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OVERVIEW AND EVALUATION OF TRANSNUCLEAR NEW TECHNOLOGY FOR STORAGE AND TRANSPORTATION

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ABSTRACT

Transnuclear (TN) through an effective blend of technology development, innovation and strong customer focus has become the leader in the supply of used fuel dry storage and transportation solutions. Both the NUHOMS® and TN Metal Cask product lines have evolved into an extensive line of products with state-of-the-art features to meet the varying needs of our users.

TN has developed used fuel dry storage systems with the highest thermal limits and the best shielding of any cask system in the US. TN adapted our European cask designs to meet US NRC requirements to produce the most advanced high heat basket design in the industry today. The new generation systems are the only high heat systems that have received approval from the NRC. TN's 40.8 kW system is already approved and has been loaded with record heat loads with remarkably low occupational exposure.

The heat loads and capacity of the used fuel dry storage systems have far outpaced the ability to provide future transport of this stored fuel. TN is actively upgrading its current transport packages to be closer in line with the future transportation requirements.

- The TN-40 Cask previously licensed for storage only is being upgraded for storage and transport of high burnup fuel.
- The TN-68 Dual Purpose Cask is being upgraded to store and transport high burnup fuel.
- The MP 197 Transport Cask which was originally designed to meet both the European and US requirements for BWR fuel is being upgraded to handle PWR fuel assemblies, higher burnups and higher heat loads. The goal of this upgrade is to achieve heat loads in excess of 26kW for US transport while maintaining European compatibility.
- The MP TAD Transport Overpack conceptual design is complete. This cask is designed to be used in conjunction with the TAD TN21P and TN44B canister systems with heat loads of approximately 26kW.

TN is continually in the process of enhancement and development to bring the most cost effective solutions to the used fuel storage and transport industry.

INTRODUCTION

TN is part of the AREVA family of companies and of the Logistics Business Unit. AREVA operates the largest fleet of transportation casks in the world. AREVA organizes more than 3000 multi-modal shipments of nuclear material each year; more than 70 shipments are in progress at any given time. TN is a wholly owned subsidiary of AREA.

TN was established in 1965 to provide transport casks and logistics services to move used fuel and other nuclear materials in anticipation of development of reprocessing facilities in the U.S. When reprocessing was abandoned in the mid 80's, the company shifted its focus to dry storage to support commercial utility needs to manage nuclear used fuel. TN through Metal Cask development and strategic acquisition of the NUHOMS® has moved into a leadership position in the dry used fuel storage industry with 450 systems deployed at 29 ISFSIs in the U.S. TN has now turned it's attention to upgrading it's fleet of transportation casks to move closer to the current storage capabilities.

CURRENT SITUATION

The requirements of the commercial nuclear power industry have evolved over the past few years. Fuel storage requirements moved to ever increasing heat loads, burnups and dose requirements for new storage systems. Optimization of space has also become a major concern as the timeline for permanent disposal has continued to be a moving target. TN has met each of these challenges and now has storage systems which support high capacity, high heat loads, high burnups and the lowest dose in the industry.

TN has now turned it's attention to upgrading it's fleet of transportation casks to move closer to the current storage capabilities. This move toward transportation has several drivers.

1. Requirements by state and local authorities that transportation be available for interim storage systems prior to ISFSI approval.
2. Development of the TAD systems which requires a Transportation Overpack to move canisterized fuel from the utility site to the disposal site.
3. Supply the international used fuel transportation market.
4. Preparation for the potential for reprocessing/recycling fuel in the U.S.

TN licensed used fuel transportation casks include bare fuel casks and canisterized fuel casks. The older bare fuel BWR and PWR used fuel casks, although used quite effectively in the past for transshipment of used fuel assemblies, are of limited use when considering the needs of the future market. Table 1 provides information on three TN more recently licensed large capacity commercial used fuel transportation casks. These casks exceeded the needs for the products being stored at the time of licensing.

Table 1. Current TN Licensed Commercial Used Fuel Transport Casks

Cask Designation	Heat Load (kW)	Type	Payload
TN 68	21.3	Dual Purpose	BWR Bare Fuel
MP 187	13.5	Dual Purpose	PWR Fuel Canister
MP 197	15.9	Transport	BWR Fuel Canister

Figure 1 Loading TN 68 Dual Purpose Cask

Figure 2 Loaded TN 68 Dual Purpose Cask

There are currently 2516 BWR commercial used fuel assemblies loaded in TN 68 Dual Purpose casks (see Figures 1 and 2). The MP 187 Dual Purpose cask shown in Figure 3 has been used to move 504 intact PWR assemblies, 13 failed PWR fuel assemblies and over 41000 lbs of GTCC waste into NUHOMS® storage systems.

Figure 3 Loading MP 187 Dual Purpose Cask

LOOKING FORWARD

The establishment of parameters for the next generation of TN Transport casks is based on planned fuel storage, state and local authorities, the international market, the potential for direct transport of current fuel inventories to the AREVA La Hague reprocessing facility in France or a future reprocessing site, and transport to a final repository. The key features driving the future designs are higher heat loads, higher burnups and higher capacity.

Parameter Impact on Design

TN storage system heat loads have increased from 7kW to a maximum of 40.8kW (the maximum heat load stored to date is 30.2kW in a canister system). The maximum heat load, although an essential design feature, is not the controlling factor for the larger transport casks. The use of vertical or radial fins to dissipate the heat can be incorporated in the design to resolve the high heat issue.

TN PWR storage systems have evolved from 7 PWR fuel assemblies to currently 32 PWR fuel assemblies. BWR system capacities have expanded from 52 to 68 fuel assemblies. TN is planning to expand these systems to even higher capacities in the near future. The larger capacity bare fuel baskets and especially larger capacity used fuel canisters challenge the transport cask design in diameter and weight.

The other major parameter which is considered for the next generation transportation is the maximum burnup of the fuel. The burnups for the fuels in storage has steadily increased and is approaching 60 - 62 GWd/MTU. The source terms expected from this higher burnup fuel is a major impact in terms of remaining below the required transport dose rate limits.

The TN Solution

Both the TN40 Storage Cask and the TN68 Dual Purpose Cask parameters are being addressed to satisfy local authority concerns and future storage/transport needs. An application is currently under review by the NRC to convert the TN40 Storage Cask into a Dual Purpose Transport and Storage Cask. Once this transport certificate is approved, TN will revise the

certificate to provide for high burnup fuel. The TN68 certificate will also be revised to include high burnup fuel with a higher enrichment and higher decay heat load. Both the TN-40 and the TN-68 casks are used to store and transport bare fuel assemblies.

Figure 4 Loaded TN 40 Storage Casks (being licensed for transport

TN has currently selected the MP 197 as the most versatile U.S. licensed Transport Cask for expanding the capabilities. The MP197 has a cavity which is adequate for both PWR and BWR canisters and bare fuel baskets. TN is adapting the Neutron and Gamma shielding to accommodate the source terms expected from high burnup fuel. This optimization results in the most efficient design without excessive shielding or excessive weight which allows greater capacity for the cask.

TN is also addressing opportunities which exist to transport used fuel directly from fuel pools to an interim repository either as bare fuel or in a fuel canister. A significant amount of the low heat load and low burnup fuel in the U.S. is already in dry storage (not compatible with the TAD canister) and is not available to be taken to the interim repository. Therefore, the transport package needs to have higher heat load capacity and a versatile cavity.

Lastly, TN currently has two standard diameter dry used fuel storage canisters licensed for storage. Cavity versatility is essential to handle different diameter canisters along with several new bare fuel basket designs.

MP197 Upgrades

Due to the versatility in the original design, the upgrades to the body of the MP197 cask are considered minimal to achieve the significant increase in performance. The first step is to reduce the thickness of the original lead thickness by approximately 1.0 inch and increase the neutron shielding by a similar amount. This minimal change optimizes the shielding capability and reduces the overall weight of the package allowing slightly heavier payloads. This is accomplished by using an AREVA proprietary resin. With the dose rate limits optimized, fins are then added to the neutron shield to remove the maximum amount of heat.

The changes being implemented make no significant impact on the impact limiter geometry. Additionally, based on the small changes in weight and overall dimensions, the impact limiter material also remains the same. This makes it possible for TN to qualify the impact limiters based on test correlated analytical results instead of performing new impact limiter drop tests.

The MP197 was developed as a joint project with Transnuclear International several years ago and was designed to be compatible with transport to the AREVA Le Hague reprocessing facility. Since there are no significant overall changes to dimensions, weights, impact limiters, etc., the upgraded MP197 cask will remain compatible with the Le Hague facility.

Final Transportation Parameter Goals

The expected outcome of the near term upgrades discussed above is presented in the Table 2. This expected outcome is based on TN's design efforts to date.

Table 2. TN Licensed commercial Used Fuel Transports Casks Looking Forward

Cask Designation	Heat Load (kW)	Burnup (GWd/MTU)	Type	Payload
TN 40	21.0	65	Dual Purpose	PWR Bare Fuel
TN 68	21.3	65	Dual Purpose	BWR Bare Fuel
MP 187	13.5	45	Dual Purpose	PWR Fuel Canister
MP TAD	24-30*	65	Transport	BWR/PWR TAD Canister
MP 197	30-33*	65	Transport	BWR Fuel Canister PWR Fuel Canister BWR Bare Fuel PWR Bare Fuel

*Depends on canister type

CONCLUSIONS

AREVA using Transnuclear, Inc. and Transnuclear International technologies, is upgrading the fleet of Transnuclear nuclear used fuel transportation casks to meet U.S. and International future needs. This upgrade provides AREVA with significant flexibility and versatility consistent with ever changing world wide nuclear policies.

REFERENCES

10 CFR 71 CoC 9293 – TN 68 Transport
10 CFR 71 CoC 9255 - MP187 Transport
10 CFR 71 CoC 9392 – MP197 Transport
10CFR 72 CoC 1027 – TN 68 Storage
10CFR 72 CoC 1004 – NUHOMS® Storage
NRC Docket No. 71-9313 TN40 Transport Application

