TN 81 TRANSPORT / STORAGE CASK FOR HIGH ACTIVITY REPROCESSING WASTE

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SUMMARY

The return of vitrified High Activity Wastes (HAW) to the foreign countries that have their spent fuel reprocessed in France started in 1995: to Japan with TN 28 V casks, to Germany with Transnucléaire's TS 28 and also other casks. These transports are under preparation for Belgium and Switzerland.

In Japan and Belgium, air cooled pits were built for the interim storage of the vitrified waste canisters and to serve the needs of these countries, cask versions adapted to transport only have been designed. In Germany and Switzerland, the interim storage of the waste canisters will take place in "dual purpose" cask versions.

Such casks will stay in an intermediate storage facility for 40 to 50 years and they must comply with specific requirements such as maximum allowable dose rate at surface, leaktightness monitoring, etc.... They may also have to be specially protected in the event of an aircraft crash.

For canisters with a high thermal power (2 kW), current casks can only accommodate a payload of 20 canisters and a new cask design was required.

The TN 81 cask has therefore been developed to allow transport and interim storage of 28 HAW canisters with a total heat load of 56 kW.

DESCRIPTION OF THE TN 81 DUAL PURPOSE CASK

TN 81 packaging design

See figure 1

The cask is composed of:

- a forged steel body equipped with 4 trunnions for handling and tilting operations,
- a primary and a secondary lid, also made of forged steel,
- a basket providing 7 cylindrical lodgements, each of them containing 4 canisters.

During transport, the cask is equipped with two shock absorbers and two additional lateral impact limiters.

In interim storage, the cask is equipped with a leaktightness monitoring system and can also be equipped with an anti aircraft crash cover and/or a secondary lid, depending on the specific requirements of a given storage facility. The design of TN 81 offers flexibility for a wide range of storage specifications.

Overall dimensions

In transport configuration, with shock absorbers, the overall length of the cask is less than 7 m; its maximum transverse dimension is 2.75 m and its total loaded weight is approximately 113 t.

In storage configuration, and when equipped with a secondary lid and an anti aircraft crash cover, the overall height of the cask is less than 7 m ; its maximum width is lower than 2.5 m at the level of the trunnions and its total weight does not reach 118 t.

Cask body

The casks body is composed of a forged carbon steel shell surrounded by extruded aluminium compartments containing neutron shielding resin.

The shell, at least 20 cm thick, is forged in a single piece, and the forged bottom is shrink-fitted and welded to the shell by a controllable weld process.

The extruded compartments are bolted onto the forged shell and fit tightly together. They are filled with Transnucléaire's neutron shielding resin compound and with a layer of lead for additional gamma shielding. Thicknesses of lead and resin can easily be adapted for a range of sources while keeping the same basic design. For this reason, the TN 81 concept is adaptable to a large variety of requirements.

Another function of the aluminium compartments is to transfer decay heat from the cask body to the environment. To enhance heat dissipation in the ambient air, the outer surface of the resin compartments is provided with longitudinal fins.

The lower end of the cask is extended by a drum made of steel plates enclosing neutron shielding. This ensures better operator radioprotection during handling and transport. The bottom drum withstands the weight of the cask in vertical position.

All outer surfaces of the body are protected from corrosion by layers of high emissivity paint.

Containment

Forged carbon steel is used to manufacture the three main components making up the containment: thick shell, bottom, primary lid.

The selected grade of carbon steel combines a series of advantages:

- mechanical behaviour under the specified temperature range (- 40°C, 250°C),
- good heat transfer characteristics,
- standard and internationally well known manufacturing and inspection techniques.

The primary lid is equipped with two concentric metallic gaskets providing a high level of leaktightness.

The primary lid includes a neutron shielding compartment for better radioprotection of operators and a handling pintle. The lid has an orifice provided with a shielded plug and protected by a cover plate. All sealing surfaces are protected by stainless steel cladding.

Closure system

The sealing arrangement includes:

- in transport configuration, one leaktight barrier with a testable gaskets interspace, guaranteeing that the transport regulatory criteria for activity release are met even under accident conditions, in accordance with type B(U) requirements,

- in storage configuration, one leaktight barrier using metallic gaskets is tested for a leaktightness better than 10^{-8} Pa m^3/s. The Helium pressurized interspace is continuously monitored and guarantees zero-release over the whole period of storage.

Basket

The basket provides an efficient thermal path from the canisters to the cavity. It consists of 6 formed copper plates attached together and bolted to the cavity wall. These copper plates define one central and six peripheral lodgements allowing to stack 4 levels of 7 canisters

Shock Absorbing Devices

Top and bottom shock absorbers limit accelerations under axial and angular drop conditions. These leaktight casings are made of stainless steel plates filled with energy absorbing material. The shock absorbers are bolted onto the cask and further improve shielding efficiency during transport.

To protect the cask body under lateral drops, 2 aluminium rings are used as impact limiters. Each impact limiter consists of two half rings assembled before transport when the cask is in horizontal position.

Manufacture

This packaging combines well known materials and technologies allowing to optimise performances in the various fields:

- Thermal release: basket made of formed copper plates, and extruded aluminium compartments bolted on the cask body,
- γ shielding: forged steel and laminated lead plates,
- Neutron shielding: proprietary polyester resin poured in the extruded aluminium compartments,
- Containment: forged vessel with bolted forged lid,
- Shock absorbing devices: wood confined in stainless steel casings and aluminium rings.

CASK PERFORMANCES

Content

The TN 81 can transport 28 canisters with sources corresponding to the guaranteed parameters of COGEMA and with a thermal release up to 2 kW each:

- activity per container at the time of vitrification:
  137 Cs: < 180,000 Ci
  90 Sr: < 125,000 Ci

- actinide content per container:
  U: < 4500 g
  Pu: < 110 g
  Cm: < 90 g

Compliance with IAEA regulations

The cask has been designed to comply with the type B(U)F requirements of IAEA regulations, edition 1996, and also take into account the new ICPR 60 neutron quality factor.

A drop test campaign on a 1/3 scale model is scheduled to confirm preliminary evaluations based on calculations and small scale testing. The model will be tested under various orientations with different components representing the two cask configurations.

Compliance with reprocessing plants requirements

The TN 81 cask complies with the acceptance criteria for loading residue transport packagings at La Hague reprocessing plant. Compatibility of the TN 81 with the loading facility of Sellafield will be confirmed in the near future.

Compliance with storage facility requirements

In addition to transport regulations, storage facilities impose their own requirements such as surface dose rate limitation, allowable leak rate, long term behavior of the components, maximum allowable temperatures on facility wall or floor, protection against an aircraft crash, need for a double containment barrier.

The TN 81 complies with the following criteria:

- Gorleben, Germany:
  - Maximum calculated average dose rate at cask surface
    - photons: 0.10 mSv/h
    - neutrons: 0.25 mSv/h (ICRP 60)

- Confinement of the cask inventory ensured with a double barrier system with a leaktightness better than 10^{-8} Pa m^3/s per barrier.

- Zwilag, Switzerland:
  - Maximum dose rate at cask surface:
    photons + neutrons: $\leq$ 0.5 mSv/h
  - Leaktightness of the cask below 10^{-8} Pa m^3/s

CONCLUSION

The TN 81 cask will be available for the return of high heat power HAW canisters in the beginning of year 2000 and it has been designed to suit a wide range of customer requirements. The design has been optimised to ensure that the cask can be offered at a competitive price for a capacity of 28 canisters even for the strongest sources. Shielding features can be readily adapted to suit varying batches of HAW canisters.

This new cask complies with all published customer storage specifications and can be supplied either as a routine transport cask or as a dual purpose transport / storage cask.

REFERENCES

Acceptance criteria for loading at the La Hague plant the residues transport packagings A 9810 SP 001 rev. 1
Specifications of vitrified residues produced from reprocessing at UP2 or UP 3 La Hague plant, 300 AQ 016 second series July 1986.

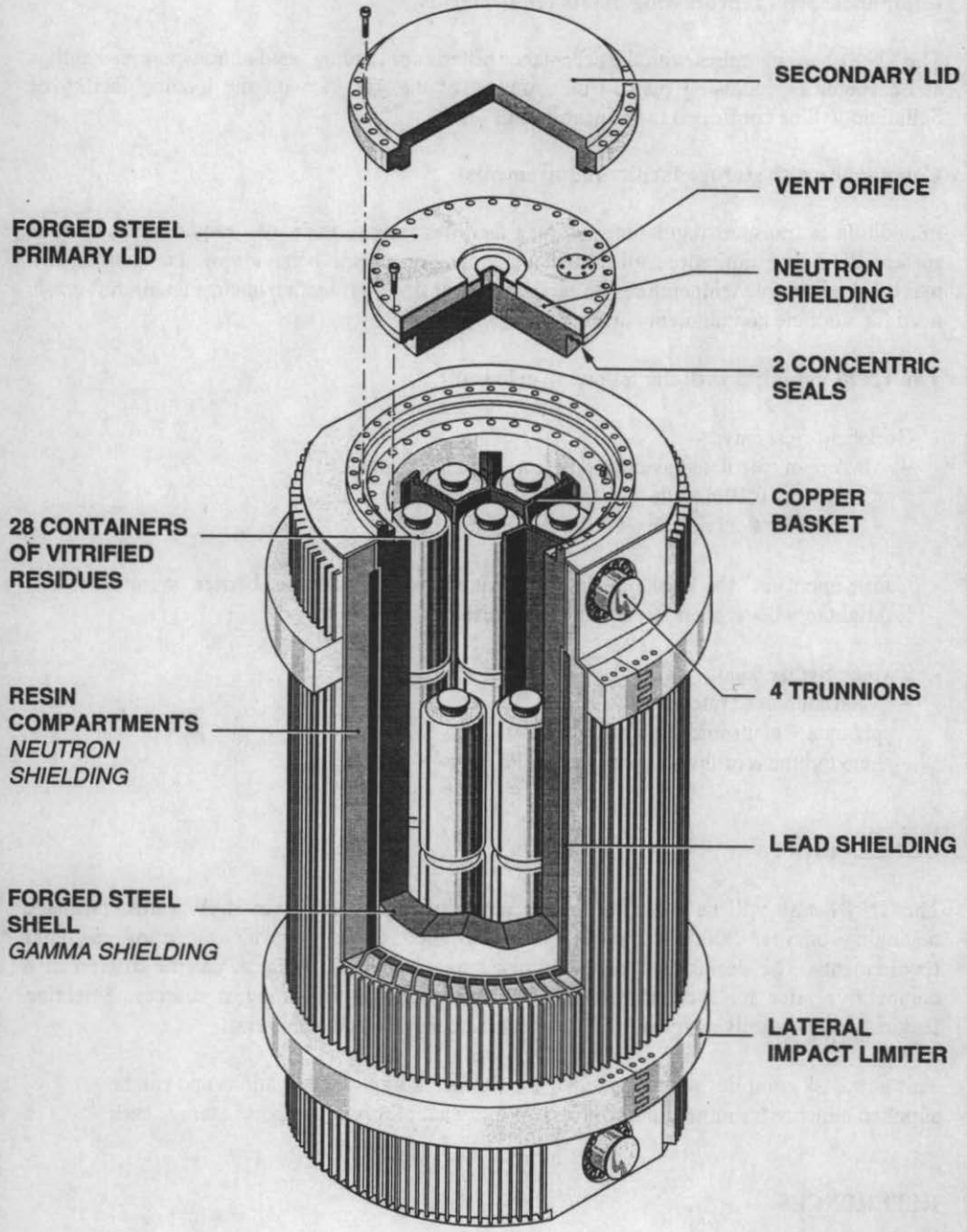

Figure 1: General view of TN 81 cask