuck half way into the cask. After several attempts, the basket was unloaded from the cask and an investigation of both basket and cask was performed. The cask had been in use for about 10 years and had gone through about 55 transport cycles.

All casks are checked and maintained in accordance with a dedicated program, in Europe known as " the Green Book ". This means that the casks are checked and controlled at each transport and maintained after each 15 cycle or 3 years and after each 60 cycle or 6 years.

This incident with the cask was one of the very few that has occurred during the time of operation of the transport system.

DAMAGE EXAMINATION

In cold conditions the normal gap between the inner wall of the cask and the basket is 2 mm. This has earlier never caused any problem when changing baskets, which is done quite frequently at the CLAB facility.



Transport cask for spent fuel

To find out the reason for the failure in changing the baskets , a measurement control of the stuck basket was first performed. The result showed no discreprencies.

The cask inner surface was then checked by ultrasonic(UT) and penetrant testing (PT) . The PT showed no cracks but the result of the UT showed that the stainless steel lining inside the cask had become separated from the base material on numerous spots . All casks were taken out of operation and checked by UT testing. The result showed that no damages had occurred on the other casks and not even on the two casks where the same welding method had been used.

The purpose of the stainless steel liner is to protect the cask from corrosion and enable easy decontamination of the inner surface. Thus , the liner has no safety function.

The SKB casks have been manufactured both in Sweden and Japan. For the actual cask a new welding method, submerged arc strip welding in axial direction, had been used. In cooperation with the designer, Transnucleaire, TNP, and the manufacturer, Uddcomb, SKB established a working group whose aim was to find an explanation as to how the damage had occurred and a procedure for repairing the cask.

In the meantime analyses performed by TNP showed that the safety and radiation protection conditions of the cask had not been influenced by the damage. However, the heat transmission had been slightly reduced.
Test samples were taken out from the liner and were analyzed both by the manufacturer and the designer. The cask cooling down process in CLAB was also checked and found to fulfill the conditions specified in the safety analyses report for the cask.

RESULT OF DAMAGE EXAMINATION

The analysis of the test samples did not result in a definite explanation to the damage. Probably carbon diffusion has occurred during the post weld heat treatment and a small zone with reduced ductility developed. Thermal shocks which appear when cold water is introduced into the cask at the cooling down process could have resulted in crack propagation from welding defects.

It was decided to repair the cask by removal of the damaged cladding and by welding a new cladding without a post-weld heat treatment.

REPAIR OF THE CASK

WORKSHOP

To avoid unnecessary transports of the cask (weight about 80 tonnes) and contamination problems during the repair work, a temporary workshop was set up inside the CLAB facility.

Temporary workshop at CLAB

An intermediate cask storage position in the cask reception building was used and equipped with all necessary installations and equipment for the repair.

The cask was carefully decontaminated and cleaned to a level that made it possible to work inside the cavity with a minimum of protection cover. The doserate was 0.01 mSv/h which resulted in a collective dose of 0.07 mmanSv for the decontamination work.

The cask was equipped with circular plates at the ends and placed on rollers to allow rotation during the welding operation. Ventilation pipes were connected to the cask bottom orifices and led by a filter to the main ventilation system. The workshop was finally covered with plastic sheets which made it possible to continue the normal operation of CLAB during the repair period.

PRETESTING

Before the repair work started tests were performed on samples to verify both the machining and welding procedures. The tests were supervised by an independent control organization and approved by the designer, Transnucleaire, which had the overall responsibility for the repair work.

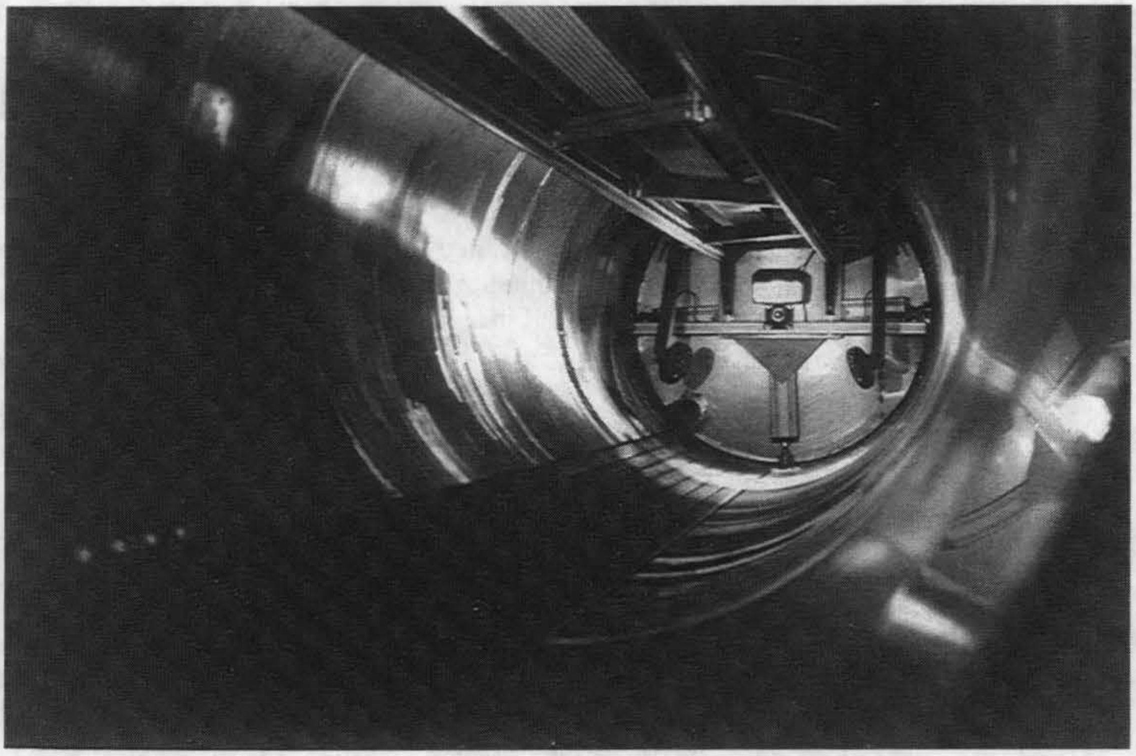
REPAIR

Machining

The repair work started by installing a boring machine earlier used for ship propeller tubes. The complete inner cladding was removed . This work lasted for 3 weeks and was performed by two working shifts. Following machining, the inner surface of the cavity was checked by penetrant testing.

Welding

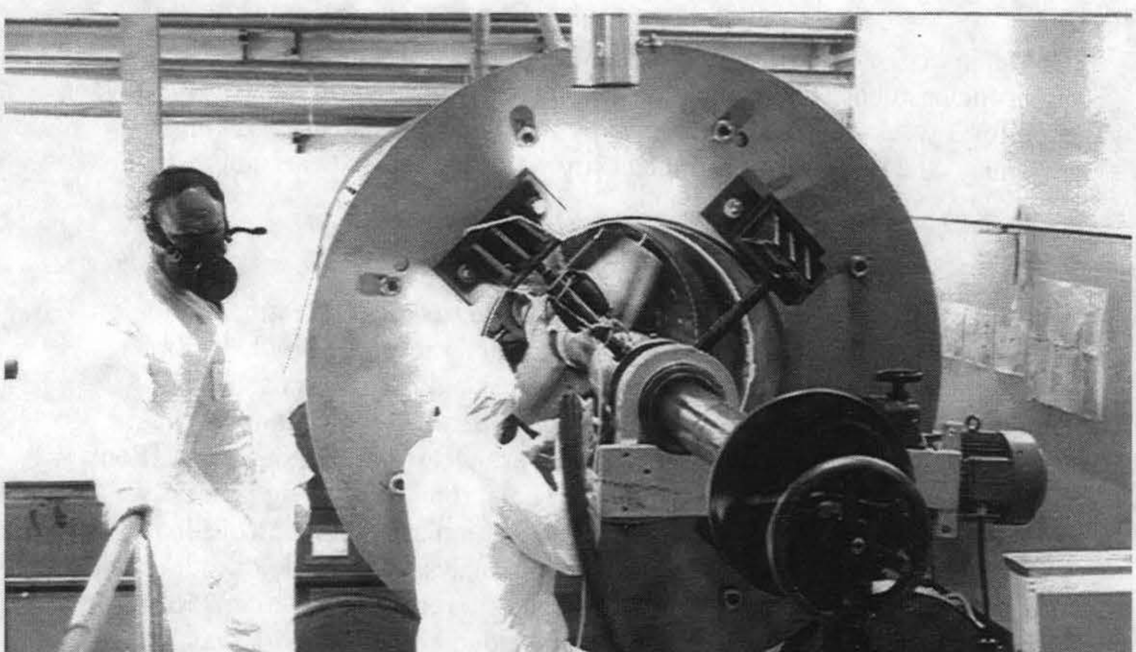
Due to the neutron shielding material around the cask, heat treatment after welding was not possible. A new welding method, developed by Uddcomb Engineering, for repair of digesters in the paper industry, was used. The method, called GMAW-P, Pulsed spray Gas Metal Arc Welding, implies that 50-mm broad and 2.5-mm thick stripes are welded along the cavity . Four layers were welded on top of each other. The automatic welding process was supervised by a third party inspection organization and was controlled via a video system . After welding of each layer an analysis was made of the welded material. The complete welding operation took 2 months , welding 256 stripes in four layers, corresponding to 200 m^2 of welded area. The work was performed in three shifts.



Welding the new liner

Final Machining

The 14- day-long machining of the welded cladding down to final dimensions was done by using the same boring machine that had been used for removing the damaged cladding. .



Final machining

CONTROL AND TESTING

During the complete repair process a third party inspection company, MRQ, approved by the authorities, had supervised the work and performed the tests specified in the inspection program. After the final machining, a final ultrasonic test (UT) and penetrant test (PT) was performed. The result was excellent and the welding method had shown to fulfill the special requirements for the repair. A new UT was done after 6 months of operation and showed no remarks.

DOSE RATES

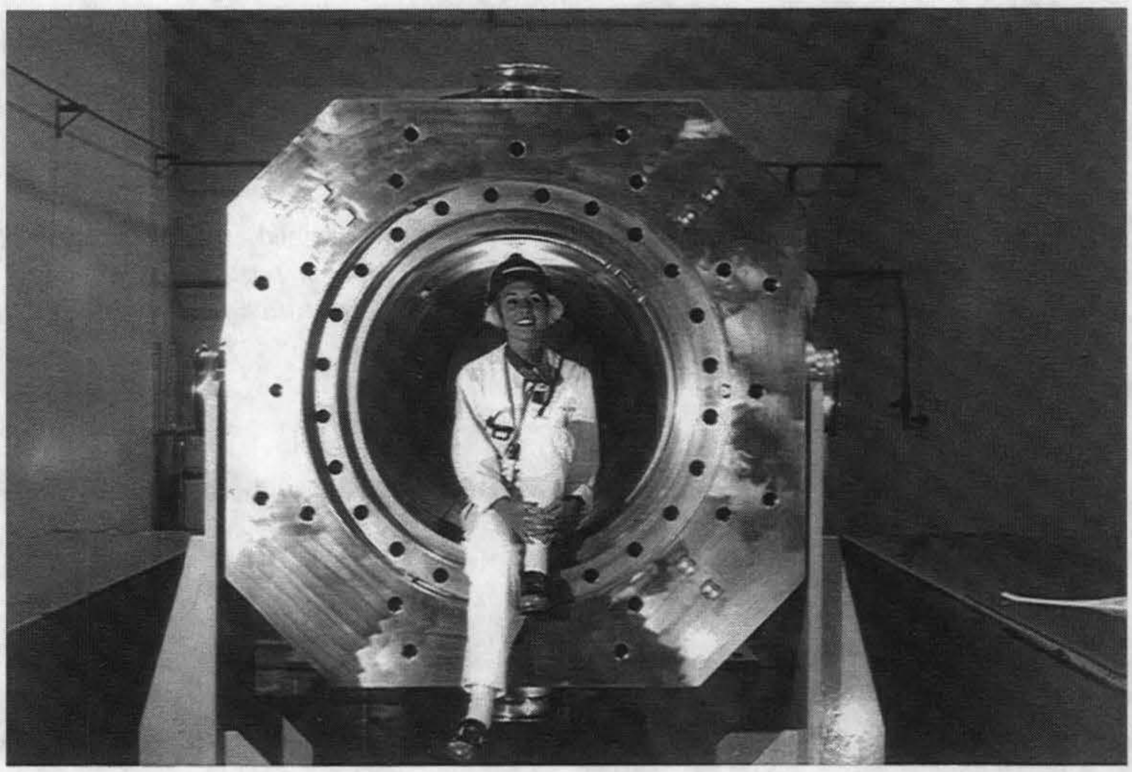
Before the repair work started the cask was carefully cleaned using both high pressure water and warm (50° C) water . Finally the inner surface was cleaned with ethanol. This resulted in very low dose rates to the staff involved in the repair work. For the complete repair, the collective dose was less than 1 mmanSv. The results are given in Table 1.

Table 1. Result of Radiation Doses to the Staff Involved in Repair of the Cask

Phase	Collective dose (mmanSv)
Prerepair of cladding	0,1
Decont.	0,07
Machining	0,2
Welding	0,2
Final machining	0.1
UT/PT test	0,1
Cleaning	0,1
TOTAL	**0.87**

TIME SCHEDULE

From the start of the project until the cask could be taken into operation again took 8 months. The qualification and test period lasted 2.5 months and the welding of the new cladding was performed during 2 months. The repair work was completed within the project time schedule and the cask was ready for operation in September 1994.



Beautiful work

SUMMARY

This is probably the first time that such a big repair has been done inside a cask which had been in operation. The successful decontamination allowed the staff full access to the cavity during the repair. Due to the very good planning and pretesting work the repair was performed on time and with a very small radiation dose to the persons involved.

Session IV-3: Thermal Analysis I