GOVERNMENT/INDUSTRY DEVELOPMENT OF A SPENT NUCLEAR FUEL DRY TRANSFER SYSTEM

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SUMMARY

The United States Department of Energy (DOE) is currently engaged in a cooperative program with the Electric Power Research Institute (EPRI) to develop a spent nuclear fuel dry transfer system (DTS). The system will enable the transfer of individual spent nuclear fuel assemblies between a conventional top loading cask and multi-purpose canister in a shielded overpack, or accommodate spent nuclear fuel transfers between two conventional casks. The DTS has several significant applications and could benefit the Federal waste management system and utilities in a number of ways. It has the potential to:

- permit shutdown reactor sites to decommission pools;
- provide capability at interim storage facilities to transfer assemblies from small transportation casks to sealed canisters;
- provide capability at reactor sites with limited crane capacity to transfer assemblies into large packages to facilitate on-site storage in larger capacity casks;
- allow recovery operations at shutdown reactor sites with independent spent nuclear fuel storage installations;
- provide a means for utilities that can presently handle only a truck cask to utilize a rail cask;
- allow transfers of spent nuclear fuel from existing utility dual purpose systems into alternative systems if required, without returning to the reactor storage pool; and
- support existing and future DOE spent nuclear fuel management activities.

The project is managed by a Technical Management Committee consisting of DOE and EPRI representatives and includes a member from Battelle Pacific Northwest National Laboratory.

INTRODUCTION

Research studies by EPRI established the technical and operational requirements necessary to enable the on-site cask-to-cask dry transfer of spent nuclear fuel. Following further evaluations by DOE and National Academy of Sciences, the United States Congress appropriated funds in 1992/93 to develop the DTS and a Transportable Storage Cask. In October 1993, the DOE issued a Cooperative Agreement to EPRI for development of a DTS that was licensable by the Nuclear Regulatory Commission. The Transportable Storage Cask is being developed under a separate Cooperative Agreement with the Sacramento (California) Municipal Utility District.

Transnuclear (TN) Inc. of Hawthorne, New York, was contracted by EPRI to design the DTS. TN selected SGN Reseau Eurisys of France to perform the design and analysis of the mechanical equipment used for cask and fuel assembly handling. SGN has performed equipment and process design for the La Hague spent fuel reprocessing facility and bought that experience to the project. Other principal subcontractors included Foster Wheeler Energy Company of Clinton, New Jersey, and National Technical Service of Acton, Massachusetts. The DTS was designed in accordance with the technical and quality assurance requirements of the Code of Federal Regulations, Title 10, Part 72 (10CFR72). EPRI delivered the final design report to the DOE in December 1995, and the DTS topical safety analysis report in August 1996.

The DOE submitted the DTS topical report to the Nuclear Regulatory Commission in September 1996. It is expected that the Commission will issue a safety report by year-end 1998. A prototype DTS was fabricated based on the EPRI/TN design. That system will be demonstrated with mockup commercial fuel at the DOE Idaho National Engineering and Environmental Laboratory in mid-1998. A five-month test and demonstration program is planned and a final report of findings will be published in December 1998.

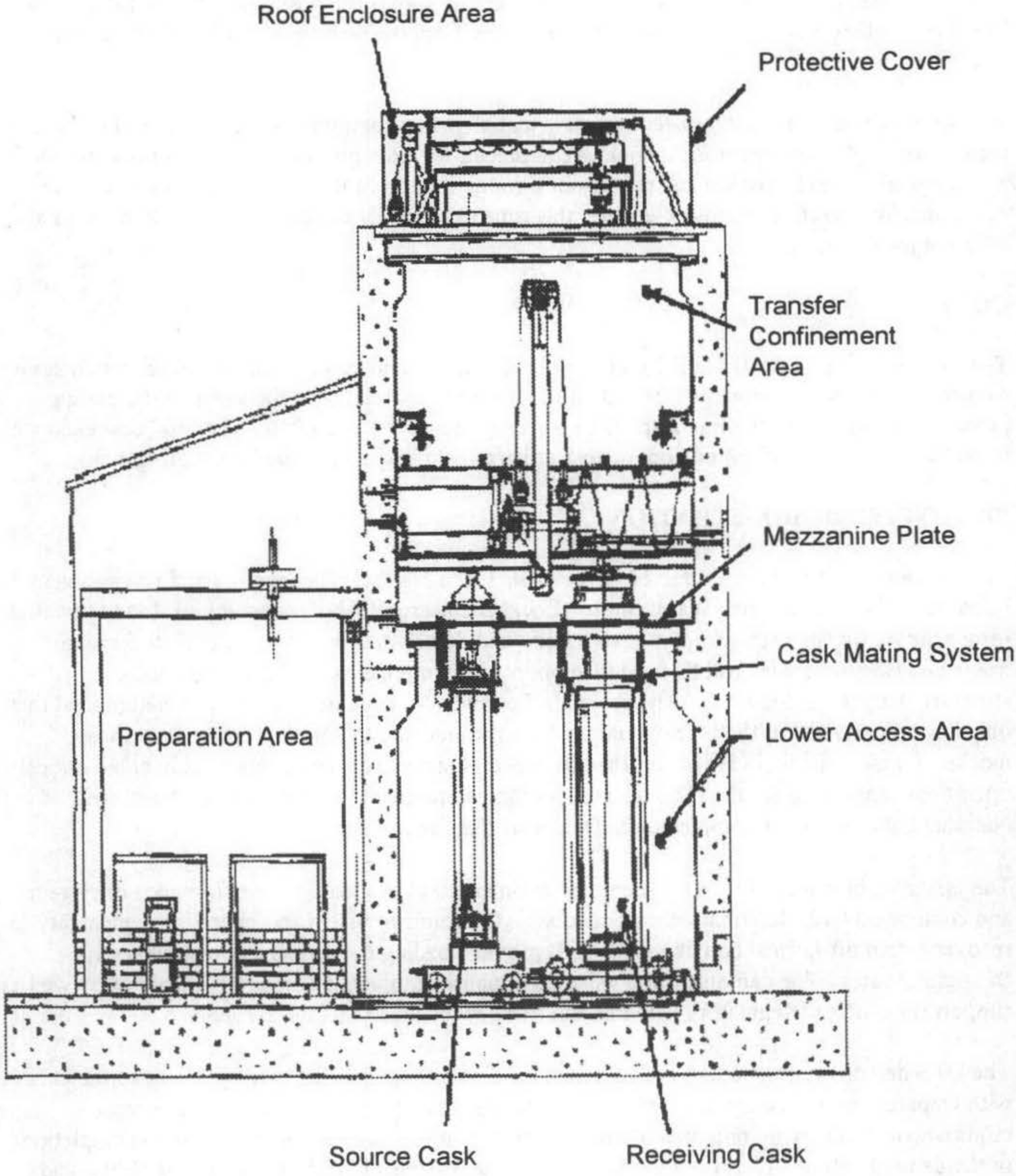
DRY TRANSFER SYSTEM DESCRIPTION

The dry transfer system, depicted in Figure 1, consists of a facility to perform cask preparatory activities and provide shielding during spent nuclear fuel transfer operations.

Appropriate operations and support systems are included. The base dimensions of the facility will be approximately 40x60 feet with a height of approximately 45-50 feet. It consists of a Preparation Area, a Lower Access Area and a Transfer Confinement Area. The Preparation Area is a sheet metal building where casks are prepared for unloading, loading or shipment. The Lower Access Area and Transfer Confinement Area are the first and second floor, respectively, of a concrete cell which has walls approximately 3 feet thick. The sheet metal building abuts the concrete cell which allows casks to be moved into the Lower Access Area from the Cask Preparation Area. A large shield door separates the Preparation Area from the Lower Access Area. The Lower Access Area and the Transfer Confinement Area are separated by a floor containing two portals in which the casks are aligned. The fuel handling machine is located in the Transfer Confinement Area and moves fuel assemblies from one cask to the other. On the roof of the Transfer Confinement Area is a crane dedicated to handling cask shield plugs and lids. The crane can be operated manually for off-normal recovery. The heating, ventilation and air conditioning (HVAC) systems are balanced to ensure airflow from the Preparation Area (uncontaminated) to the Lower Access Area, to the Transfer Confinement Area (potentially contaminated). The control room and HVAC systems are separate from the facility and are envisioned to be portable, i.e., housed in a trailer or van. The transfer operations are performed remotely, however, maintenance on the facility equipment is manual.

The fuel handling machine includes a single fail safe crane and a transfer tube that contains the spent nuclear fuel assembly during the transfer operations. At the bottom of the transfer tube is an "anti-crud device" which closes when the spent fuel assembly is in the transfer tube. The device catches crud during transfer and prevents the spreading of contamination in the Transfer

Figure 1
Cross Section of DTS Design



Confinement Area. When the spent fuel transfer tube is aligned with the receiving cask, the device opens and any accumulated crud falls into the receiving cask, e.g., the MPC. There will be two monitoring systems in the facility to ensure proper grappling of the fuel: (1) a video monitor and (2) a series of switches, to assure that the operator knows the position of the fuel at all times. The fuel handling machine can be operated manually from the facility catwalks for off-normal recovery.

A unique feature of the dry transfer system is that all major components are transportable, except the concrete cell. The spent fuel handling equipment, for example, as well as the floors and roof are designed to be lowered-in and raised-out through the top of the cell. This feature is economically attractive because it enables the same dry transfer system equipment to be used at different locations.

COST

The total estimated cost of the DTS structure, equipment, and systems for operation with a sealed canister system is $5.53 million (1995 dollars). Other costs related to the site-specific design, procurement, and construction of the DTS are estimated to be $825,000. The total cost estimate to build this facility is $7.63 million in 1995 dollars, including a $1.27 million contingency.

PROTOTYPE DEMONSTRATION

The demonstration will be conducted at the DOE Idaho National Engineering and Environmental Laboratory Test Area North Warm Shop. Lockheed Martin Idaho Technologies, Inc has overall responsibility for the DTS prototype fabrication and demonstration. A structural steel space frame and existing cranes will be used to support test components, in lieu of the concrete structure depicted in Figure 1. The project's Technical Management Committee determined that only key components of the DTS would be demonstrated and that initial testing would use mockup commercial fuel. However, the scope and objectives of the demonstration entail critical operations envisioned for the DTS in an operating environment. Battelle Pacific Northwest National Laboratory has completed the Demonstration Test Plan.

The primary objectives of the DTS demonstration are to (1) validate the performance of systems and components, (2) determine design adequacy, (3) confirm system and operational capability to recovery from off-normal conditions, and (4) provide loading cycle time and overall system throughput rates. The demonstration will also establish equipment cost and fabricability as well as support the Nuclear Regulatory Commission's review of the DTS topical report.

The DTS demonstration budget is $4.55 million. The project is being managed in accordance with Department of Energy (RW-0333P) and nuclear industry (NQA-1) quality assurance requirements to facilitate potential use of the equipment in a licensed operation upon completion of the demonstration. Testing of the DTS prototype is expected to begin by June 1, 1998, and continue for five months. The DOE and EPRI will publish final reports in December 1998.

CONCLUSION

Development of the DTS is proceeding favorably. Vendors have not experienced problems with equipment fabrication and costs are within budget. The Nuclear Regulatory Commission's review of the DTS topical report is proceeding and the Commission is monitoring the progress of the prototype demonstration. EPRI has formed a Utility Advisory Group that is also monitoring the demonstration. It is expected that demonstration and current regulatory activities will be completed by year-end 1998 as scheduled.

REFERENCES

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