ROUTINE TRANSPORT WITH A DUAL PURPOSE CASK: THE TN 52 L

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Introduction

The Leibstadt NPP (KKL) spent fuel management strategy consist of cooling of the spent fuel assemblies (SFA) at the reactor site prior to reprocessing a limited quantity of SFA and storing the remaining SFA in casks at ZWILAG. ZWILAG is a centralised off-site interim storage facility built by the Swiss NPP operators and recently (July 2001) came into operation. At some late stage, these SFA would be sent for reprocessing or directly disposed off.

In order to implement this strategy in a cost-effective manner, EGL (on behalf of KKL), having identified the needs and requirements and after a thorough evaluation, purchased from Transnucléaire a dual-purpose high capacity transport cask that could also be used for interim storage. It also purchased six TN 97L dual-purpose casks for storage of spent fuel at ZWILAG.

The TN 52L design is based on the TN 24 family cask, where it can accommodate up to 52 BWR assemblies, with burnups that can reach 55 GWd/tHM and 30 month minimum cooling period, for an initial enrichment up to 4,95 % in weight. It can dissipate 53 kW of residual heat; reduced to about 40 kW due to particular transport constraints.

The TN 52L cask is the first dual-purpose high capacity spent fuel cask ever to have been transported internationally. It makes use of a newly certified railway wagon Q76 and of a new high-powered vehicle for the final road journey. It endorses the single – orifice transport cask concept, especially in terms of loading, drying, re-flooding and unloading in a pool at the reactor site as well as at a reprocessing plant. It also illustrates how close collaboration between the cask engineering company, the NPP operator and the transport company results in safe and smooth operation.

The TN 52 L

Forged carbon steel 250 to 300 mm thick (ASTM 350 LFI) is used to manufacture the three main components making up the containment ; thick shell, bottom and primary lid.

The containment system also provides the main gamma shielding; its thickness is determined by shielding requirements which greatly exceeds the mechanical strength requirements.

The thick shell is forged in a single piece and is then welded to the forged bottom by a full penetration weld.

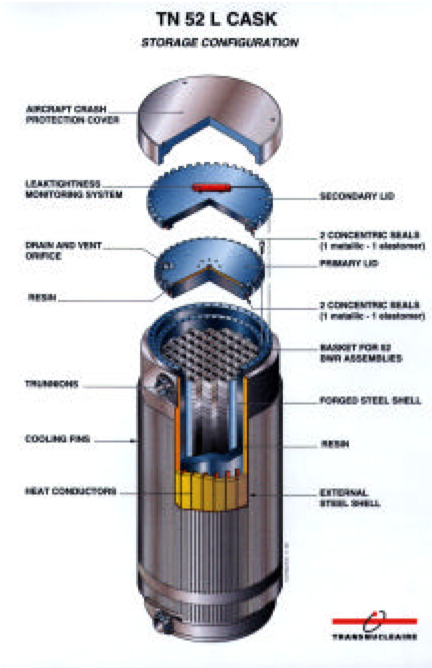

Fig. 1 – the TN 52 L

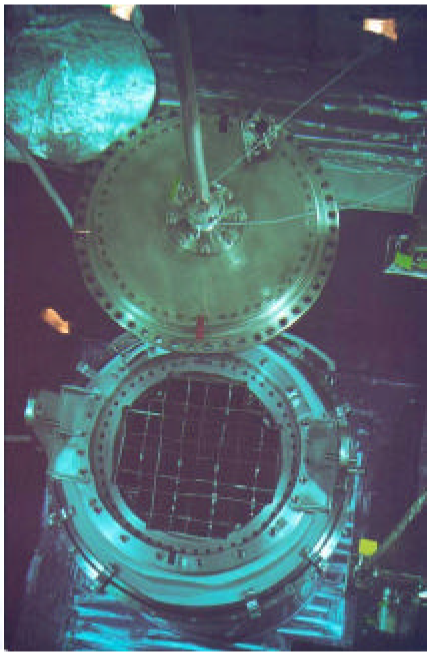

Fig. 2 – Removing the lid

Closure of the cavity is assured by the carbon steel primary lid (leaktightness is obtained by checkable concentric seals) which is bolted to the upper end of the cask.

A layer of borated resin acting as neutron shielding enclosed within an external steel envelope surrounds the cask body made from the above-mentioned containment system. The cask outer diameter is 2.7 and 6.4 m long.

Embedded in the resin are longitudinal copper plates that connect the forged steel shell to the external envelope so as to transfer the decay heat from the fuel assemblies to the surrounding. The vertical cooling fins welded to the external envelope enable the TN 52L cask to achieve a high thermal performance, reaching up to 53 kW.

Two pairs of trunnions bolted at both ends to the thick forged steel handle the cask.

The primary lid is equipped with a single orifice, which is connected to a draining tube reaching the lowest part of the cavity. The orifice allows all the operations to be carried out that are necessary after the fuel assemblies have been loaded into the cask; draining water from the cavity, venting, drying, vacuuming and back-filling with an inert gas (helium/nitrogen).

The 52 position basket is made of boronated aluminium and stainless steel interlocking plates. Integral to the basket are additional shielding plates that also insure a good thermal contact with the cavity. The BWR fuel assemblies can be transported with or without their fuel channels.

A pair of wood shock absorbing covers encased in stainless steel, is fitted to the top and bottom end of the cask. In addition two aluminium lateral impact limiters protect the cask against the slap down effect. In transport configuration, the cask weighs a maximum 118 t loaded.

The TN 97L is a larger cask accommodating 97 long-cooled KKL spent fuel assemblies. Its design is very close to that of the TN 52L, being based again on the TN24 family cask. Its weight in transport configuration reaches 135 t.

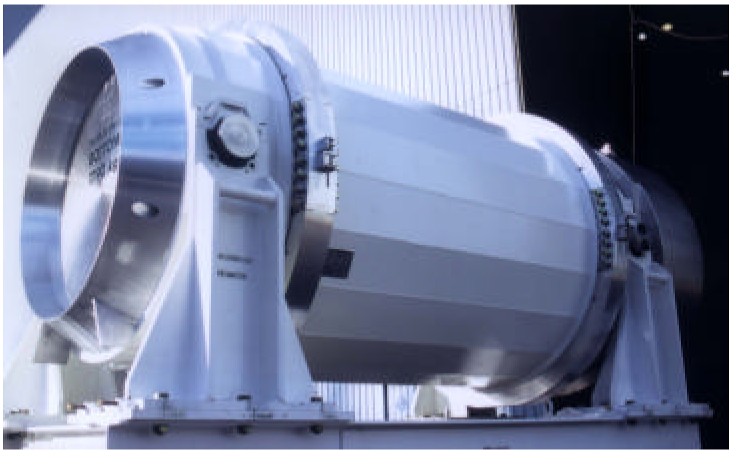

Figure 3

Differences between the both casks include the type of internal surface (stainless steel for the "routine transport" TN 52L, metal spray for the TN 97L) and the fatigue analysis of trunnions.

Licensing

As regards cask licensing for transport, the TN 52L and the TN 97L casks are licensed B(U) in France and validated in Switzerland by the HSK, the Swiss competent authority, according to the IAEA Regulations.

Regarding use for interim storage at ZWILAG, the TN97L topical safety analysis report demonstrates the compliance with the ZWILAG Acceptance Criteria, some of which are briefly summarised in the table below.

	FIELD	MAIN CRITERIA
Normal conditions	Thermal	Ambient Temperature: 32°C, temperature of cladding < 350°C – 390°C Natural convection
	Activity Release	Double barrier, each guaranteeing a leak rate less than 10^{-8} $Pa.m^3.s^{-1}$
	Radiation Protection	Surface dose rate < 0.5 mSv/h Surface contamination α < 0.37 Bq/cm^2 β/γ < 3.7 Bq/cm^2
	Criticality	Keff + 2 σ < 0.95 σ = standard deviation
Accident conditions	Thermal	} Fire 60 min, 600°C. + Temperature of cladding < 350°C – 390°C After aircraft crash (fighter F18) integrated dose to population < 100 mSv
	Mechanical (drop on concrete)	} After design basis accident, dose to population < 100 mSv
	Radiation Protection	
Earthquake	Mechanical	No tip-over nor domino effect

Table 1

The topical safety analysis report was successfully submitted to the HSK for review and acceptance.

Figure 4

A Typical Transport (TN52L)

Preparation:

<u>At shipping and receiving facilities</u>

The design and delivery of loading ancillary equipment were carefully studied in close collaboration between KKL operators and Transnucléaire during the project and completed prior to the maiden voyage. This involves a new metallic skirt with a bottom end piece that isolates in addition to the cask outer wall, the bottom of the cask from the pool water. Some of the ancillary equipment have been designed to be also used with the TN97L casks.

A fully comprehensive training programme was carried out by the KKL operators with the assistance of Transnucléaire. This training consisted of classroom lectures and cold - handling of the cask (including the complete drying and leaktightness testing sequence).

The receiving facility (NPH pool at La Hague) in parallel also made sure that handling would be trouble-free; cold - handling of the cask was performed in 1999 prior to the first shipment.

In addition, Transnucléaire provided technical assistance to the KKL operators during the actual loading.

<u>Transportation</u>

The new Q76 rail wagon designed by Transnucléaire for COGEMA was fully qualified according to the RID. The rail wagon was tested and certified for use on all European gauge railways at full commercial speed (100 km/h) with a 120 t payload. The wagon can also carry larger casks at lower speed.

A specific study was performed with the Swiss railways (SBB/CFF) to check every bridge and tunnel on route to KKL, which has a rail link.

KKL uses a heavy load road vehicle, the “Scheuerle”, for the transfer of the cask from the reactor building to the internal rail transfer station.

Finally, the preparation of the transport also involves the new Titan heavy load vehicle of the Le Maréchal trucking company with a "centipede" like trailer for the last part of the voyage between the Valognes rail terminal and La Hague.

Implementation

Typical loading and readiness for shipment require about 10 days of operation. All operations at KKL are carried out in accordance with the approved Quality Assurance procedures. In addition, independent contamination controls have shown transports to be under the IAEA contamination limits.

Next, in Valognes rail terminal, the cask is smoothly transferred from the Q76 rail wagon to the heavy load road vehicle and delivered to La Hague, after a thorough check of surface contamination cleanliness.

The cask is then unloaded at NPH pool, the single orifice concept and the special orifice tools allow simple unloading and draining of the cavity.

These transport operations were also a rehearsal of methods and techniques to perform the loading and the transport over a much shorter distance by road of the TN 97L dual-purpose cask from KKL to ZWILAG.

It has become the first, and largest spent fuel cask in the world, to be put into storage at ZWILAG.

Figure 5

Conclusion

The TN 52L transports are instrumental in demonstrating:

- The viability of the TN 24 family concept of dual purpose casks, its versatility and its efficiency in international transport ; the Transnucléaire's solution allows NPP operator's flexibility in implementing their spent fuel management strategy, as also shown by the TN 97L,
- The contribution of rigorous training and preparation for a safe and smooth "contamination-free" transport,
- The importance of mastering all aspects of the cask business so as to develop integrated solutions together with NPP operators.

References

1. Roland, V., Lebrun M., Differences and similarities between transport casks and transport/storage casks, KTG 1999, Karlsruhe
2. Roland V., Afonso J., The Maiden Voyage Of The TN 52 L Dual Purpose Cask, KTG 2001, Dresden