A Cask Maintenance Facility Feasibility Study

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INTRODUCTION

The Oak Ridge National Laboratory (ORNL) is supporting the USDOE Office of Civilian Radioactive Waste Management (OCRWM) in developing a transportation system for spent nuclear fuel (SNF) and defense high level waste (HLW) as a part of the Federal Waste Management System (FWMS). In early 1988, a feasibility study was undertaken to design a stand-alone, "green field" facility for maintaining the FWMS casks. The feasibility study provided an initial layout facility design, an estimate of the construction cost, and an acquisition schedule for a Cask Maintenance Facility (CMF). The study also helped to define the interfaces between the transportation system and the waste generators, the repository, and a Monitored Retrievable Storage (MRS) facility. The data, design, and estimated costs resulting from the study have been organized for use in the total transportation system decision-making process. Most importantly, the feasibility study also provides a foundation for continuing design and planning efforts.

The feasibility study was based on an assumed stand-alone "green field" configuration because of the flexibility this design approach provides. A stand-alone facility requires the inclusion of all support functions as well as the primary process facilities thus yielding a comprehensive design evaluation and cost estimate. For example, items such as roads, security and waste processing which might be shared with an integrated or collocated facility have been fully costed in the feasibility study. Thus, while the details of the facility design might change, the overall concept used in the study can be applied to other facility configurations as planning for the total FWMS develops.

Fleet servicing facility studies (McCreery 1980), operational studies from current cask system operators (NAC, 1988, TN, 1988), a definition of the CMF system requirements (Attaway, 1988), and the experience of others in the radioactive waste transportation field were used as a basis for the feasibility study. In addition, several cask handling facilities were visited to observe and discuss cask operations to establish the functions and methods of cask maintenance expected to be used in the facility. Finally, a peer review meeting was held at Oak Ridge, Tennessee in August, 1988, in which the assumptions, design, layout, and functions of the CMF were significantly refined. Attendees at the review included representatives from industry, and, DOE and contractor representatives from the repository and transportation operations.

BACKGROUND

The OCRWM cask system will provide approved packages to safely transport SNF and HLW between different facilities. The cask system will consist of (1) several types of casks, (2) associated cask transport vehicles (truck-trailer, railcar, or barge), and (3) any associated ancillary equipment (vacuum drying systems, lifting devices, etc.).

Major OCRWM components and operations are defined; however, much detail information, particularly concerning the cask fleet, remains to be developed. Therefore, the feasibility study relied on generally accepted assumptions as described in the FWMS literature, particularly Generic Requirements for a Mined Geologic Disposal System (Roy F. Weston 1986) and Analysis of Radiation Doses from Operation of Postulated Commercial Spent Fuel Transportation Systems (Schneider 1987).

In addition, several fleet characterization assumptions were based on current efforts at ORNL and in other parts of the OCRWM system. It is assumed the that cask fleet will consist of 75 rail and truck casks (Joy, D. 1988) of at least 12 different designs. It was also assumed that the existing commercial cask fleet will be used during the startup of the FWMS and that these casks may also be processed at the CMF. The average cask will be processed twice annually at the CMF. Larger cask fleets, providing longer lag storage capacity at the repository, have also been postulated. This scenario was not analyzed with respect to the CMF. It should be noted, however, that if maintenance and testing are based on cask use rate, then servicing of the fleet will not vary directly with the total fleet size. Finally, it was assumed that the CMF will not process casks loaded with SNF or HLW. This significantly reduces the operational, design and licensing requirements placed on the facility.

FUNCTIONAL REQUIREMENTS

The mission of the CMF is to maintain casks as required to retain the certificates of compliance (CoC) for each FWMS cask in accordance with 10 CFR Part 71 Packaging and Transportation of Radioactive Material and 49 CFR Part 173 General Requirements for Shipments and Packaging - Authorized Packaging - Fissile Materials. The functions necessary to accomplish this and related tasks will include the following:

- perform routine cask system maintenance such as seal and valve replacement;
- confirm and document continued conformance of the cask with its CoC;
- provide for exchange, storage, cleaning, and other maintenance of contaminated cask components in order to prepare a cask for its next payload;
- clean and decontaminate casks to meet regulatory requirements and/or to facilitate component exchange, repairs, testing, or maintenance;
- rework, repair, or modify cask system components for improved performance, or to comply with a regulatory agency request;
- maintain record documentation, including (1) the CoC, (2) design drawings and specifications, (3) manuals, and (4) procedures;

- prepare cask system components for decommissioning and disposal;
- prepare transport railcar and trailers for off-site maintenance;
- provide storage for spare and temporarily out-of-service cask system components; and
- participate in the resolution of special situations which will periodically occur off-site.

PHYSICAL DESCRIPTION

The proposed CMF will have two major buildings and two vehicle storage areas on a 20-acre fence-secured site (see Fig. 1). The primary facility functions, cask testing and maintenance, will be performed in the process building. Some vehicle maintenance and repair will be performed in the vehicle inspection and bead blast building. Outdoor storage areas will be provided for 15 rail and 15 truck casks. Additional cask storage is available in the operational areas of the process building. Auxiliary cask system equipment, such as lifting yokes, may arrive on separate transporters and will be stored, maintained, and inspected in the process building. A separate loading dock will be provided to prevent auxiliary equipment operations from interfering with cask operations.

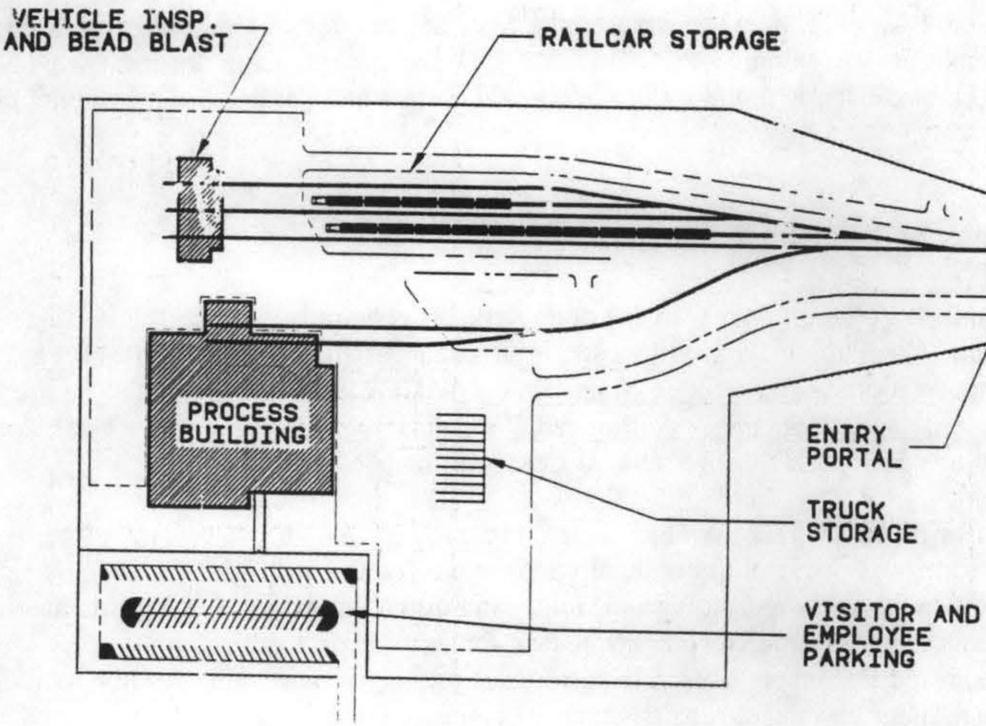

Fig. 1. CMF site plan.

Process Building

The process building is designed as the primary facility on the CMF site (see Fig. 2). It houses all the cask servicing and testing operations as well as the waste processing, shop support, and administration facilities. The layout of the building was developed using cask handling efficiency as the primary criterion and liquid waste handling as the secondary criterion. Cask handling will be accomplished in the central high bay corridor by two 175-ton cranes which will be the primary mode for cask transport. The corridor includes five work stations; (1) cask unloading/loading, (2) cask external cleaning, (3) cask test and maintenance, (4) cask reconfiguration, and (5) auxiliary equipment maintenance and repairs.

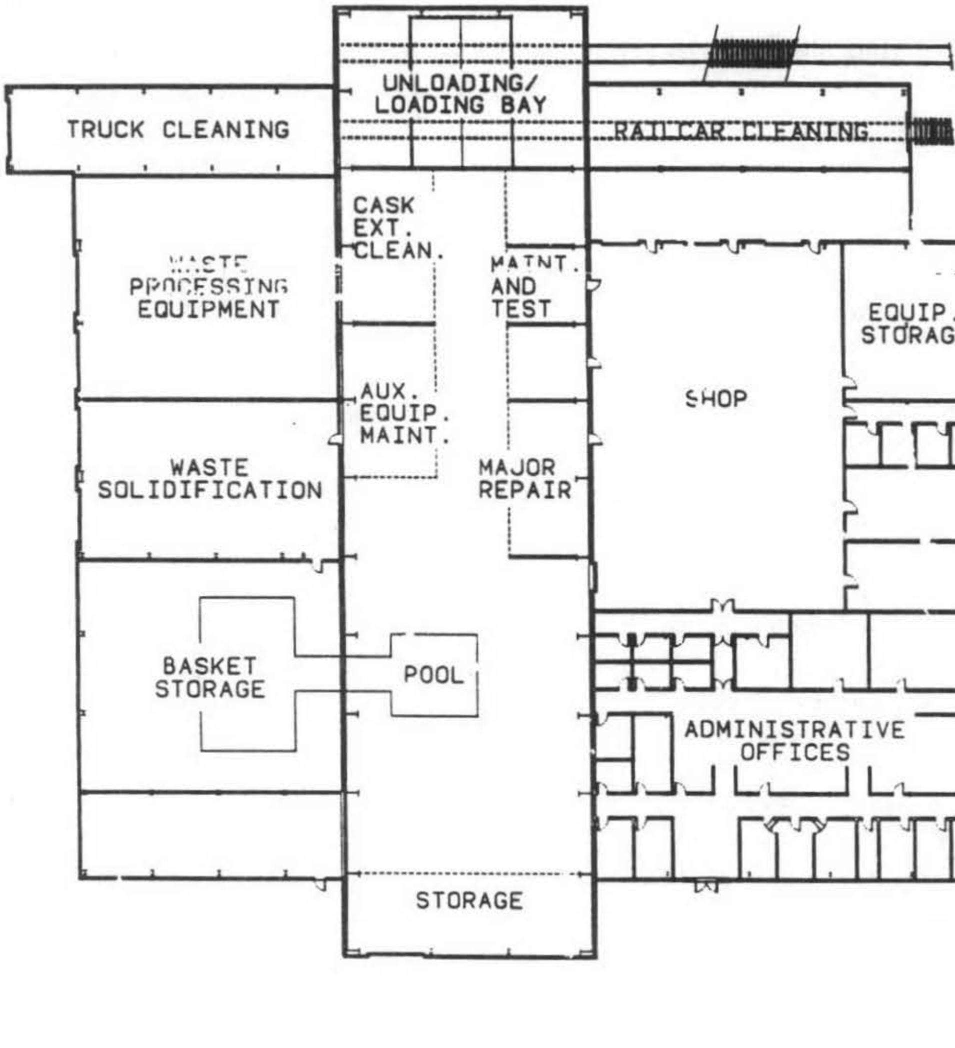

Fig. 2. Process building layout.

Cask operations in the proposed facility would begin when vehicles arriving at the CMF are moved to the process building following a security inspection and a radiological survey. Casks are removed in the unloading/loading bay and empty vehicles are then cleaned in one of the vehicle cleaning bays. The vehicles are then moved to storage or to the vehicle inspection building for inspection and maintenance. Meanwhile, casks are moved to one of the three process stations in the central corridor for external cleaning, maintenance and testing, or reconfiguration. Cask storage and an area for maintenance and testing of auxiliary cask system equipment (such as lifting yokes) are also located in the corridor.

A number of assumptions were used to size the CMF. Some of these are described here. First, the dedicated, 150-ton MRS/repository shipping cask established the capacity of the bridge cranes and high bay building structure. Second, the cask fleet will be composed of 75 rail and truck mounted casks. Third, the average cask will be processed through the CMF twice annually. Fourth, a normal processing time of between 18 and 23 hours was extrapolated from the individual handling times for loading and unloading casks at existing facilities, and from the maintenance experience of the current cask fleet operators; this estimate was used to determine the quantity and size of individual CMF work stations.

The building areas on either side of the high bay will house process support functions, and these areas will not be accessible to the casks. The east wing includes the administration office area, change rooms, and operations support shop. The west wing will house the liquid waste handling and processing equipment. The west wing will also include a pool attached to the high bay pool, for basket storage. A dry inspection booth will be provided between the high bay pool and storage pool for basket inspection and repair.

A dry containment cell, similar to those proposed for unloading casks at the repository, has been considered for cask reconfiguration instead of the proposed pool. A preliminary comparison of this option with the pool concept showed that the dry approach would be more expensive. Furthermore, the dry cell would not adapt well to the wide variety of cask types expected to be processed by the CMF. Because of the complexity of the operational and cost tradeoffs involved with these options, additional study is required. Both the dry cell concept and the pool concept can be accommodated in the proposed process building layout. Therefore, a major revision of the entire CMF layout will not be required to incorporate the dry cell should it be decided that one is required. However, the cost and schedule would be affected.

The proposed CMF process building configuration will permit integration of the CMF into the repository or an MRS without a major change in the facility design. Integrated loading and vehicle preparation facilities would be shared. Thus, cask transfers could be made, both between operations or from the transport vehicles, into either facility. Similarly, the CMF process building lends itself to modification for collocation (rather than integration) without a significant configuration change. Reductions in office and shop requirements as a result of collocation could be easily accommodated, since these areas are housed in areas which are separate from the process operations.

The CMF concept uses manual local control of all operations but does not preclude automation of certain functions. The primary benefit of automation is reduced personnel exposure. Casks received at the CMF will contain neither SNF nor HLW; hence, automation could not be justified at this stage of the design process. Other economic or technical factors may be found in future efforts which would result in an increased level of automation and/or remote control of some operations.

Vehicle Inspection and Bead Blast Building

The vehicle inspection and bead blast facility will be a three-bay service facility designed to perform inspection and maintenance on the cask transport vehicles, trailers, and rail cars, as well as site vehicles and yard tractors. This work will include minor repair, preventative maintenance, pre-shipment inspections, paint removal, and repainting. All major trailer repairs, regularly scheduled railcar maintenance, and truck tractor and rail engine repair and maintenance will be performed off-site by contract vendors. The facility is needed because of the potential for the cask-carrying vehicles to become contaminated, and those vehicles must be decontaminated to an ALARA level before release for non-CMF maintenance work.

COST AND SCHEDULE

The cost of constructing a stand-alone CMF on a "green field" site is estimated to be $83 million in constant FY 89 dollars. This cost includes $8 million for preliminary (expense funded) project activities and $75 million for the capital cost of the facility. Escalated over the project cycle, assuming the start of operations in the first quarter of FY 2003, the total cost becomes $143 million.

An analysis was made of the potential savings in capital project costs that could result from collocation of the CMF with an existing facility rather than on a "green field" (or independent) site. Two different collocation arrangements were considered. One for a site physically adjacent to an existing facility and the other for a CMF located within the perimeter (shared site, same fence) of an existing facility. Based on this cursory evaluation, it was estimated that approximately 10% savings would occur in the case where the CMF shares the same site with an existing facility.

Design and construction of the CMF is estimated to require 110 months (see Table 1) from the start of conceptual design to the start of operations, if the project is pursued as a government-owned, contractor-operated (GOCO) facility. Implementation time could vary significantly, depending upon several factors that were identified during the study as uncertainties. These include potential delays due to regulatory review, constraints resulting from interfaces with other elements of the waste management system, and the management structure selected for the acquisition. It was assumed that all design efforts and the operation of the facility would be accomplished by commercial contractors selected by competitive bid.

Table 1. Estimated CMF project schedule
Duration by Phase

Phase		Duration (months)	
		Incremental	Cumulative
Conceptual design:		22	22
Prepare design criteria	(4)		
Bid and award contract	(3)		
Conceptual design	(15)		
Regulation compliance:		6	28
NRC interaction	(15)[a]		
NRC review	(6)		
Titles I and II Design:		33	61
Prepare design criteria	(6)[a]		
Bid and award contract	(3)		
Title I & II design	(24)		
DOE design verification	(6)		
Construction:		40	101
Utilities & temp. fac.	(17)[a]		
Bid and award contract	(4)		
Construction	(36)		
Testing and startup:		9	110
Testing	(6)[a]		
Testing & cold startup	(9)		

[a]Overlaps with preceding phase.

CONCLUSIONS

The feasibility study concluded that a stand-alone or collocated CMF based on available technology is a good method of accomplishing the missions required to maintain the cask fleet. The study also concluded that a CMF can be designed, constructed and placed into operation within the time frame of full FWMS fleet operations at a cost of approximately $83 million in FY 89 dollars.

The feasibility study report noted the importance of early site selection. Location has a critical effect, not only on the construction details, but the system throughput and coordination. For example, collocation with the repository could significantly change such operations as cask cleaning and cask reconfiguration at both facilities.

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