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ATB8K - THE NEW TYPE B (U) CASK IN THE SWEDISH TRANSPORT SYSTEM

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ABSTRACT

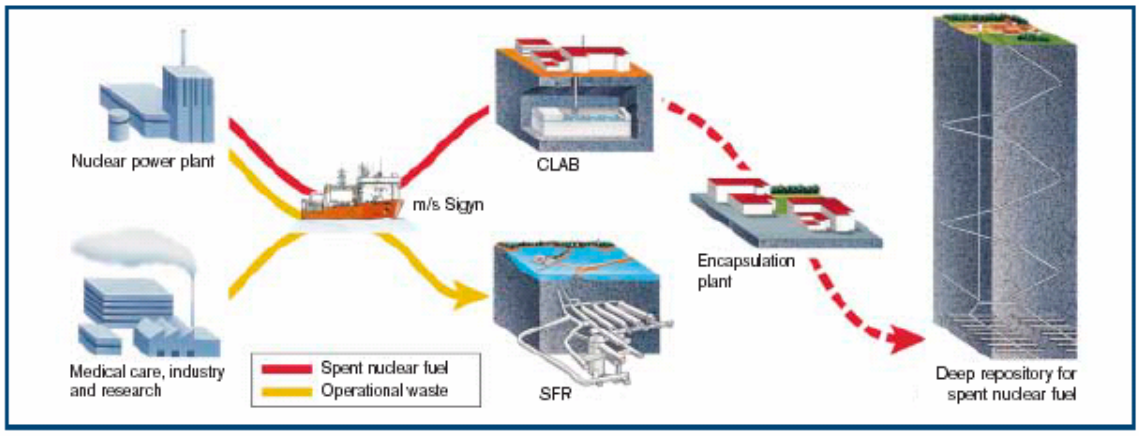
For transports of radioactive waste from the Swedish nuclear power plants to the final storage, SFR in Forsmark, special IP-2 containers, ATB, has been developed in the 1980´s by SKB. These containers are used for transports of waste with surface dose rates up to 60 mSv/h. Since SFR is designed for waste with surface dose rates up to 500 mSv/h, there has been a need for a container capable of transporting this type of waste. The activity in this waste is too high to be transported in IP-2 containers and a type B package is required in accordance with the IAEA regulations.

In the 1990´s a new type B package, ATB 8K, was designed by TN International in co-operation with SKB. The ATB 8K was licensed in Sweden in 2000, manufactured in France 2004 and taken into operation in Sweden in 2005.

The paper will describe the different steps and background for licensing including testing with a prototype, manufacture and operation of the new type B container ATB 8K in the Swedish Transport System.

1. RADIOACTIVE WASTE MANAGEMENT IN SWEDEN

SKB, the Swedish Nuclear Fuel and Waste Management Co, is responsible for handling, transport and storage of the spent fuel and radioactive waste in Sweden.
The waste management policy is based on a sea transport system and facilities to store the radioactive waste from Sweden's nuclear power plants. The operational waste is transported by the special designed ship, M/S Sigyn to the final repository for radioactive waste, SFR, in Forsmark and the spent fuel to the central interim storage facility for spent nuclear fuel, CLAB, which is located at Simpevarp outside Oskarshamm. (See picture n°1).



Sweden has a system for management and disposal of the country's radioactive waste. What remain to be built are an encapsulation plant and a deep repository for the spent nuclear fuel.

Picture n°1

SFR started operation in 1988. It is a final storage for low-and intermediate level waste, built as an underground rock facility, 50 meters under the sea bed outside Forsmark. Up to day more than 30 000 m^3 of waste have been transported to and finally stored at SFR l. The waste is produced either as operational waste from the NPP or radioactive waste from industries and hospitals having been conditioned at Studsvik.

2. ATB-8K DESIGN

SKB and TN International have developed a new type of transport cask for low and intermediate level operational waste. The cask will be used mainly for waste shipments from the NPP to the final repository for radioactive operational waste (SFR). The cask is designed in accordance with Swedish and international standards relating to B type package.

2.1 Generalities

The ATB-8K package meets the regulatory requirements applicable to the type B (U) packages. This container is allocated for transport under exclusive use, of radioactive waste packages (moulds or drums and large scrap components).
It is designed to fit with the SKB transport system, i.e. transported by the terminal vehicles (see picture n°2) and lashing system at M/S Sigyn. It fits with the loading and unloading systems road the nuclear power plants and SFR facilities in Sweden.
The total weight of the ATB 8K package including the basket and the waste is about 111, 5 tons. With the frame it is about 124 tons.

Picture n°2 = ATB8K on its frame on the terminal vehicle

2.2 Packaging design

The ATB 8K is constituted by 5 main components: the body, the lid, the closing system, the locking device and the manual tightening system. The cask is a metallic cube (of nearly 3 meters side), constituted by the body and the lid. The body has a 200 mm carbon steel wall thickness. The lid is a square carbon steel plate of 200 mm thickness. The body and lid are provided with handling equipments that fits to the facilities. The closing system of the lid to the body consists of 8 bolts which penetrate to 8 staples (shrink fitted and welded to the cask walls). The four bolts of each edge are fixed on a closing bar which can be actuated either manually or remotely. The closing system can be remotely actuated by the facility crane, so that no human action is necessary close to the container. The system can also be manually actuated in case of need. The manual tightening is equipped with two locking devices on which seals are fixed to prevent any unintentional opening during transport. The closing system, locking device and manual tightening systems are made of stainless steel and bronze.

The mass of the body is almost 60 tons and the mass of the lid nearly 14 tons.

The cask is fixed to a transport frame which fits to the terminal vehicle which eases the loading or unloading on the vehicle.

2.3 Internal arrangement design

The waste positions in the cask are limited by an internal arrangement constituted by a stainless steel frame. This internal arrangement defines 4 locations in which two rows of waste moulds or drums can be superposed. It is also possible to load the waste without this internal arrangement

2.4 Waste description

Different kinds of waste and different conditioning can be transported in ATB 8K: steel drums, steel moulds, or concrete moulds. The maximum weight of waste, including moulds or drums weight, is 34 tons per package. The internal thermal power, of every waste, is negligible. The cask capacity is 8 moulds or 32 drums.

The moulds are 1, 2 meter side, and can be either in steel or in concrete. Their total loaded mass can be up to 5 tons.

The drums are cylinders, diameter 0, 59 m, height 0, 88 m, their capacity is up to 216 litres, and the maximum loaded mass is 625 kg.

The radioactive waste transported in moulds or drums can be:

- Ion exchange resins from primary circuit solidified in concrete.
- Scrap metal with radiation point sources solidified in concrete.
- Small amounts of burnable material may be present in the waste (a few kilograms).

The maximum allowable activity in the whole package is 80 TBq.

3. ATB-8K DROP TESTING ACCORDING TO IAEA TYPE B TESTING

Since no previous drop tests are sufficiently representative of the ATB-8K cask, the drop resistance has been demonstrated by a complete series of drop tests.

The drop test program has been prepared to verify every drop configuration and in particular the most damaging. It has been presented to the Swedish authorities for advice before the test. It resulted in a series of one punch test and four 9 meter drops. The drops tested the impact on a face, on an edge, on a corner and on the lid.

The scale of the drop model was fixed to 0, 4. The cask and the closing systems have been precisely modelled, only minor things have been change which does not improve the mechanical behaviour of the scale model. The content of the scale model was constituted by eight concrete cubes substituting the loading of eight moulds and taking into account the weight of the internal arrangement.

The model was instrumented to measure the accelerations during the drops. As the analysis is not based on the leak tightness of the packaging, no leakage tests were made. However, it was verified that the content was still surrounded by the metallic cask.

The maximum deceleration occurred during a drop on a face and was equal to 660 g for the scale one package.

The drop tests demonstrated the very good mechanical resistance of the cask and that no break and no wide breach had occurred. It also established that the lid kept safely attached to the body. The wall thicknesses are unchanged after the drops and the damages on the cask are restricted in limited areas. The closing systems were damaged but not in a way that could lead

to a cask opening. In particular, the pins that are the most important closing components did not present any rupture initiation.

These drops have shown that the ATB 8K container meets the requirements and confirmed the assumptions taken for confinement and shielding analysis.

4. SAFETY ANALYSIS REPORT

The safety analysis report consists in demonstrating that the release of activity and dose rate around the package are acceptable according to IAEA regulations. This demonstration is based on the container status after the tests for type B packages.

The mechanical evaluation of the ATB-8K is based on the drop test, completed by a brittle fracture analysis and the handling and tie down structure calculation.

The thermal evaluation is made by finite element calculation.

The dose rate evaluation around the package is made by calculation with "MERCURE V" code.

The unusual point of this safety analysis is the containment analysis. Effectively, the ATB-8K which is a type B(U) packaging is not required to be leak tight and the containment is mostly based on the radioactive waste containment properties. The waste are either solidified in bitumen or in concrete, these waste form have been tested and characterised, and in particular the release of activity in condition of fire and immersion. The containment analysis is based on these experiments. It demonstrates that the release of activity from radioactive waste solidified in concrete meet the IAEA requirements for drop, fire and immersion conditions.

5. MANUFACTURING STEPS

5.1 Generalities

Manufacturing of one ATB 8K cask, one frame and one basket started in June 2003, to finish in September 2004. It was then delivered to SKB in Sweden.

5.2 Forging and machining of ATB8K body and lid

The first manufacturing step was the forging and the machining of the 6 ATB8K walls. (See picture n°3)

Picture n°3 = forged walls

5.3 Welding of ATB8K body

The 5 forged carbon steel 200 mm thick walls were then welded together with a special preparation to build the ATB8K body. (See picture n°4)

Picture n°4 = set up of the first forged wall

5.4 Final assembly of ATB8K

Once the body was constituted and the lid machined, the closing system with its locking device and the manual tightening system were fixed onto the body and the lid.

Then several functional tests were achieved in the manufacturing facility:

- The basket was fitted several times inside the cavity and removed. (see picture n°5)
- The good opening and closing of the closing system was tested several times. This was tested with the automatic closing system used in Sweden.
- The lid and the manual closing system was fitted and removed also several times (see picture n°6)

Picture n°5 = basket fitting test into the cavity

Picture n°6 = lid final fitting tests

6. CONCLUSION

The ATB8K cask is the biggest of its kind in the world, giving greater flexibility in meeting future Swedish needs and ensures continued safe transportation of radioactive waste.

As the cask could be removed from its frame it is more flexible than the other ATB containers in the system and can be transported by trucks, railway, and ships.

ATB8K was the first type B cask of its kind. The design of ATB1T, a new type B cask, has been ordered by SKB to TN International. ATB1T will transport large core components placed in special steel tanks, BFA-tanks.