NUHOMS® - A COMPREHENSIVE SYSTEM

W. Bak, K. Jones

Transnuclear West Inc., 6203 San Ignacio, Suite 100, San Jose, California, 95119, United States

SUMMARY

The NUHOMS® system provides a comprehensive solution for handling utility spent nuclear fuel storage needs. The system has the flexibility to handle many fuel types under the umbrella of a standard system design. All aspects of the design are based on providing a system which maintains compatibility with existing equipment and provides for continuous improvement through operational lessons learned.

INTRODUCTION

The NUHOMS® system provides a comprehensive technology to store and transport spent nuclear fuel. The NUHOMS® system is canister based, utilizing stainless steel canisters as the spent fuel waste package and horizontal concrete storage modules as the storage overpack. The canister is loaded, transferred to the storage module, and ultimately transported to a repository or interim storage facility by means of a transfer or transport cask.

The NUHOMS® system uses standard product dimensions so that various spent fuel canister waste packages can be designed using the same transfer and transport casks, auxiliary equipment, and storage modules. This system design requires that the spent fuel canister diameters remain fixed and that standard canister lengths are utilized for PWR, BWR, or other fuel. The standardized interface dimensions also allow individual components (such as the canisters) to be modified or enhanced without affecting the remainder of the system. The system retains the flexibility to accommodate various canister lengths within the envelope of the casks and storage modules.

Prime advantages of the NUHOMS® system are its operational and performance characteristics. These advantages are:

- Use of the canister as the waste package so that there is no fuel handling required after initial fuel loading until it arrives at the repository.

- No heavy lifts of the waste package occur outside the reactor building because all transfer, module loading and transport operations are performed with the canister in the horizontal position.

- Use of concrete storage module allows flexibility in controlling radiation doses at the storage site.

- Minimal monitoring and inspection required by use of a passive storage system.

The NUHOMS® system is currently licensed for storage of PWR and BWR nuclear spent fuel under 10CFR72, and is undergoing licensing of a dual purpose (storage and transport) system for PWR fuel under 10CFR72 and 10CFR71. There are over 65 NUHOMS® canisters storing spent nuclear fuel at four nuclear plant sites and there are four additional sites planning the use of the NUHOMS®. This system provides a comprehensive family of waste packages that can be used with a standard set of storage, transfer, and transport equipment.

This paper provides a discussion of the operational and performance bases of the NUHOMS® system and its use as a complete solution for nuclear spent fuel storage needs.

NUHOMS® DESIGN BASIS

The NUHOMS® system provides a comprehensive solution for the spent nuclear fuel storage and transportation needs of utilities. The design basis of the system provides for the use of a standard canister waste package and associated storage, transfer, transport and auxiliary equipment. This key design feature provides for standardization of design, fabrication, and operation of NUHOMS® that results in increased safety and performance.

Canister

The NUHOMS® dry shielded canister (DSC) consists of a stainless steel shell and end covers with a basket assembly which provides structural support and criticality control of the spent nuclear fuel assemblies. The basic canister shell assembly consists of a 5/8 inch thick stainless steel shell with a nominal diameter of 67.25 inches. This shell assembly includes a bottom shield plug assembly which consists of an outer bottom cover plate, a carbon steel or lead shield plug, and an inner bottom cover plate that provides the pressure boundary. The top shield plug assembly consists of a top shield plug that rests on a support ring, an inner top cover plate and an outer top cover plate. These design features are standard for all NUHOMS® canisters and are shown in Figure 1.

The canister shell design utilizes a fixed diameter, which is standardized to allow the transfer and transport casks, automated welding equipment, and horizontal storage modules to be designed based on a single diameter. The canister length can be varied to accommodate different fuel lengths.

The basket assembly provides the structural support and criticality control for the fuel assemblies. The basket assembly design can be modified to handle different types of spent nuclear fuel. The current storage system utilizes a spacer disc and support rod design to accommodate 24 PWR or 52 BWR fuel assemblies in each canister. There are various basket designs in progress for the storage of failed fuel assemblies and individual failed fuel canisters. Additionally, there are different basket designs for storage only and for the dual purpose systems. While the basket assembly can be varied, each separate basket is designed to fit into the standard canister configuration.

Storage Module

The NUHOMS® storage overpacks are concrete horizontal storage modules (HSM's) which provide the overpack for the canister is its storage mode. The storage module is designed to handle the 67.25 inch diameter canister and has the flexibility to accommodate different lengths. The HSM is designed as a stand alone unit consisting of two prefabricated pieces – a base unit (floor and walls) and a roof unit. These HSM's are transported to the site storage location and set in place. They can be arranged in various configurations to minimize the radiation dose associated with the site. A standard storage module is provided in Figure 2.

The storage modules are designed to allow for the use of shield walls. These walls provide for additional radiation dose control and can be designed to assist in keeping the doses from the storage location as low as possible.

Another key feature of the HSM design is that the modules are stand alone units. The operation of the NUHOMS® system provides for no contamination on the outside of the canister due to operational considerations during fuel loading. Therefore, the storage module will not experience any contamination. This feature provides for ease of decontamination and removal of the HSM from the site. It is expected that the storage modules could be reused when the canister is transported to an interim storage facility or repository. Again, the standard design of the system provides for flexibility in the use of the storage modules.

Transfer Equipment

The NUHOMS® system utilizes a standard set of transfer equipment. The transfer equipment consists of a transfer cask; a transfer trailer, skid, and hydraulic ram; automated welding equipment; and a vacuum drying, draining and inerting system. The transfer equipment is standard for the NUHOMS® system and this equipment is often leased or shared by utility users. As previously discussed, the transfer equipment is designed around the canister diameter of 67.25 inches. This governs the design of the cask cavity, the automated welding process, and the associated equipment design. The standard NUHOMS® transfer operations are shown in Figure 3.

Transport Cask

The NUHOMS® dual purpose storage and transportation cask utilizes the canister for its operations. The transport cask is currently under license review. This cask is also designed to be compatible with all NUHOMS® storage system components. This cask can be used for fuel loading and transfer operations which places the canister into the storage module. The cask mates up with the storage module to allow for retrieval of the canister for shipment to another location – repository or interim storage facility. The NUHOMS®-MP187 storage and transportation cask is shown in Figure 4.
The NUHOMS® system provides a family of canister waste packages that can be used with a standard set of equipment to load, store and transport spent nuclear fuel. The system provides a comprehensive system that provides the user with the flexibility for selecting the spent fuel system approach – storage or dual purpose -- that best suits their needs and requirements. However, regardless of the option selected, each NUHOMS® system is compatible with all other NUHOMS® components.

NUHOMS® OPERATIONAL FEATURES

The use of standard products provides many operational and performance advantages. The standard canister allows the use of similar loading and transfer procedures for all applications. The use of a standard-based waste package provides the following major advantages:

The NUHOMS® system is designed with the canister as the waste package to minimize fuel handling. Once the fuel is loaded into the canister and the canister is sealed, all operations are designed to handle the canister and not individual spent fuel assemblies. The canister is used in the storage mode with the horizontal storage modules and is designed to be retrieved and shipped to an interim storage facility or repository using the transport cask. This design feature removes the requirement for taking the waste package back into the fuel pool for handling operations prior to final shipment.

The NUHOMS® system is also a horizontal based system. Once the fuel is loaded and all draining, drying and sealing operations are completed, the cask is placed on its skid in a horizontal orientation. When the cask and its canister waste package is moved outside the reactor building, there are no operations which require a heavy lift of the canister. The canister is transferred or retrieved from the cask to the storage module by means of a hydraulic ram, which pushes or pulls the canister out of or into the cask. The operations are simple and provide for an additional safety benefit by the exclusion of heavy lifts.

The concrete storage modules provide an inexpensive means of providing shielding and protection for the waste package during its storage mode. The concrete module is handled as a stand alone unit that can be placed on the site basemat. The concrete module also allows for the use of shield walls, which are designed to keep site dose rates to a low level. The use of this concrete system provides an easy means of access to each storage unit and provides flexibility in configuration to minimize and handle radiation dose issues.

Storage operations using the NUHOMS® system are simple and passive, with minimal requirements for monitoring and inspection. The sealed canisters do not require any on-line monitoring and utilize the passive cooling features of the storage module. The only monitoring requirements for the system are the daily inspection (visual or camera) to ensure no vent blockage and temperature monitoring of the concrete modules to track any significant changes in the operation of the system.

The interchangeability of equipment allows for multiple users of the transfer and auxiliary equipment, which provides for shared cost and operational experience among the users. The standard equipment results in standard operations and provides the basis for a lessons learned process to improve the operability of the system. Shared experience by the users has resulted in an improved automated welding process with the result being that doses due to individual canister loadings have been greatly reduced.

CONCLUSION

This paper describes some of the key benefits of the NUHOMS® system based on its standard system design and operation. Use of the seal-welded NUHOMS® canister as the primary waste package eliminates repackaging and simplifies handling. The use of standard interface dimensions between components allows each utility the flexibility to select the system – PWR, BWR, storage-only, dual-purpose etc. – which best suits its needs while maintaining full compatibility with all loading, storage, transfer, and transport equipment. Use of standard equipment also facilitates the sharing of costs and operational experience among the users.

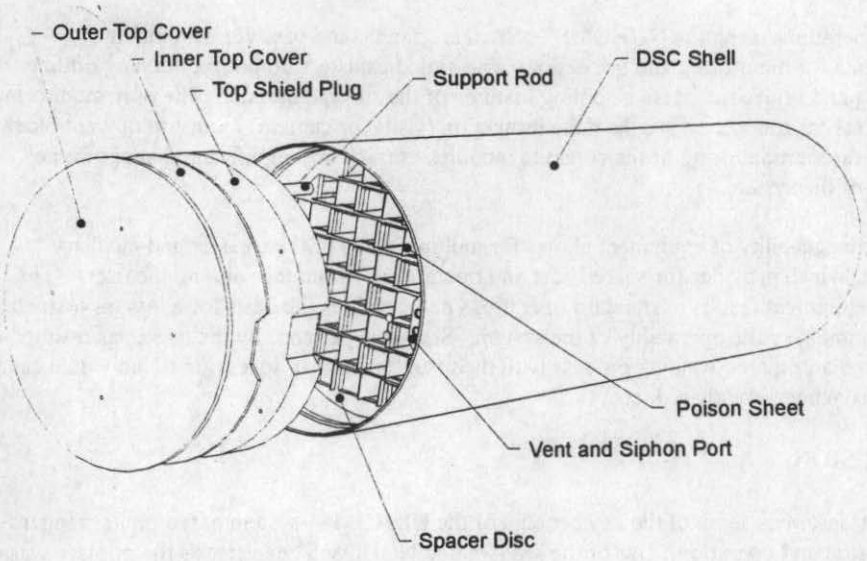

Figure 1, NUHOMS® DSC Shell Assembly

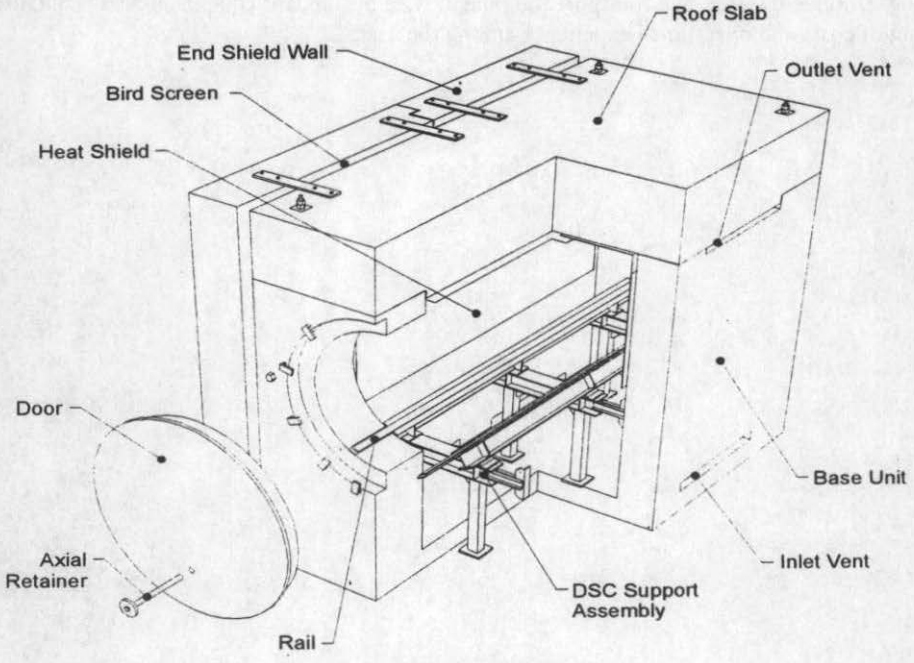

Figure 2, NUHOMS® Horizontal Storage Module

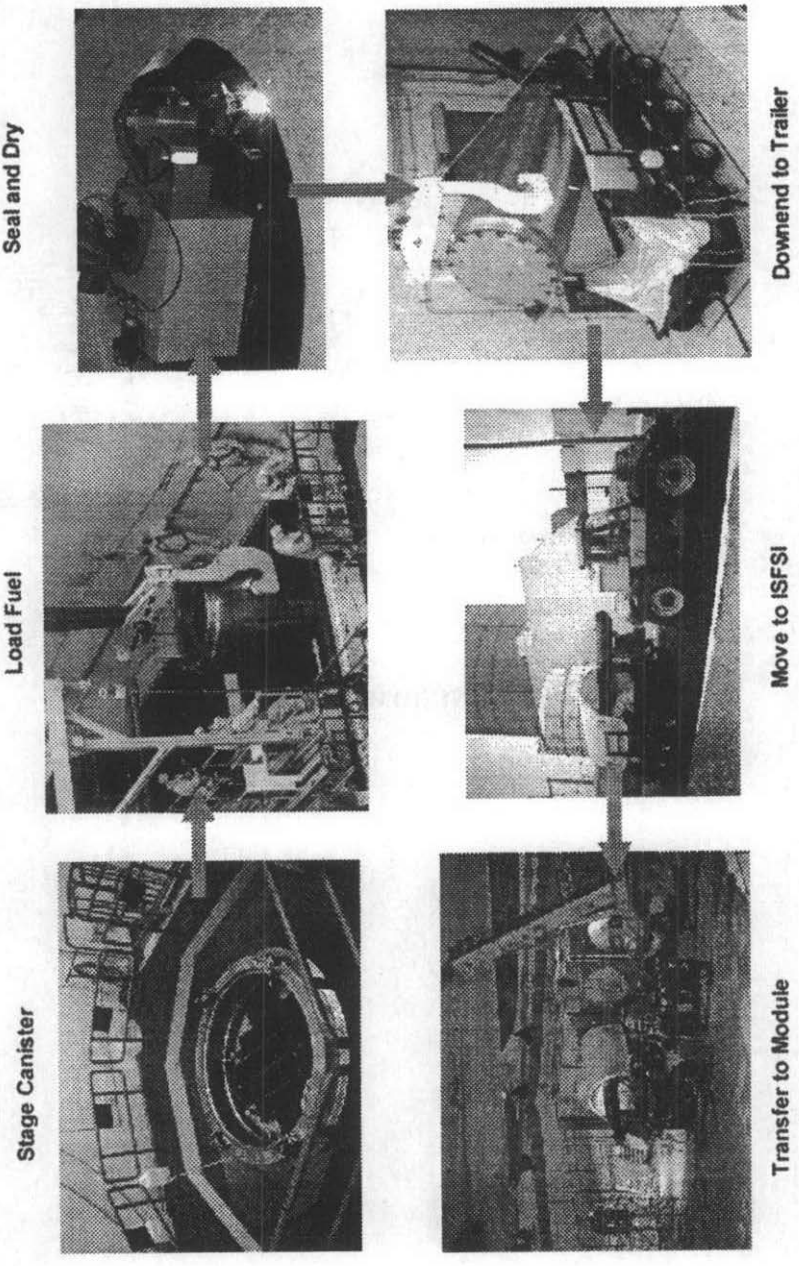

Figure 3, NUHOMS® Standard Operations

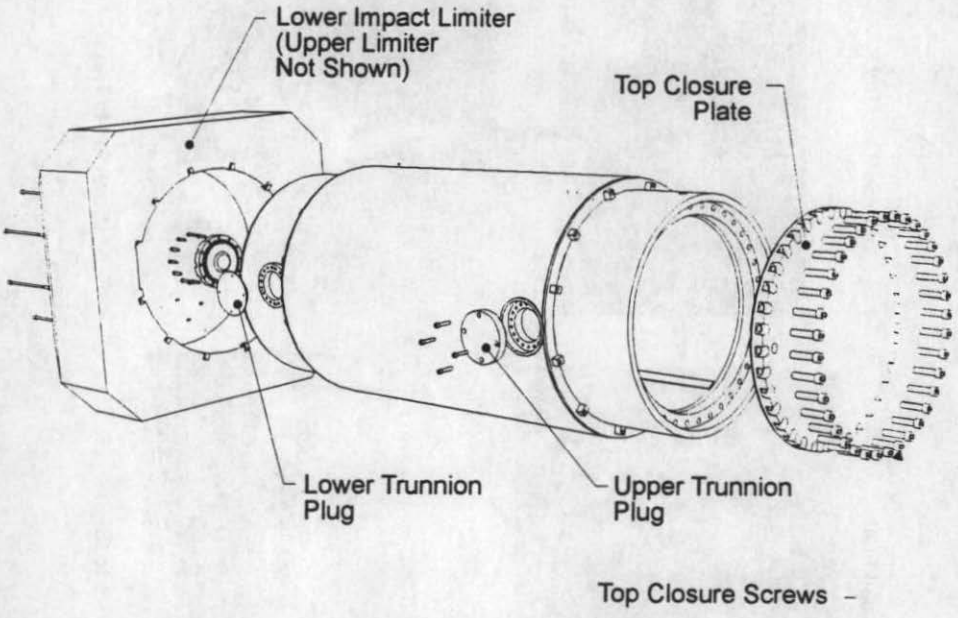

Figure 4, NUHOMS® MP187 Cask

SESSION 3.1

Regulations