THE ATB-8K PACKAGING FOR TRANSPORT OF RADIOACTIVE WASTE IN SWEDEN

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SUMMARY

The ATB-8K container has been developed on behalf of SKB, the Swedish nuclear fuel and waste management organization, to transport large volumes of radioactive waste conditioned in moulds and drums, or large size scrap components, from nuclear facilities to the Swedish Final Repository for radioactive waste (SFR). In most cases the waste is under LSA form, but when the dose rate at 3 meters from the unshielded object exceeds 10 mSv/h, the transport packaging must meet the regulatory requirements applicable to type B(U) packages, with no fissile content. Considering the dose rate around the package, it will be transported under exclusive use. The ATB-8K packaging is therefore a type B(U) packaging, specifically designed for the transportation of high activity conditioned waste.

ATB-8K DESIGN

General

The ATB-8K packaging is designed to be incorporated into the existing SKB transport system. It will be transported on a frame by the terminal vehicles and using the M/S Sigyn, the dedicated roll on - roll off ship operated by SKB to transport spent fuel in TN 17 casks to the CLAB interim storage facility. It is also compatible with the remote loading and unloading systems in use at the Swedish nuclear power plants and at SFR facilities. The total weight of the ATB 8K package including basket and content is around 110 tons, and 120 tons including its frame

Packaging design

(See figure 1)

The ATB-8K is composed of 5 major components: body, lid, closure system, locking device and manual tightening system. The container has the shape of a cube, of nearly 3 m side. The body consists of a 200 mm thick carbon steel wall and the lid is made up of a square carbon

steel plate, also 200 mm thick. Body and lid are provided with handling devices compatible with existing equipment. The lid-to-body closing system consists of 8 bolts corresponding to 8 staples shrink-fitted and welded to the cask walls. The 4 bolts of each edge are fixed on a closing bar which can be actuated either manually or remotely. The facility crane is used to perform remote operations, but the system can also be actuated manually, if needed. The manual tightening system is equipped with two locking devices on which seals are affixed to detect any tampering during transport. Closing system, locking device and manual tightening system are made of stainless steel and bronze. The container body itself weighs almost 60 tons and the lid approximately 14 tons.

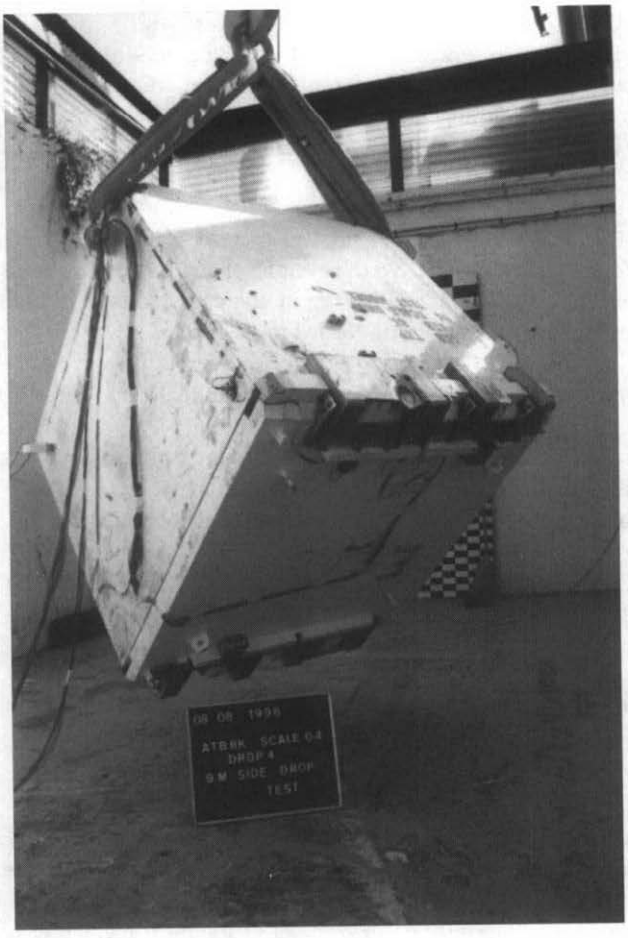

Figure 1: General view of the ATB-8K packaging

The container is fixed onto a transport frame directly lifted from the ground by the platform of the terminal vehicles, thanks to an adjustable level hydraulic suspension system. Loading/unloading operations are therefore extremely fast and simple.

Internal arrangement

The packaging capacity has been optimized to reach either 8 cubic moulds or 32 metallic drums. The waste drums or cubes are located in an internal arrangement constituted by a stainless steel frame. This internal arrangement defines 4 compartments in which two rows of waste moulds or drums can be stacked. The internal arrangement can be removed, in particular to transport large metallic parts or scrap components, etc...

Waste description

The waste can be transported when conditioned either in steel moulds, concrete moulds or steel drums. It can also consist of large scrap components directly placed in the container without using any internal arrangement. The maximal allowable mass of the conditioned waste, including drums or moulds, is 34 tons. For every waste category, thermal power is negligible.

The moulds are 1.2 m side cubes, either in steel or in concrete and their individual loaded mass can reach 5 tons providing the overall weight of the payload remains with the 34-ton capacity. The drums are steel cylinders, 0.59 m in diameter and 0.88 m high, with a capacity of 216 litres corresponding to a maximum loaded mass of 625 kg.

The radioactive waste transported in moulds or drums can include:

- ion exchange resins from primary circuits solidified in concrete or in bitumen,
- scrap metal with radiation point sources, immobilized in concrete,
- large scrap components with point sources and surface contamination.

The maximum allowable activity contained in the whole package is 80 Tbq and it should be noted that a small amount of burnable material - a few kilograms for instance - is acceptable.

DROP TESTING ACCORDING TO TYPE B REQUIREMENTS

(See figure 2)

Since no previous drop tests were sufficiently representative of the ATB-8K design, the mechanical resistance of the packaging was demonstrated by a complete series of drop tests.

A drop test campaign was carefully defined to select the most damaging configurations and submitted in advance to the Swedish competent authorities for examination. A series of one punch test and four 9 meter drops was performed as shown in figure 2. The drops orientations were chosen to check the effects of impacts on a face, on an edge, on a corner and on the lid of the packaging.

The container and its closing systems was precisely modelled at the 0.4 scale which was determined representative of the container design. Only minor details were changed, which could in no way improve the mechanical behaviour of the scale model. The container payload was represented by 8 scaled down concrete cubes corresponding to the 8 moulds.

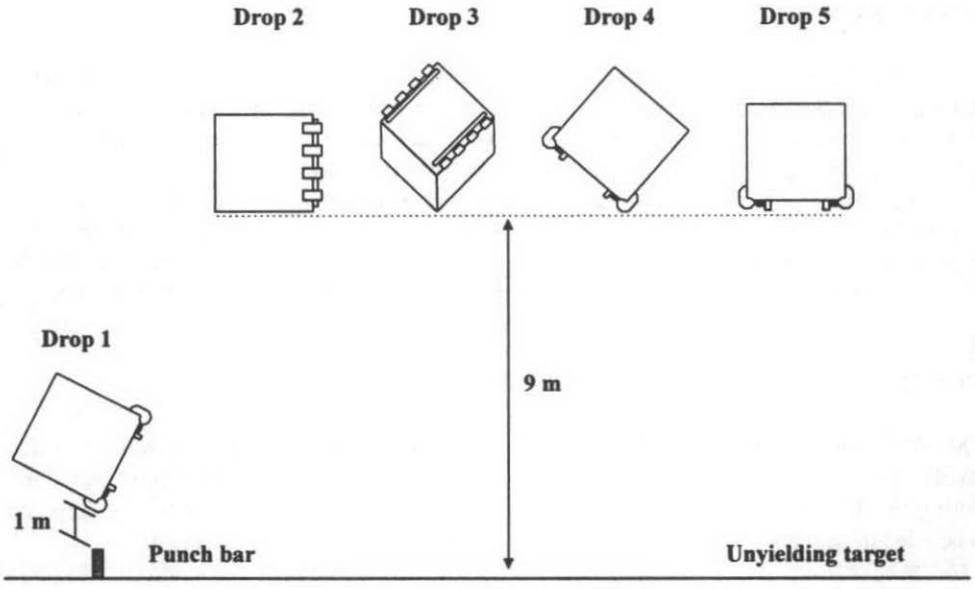

Figure 2: Various drop test orientations

The model was instrumented to measure accelerations during impacts. Since justification of containment requirements is not based on leaktightness of the packaging, no leak testing of the test model was performed after drops. However, it was verified that the content remained fully confined within the packaging. As expected the maximum deceleration was registered during a face drop, corresponding to 660 g for a scale one package, but did not cause unacceptable damage.

The drop tests demonstrated the very good mechanical resistance of the container since no cracks or breach of containment had occurred. It also established that the lid remained safely attached to the body under all drop orientations. The wall thicknesses were basically unchanged after drops and damages were restricted to limited external areas of the packaging. The closing systems were damaged but not in a way that could lead to forcing the lid open. In particular, no rupture was initiated in the pins that are the most important closing components.

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

SAFETY ANALYSIS REPORT

The safety analysis report demonstrates that activity release and dose rate around the package meet the type B requirements of the IAEA regulations. The mechanical evaluation of the ATB-8K was based on a full drop test program, complemented by a brittle fracture analysis and by calculations for handling and tie down structures. Thermal evaluation was made by finite element calculation. Dose rate evaluation around the package was calculated using the "MERCURE V" code.

The unusual aspect of this safety analysis is related to the justification of containment. Altough the ATB-8K is a type B(U) packaging, the container itself is not required to be leaktight since containment is mostly based on the radioactive waste containment properties of the conditioning materials. The waste is either immobilized in bitumen or in concrete and these waste forms have been thoroughly tested and characterised, in particular for activity release in fire and immersion conditions. The containment analysis is based on these experiments. It demonstrates that the activity release from radioactive waste solidified in bitumen or in concrete meet the IAEA requirements for drop, fire and immersion conditions.

CONCLUSION

The Safety Analysis Report of this new high capacity waste transport container was submitted to SSI, the Swedish Nuclear Inspectorate, with whom a close contact has been maintained during the design and testing phases. Licensing is now under way and 2 container units are scheduled to be launched in fabrication when the relevant approvals are obtained.

REFERENCES

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