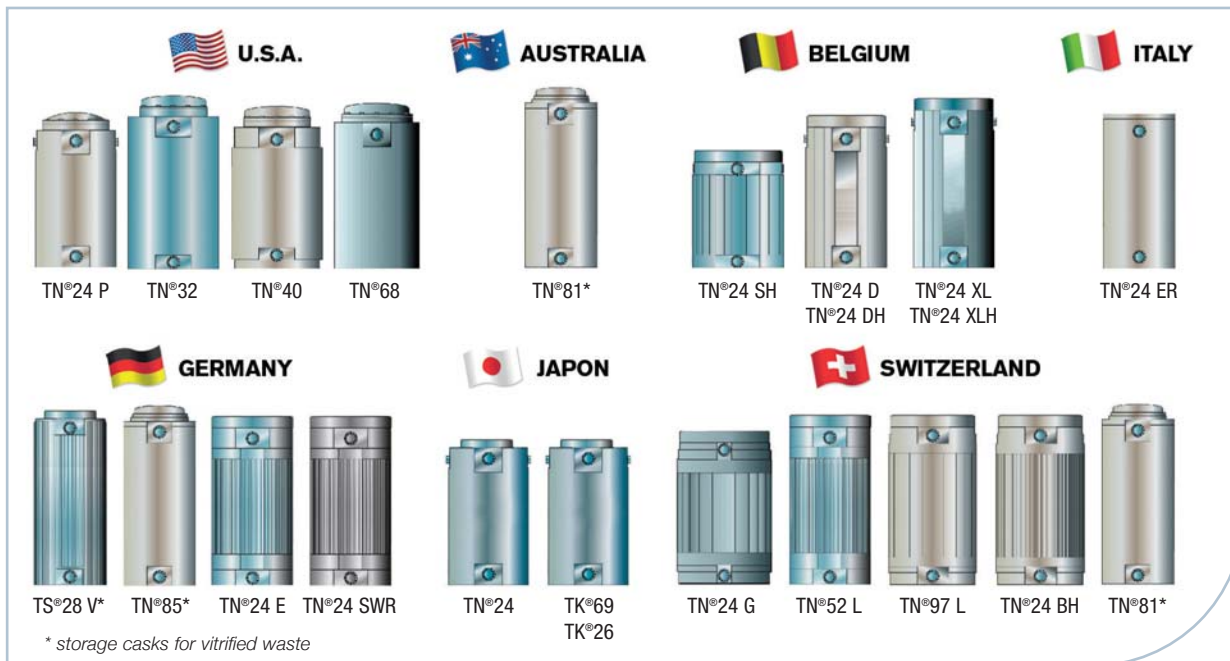


Metal Casks for Used Fuel Transport and Storage



For more than 20 years, **AREVA TN** in France, US and Japan has been developing the versatile TN[®]24 family with proven design and technology.

These transport and storage casks have been adapted to the specific needs of a variety of storage conditions and fuel.



“ Ideal for a variety of storage conditions and fuel

TN[®]24 Dual-Purpose Transport and Storage Casks

400 casks sold in 6 different countries for storing more than 12,000 used fuel assemblies.

The TN[®]24 Family Concept

- The main **gamma shielding** is provided by a forged steel body.
- **Neutron shielding** is ensured by a layer of boronated resin enclosed between the forged steel body and the external shell. Longitudinal heat conductors made of copper or aluminum plates carry the heat of the fuel assemblies from the forged steel body to the external shell through the resin.
- An **inner basket** provides compact spacing of used fuel assemblies according to the type of fuel. The basket is made of boronated aluminum and/or stainless steel, and guarantees the sub-criticality of its contents during normal operation and under accident conditions.

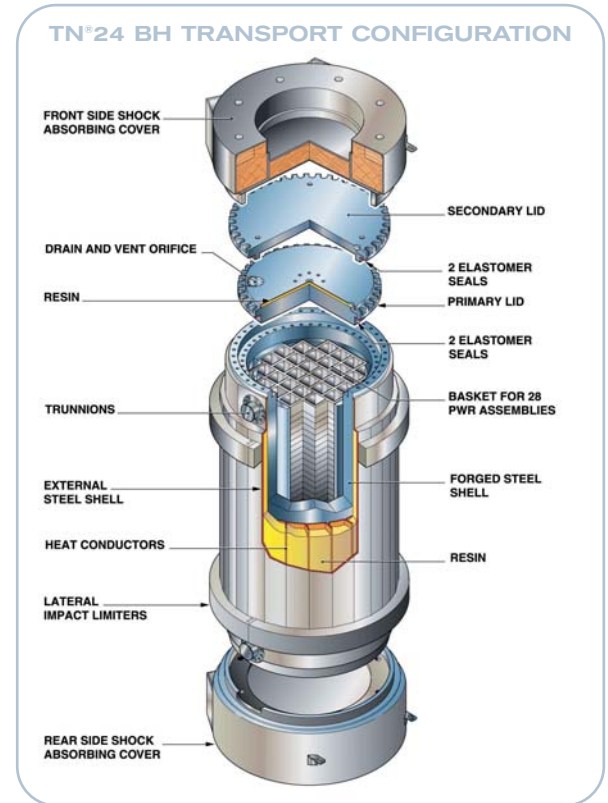
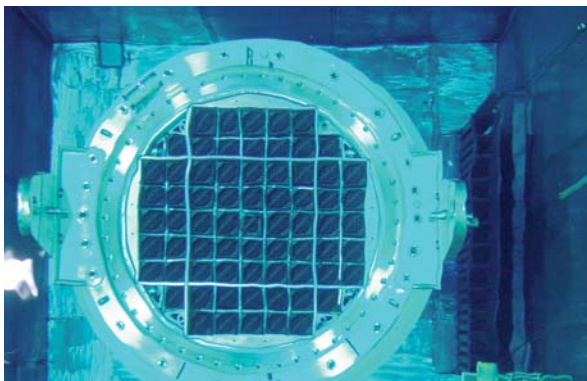
A Tailor-Made Solution: The TN[®]24 BH in Switzerland

→ When AREVA TN was asked by BKW FMB Energy Ltd. to design a dual purpose cask for Mühleberg NPP (KKM), it had to meet several complex needs. Mühleberg power plant is not able to receive a big storage cask because of the road gauge and the crane capacity.

→ Thus, AREVA TN has decided to design two casks: a transfer cask (the TN[®]9-4) for the transport of 7 BWR fuel assemblies from Mühleberg to Zwiilag (The Swiss centralized interim storage facility) and the TN[®]24 BH for the intermediate storage of 69 BWR used fuel elements in Zwiilag. The used fuel elements are transferred from one cask to another using Zwiilag's hot cell (dry loading). After ten round trips of the TN[®]9-4, the TN[®]24 BH is fully loaded.



→ 16 TN[®]24 BH casks have also been ordered to store the BWR fuel assemblies of Leibstadt power plant. The loading of the fuel elements is made directly in the pond of the power plant (wet loading). The cask is transferred by road from the power plant to Zwiilag for intermediate storage.



→ The flexible TN[®]24 BH dual purpose cask is one of the highest capacity BWR cask in the world taking into account dry and wet loadings, lifting capacity of Zwiilag and Leibstadt and the handling spaces.

In Germany

AREVA TN is the only non German Company having designed and licensed a used fuel transport and storage cask TN[®]24 E.

It provides flexibility for loading plan with high burn up fuel or with large number of MOX used fuel and easy adaptation to non standard fuel. Several dozens have already been ordered by German Utilities.

A Variety of Casks for Different Needs:

The TN[®]24 Family in Belgium

SYNATOM chose TN[®]24 family casks for the Doel Nuclear Power Plant.

- More than 80 casks of the TN[®]24 family have been delivered since 1996 to the Doel interim storage facility. According to the characteristic of the fuel assemblies, 5 versions of the TN[®]24 are in use in Doel: the TN[®]24 D and the TN[®]24 DH (High burn up), the TN[®]24 XL (long) and TN[®]24 XLH (long, high burn up) and the TN[®]24 SH (short, high burn up).
- Ten additional TN[®]24 SH have been ordered in 2013 by Synatom.

“ Tailor-made casks for the specific needs of the operators



TN[®]24

The Versatile TN[®]24 Family

- The TN[®]24 metal cask family has been designed for dry storage needs for more than 20 customers in the United States, Europe and Japan, with 400 casks ordered.
- The neutron absorber of the aluminum basket can be adapted to U-235 enrichment.
- Payload can be optimized by customized loading plans (eg: high burn up fuel, MOX SFA or last core...).
- Shielding performance can be optimized by adapting the thickness of the forged steel body and resin.
- Many SFA types can be accepted, non standard fuel included, and dimensions are adaptable.
- The casks can be adapted to the specific interface of the receiving building, loading equipment or transport requirement.

TN[®]24 Cask Advantages

- Dual-purpose - storage and transport
- Many years of trouble-free operation
- Adaptable casks
- Ease of operation
- High capacity
- Bolted closure
- Standard fabrication
- Minimal or no maintenance
- Double metallic o-ring seals
- Single failure-proof trunnions
- Low cladding temperature proven by thermal testing
- Testing proves the TN[®]24 ability to resist an aircraft crash, as required by the storage licence.

US and Japanese Experiences

Several TN[®]24 designs have been developed by AREVA TN for the U.S. market.

- Initially, customers only required systems for storage, and the TN[®]32 and TN[®]40 casks were licensed in accordance with NRC regulations for storage. Today, many customers prefer systems which are licensed for both transport and storage. This is the case with the TN[®]68 design for BWR used fuel, which is fully licensed for storage and also as a type B(U)F transport package. To date, more than 150 casks from the TN[®]24 family have been delivered to U.S. Nuclear Power Plants. All facilities store casks on-site and in open air.

In 1994, a Japanese version of the TN[®]24 cask obtained a storage license for used fuel.

- In Japan, Transnuclear, Ltd., the joint venture between AREVA TN in France and KOBE STEEL delivered 20 TN[®]24 storage casks for 37 and 52 BWR assemblies to Fukushima No.1 NPP in 1995 and in 2013. This is the first on-site used fuel dry storage installation in Japan.
- For Japanese utilities, new transport and storage casks namely, TK[®]69 for 69 BWR and TK[®]26 for 26 PWR, have been developed. They offer the highest capacity and best coverage of fuel inventory to Japanese Utilities.

“ A versatile, adaptable family of storage casks

“ 300 casks delivered and 400 ordered



THE TN[®]24 CASK FAMILY

Model	Number of Fuel Assemblies	Max Burn up MWd/tU	Cooling Time (years)	Max Enr. (%)
TN [®] 24 D	28 PWR	36 000	8	3.4
TN [®] 24 DH	28 PWR	55 000	7	4.1
TN [®] 24 XL	24 PWR	40 000	8	3.4
TN [®] 24 XLH	24 PWR	55 000	7	4.3
TN [®] 24 SH	37 PWR	55 000	5	4.25
TN [®] 24 G	37 PWR	42 000	10	3.81
TN [®] 24 (F1)	37 BWR	40 000	4	3.2
TN [®] 24 (F1)	52 BWR	40 000	4	3.2
TN [®] 24 E	21 PWR	65 000	5	4.65
TN [®] 32	32 PWR	45 000	7	4.05
TN [®] 40	40 PWR	45 000	10	3.85
TN [®] 24 P	24 PWR	33 000	5	3.5
TN [®] 52 L	52 BWR	55 000	min. 2.5	4.95
TN [®] 24 SWR	61 BWR	70 000	min. 5.5	5.0
TN [®] 68	68 BWR	60 000	7	4.7
TN [®] 97 L	97 BWR	35 000	10	4.0
TN [®] 24 BH	69 BWR	50 000	6	5.0
TK [®] 69	69 BWR	40 000	10	3.2
TK [®] 26	26 PWR	47 000	15	4.3
TN [®] 24 ER	32 BWR (th)	13 700	40	5.2

“ Depending on specific customer needs, TN[®]24 casks are licensed for both Storage and Transportation

AREVA TN Highly-Qualified Assistance Teams

AREVA TN provides on-site support, to implement and use packaging systems; this may entail training or overseeing or on-site operations such as loading, unloading, leak tightness test,...

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