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PRECONCEPTUAL DESIGN FOR AN MRS TRANSFER FACILITY

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**PRECONCEPTUAL DESIGN
FOR AN
MRS
TRANSFER FACILITY**

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ACRONYMS

ACD	Advanced conceptual design
A/E	Architect/engineering
ALARA	As low as reasonably achievable
BWR	Boiling water reactor
CCTV	Closed circuit television
CDR	Conceptual design report
CFR	Code of Federal Regulation
CMF	Cask Manufacturing Facility
DBA	Design based accident
DOE	Department of Energy
FPC	Final procurement and construction
FTE	Full-time-equivalent
HAW	High activity waste
HEDL	Hanford Engineering Development Laboratory
HEPA	High-efficiency particulate
HLW	High level waste
HTGR	High temperature gas cooled reactor
HVAC	Heating, air conditioning, and ventilation
LA	License application
LLW	Low level waste
MRS	Monitored Retrievable Storage
MTU	Metric tons of uranium
MWD	Megawatt days
NRC	Nuclear Regulatory Commission
NWPAA	Nuclear Waste Policy Amendments Act
OCRWM	Office of Civilian Radioactive Waste Management
OFF	Oldest fuel first
PNL	Pacific Northwest Laboratory
PWR	Pressure water reactor
SFHB	Spent Fuel Handling Building
UL	Underwriters Laboratory
UPS	Uninterruptible power supply

EXECUTIVE SUMMARY

The original purpose of this study was to evaluate the feasibility of building a simple hot cell transfer facility at the Monitored Retrievable Storage (MRS) site to facilitate acceptance of spent fuel into the Federal Waste Management System (FWMS) starting in early 1998. This initial premise was based on the fact that the transfer facility would be an incremental addition to the Store-Only MRS concept, which relied on a larger Spent Fuel Handling Building (SFHB), whose preconceptual design was developed previously for the Task B (Ref. 1) Report of the MRS System Studies. The intent was to develop a preconceptual design for a base case Transfer Facility that could be built in less time than a larger SFHB, thus facilitating earlier acceptance of spent fuel. The Transfer Facility was to serve a two fold purpose: provide a receiving-and-transfer-to storage capability at a relatively low throughput rate [approximately 500 metric tons of uranium per year (MTU/yr)] and provide the recovery capability needed on the site in the event of a transport or storage cask seal failure during a period of about 2 years while the larger SFHB was being completed.

As the development of the base case preconceptual design proceeded, it became obvious that there was a minimum size of facility that would be necessary to provide the required functions with assurance of continued performance, and that this facility would have throughput capabilities greatly in excess of the minimum required to avoid deployment of additional dry storage capacity at the reactors during the first 2 years of system operation. Thus, while the original study basis postulated an incremental addition to the larger, previously considered SFHB MRS configuration, one of the study results (given in Table ES-1) shows that it is very likely that the stand-alone Transfer Facility could receive and store spent fuel at annual rates of 3,000 MTU/yr or more, making the larger SFHB structure unnecessary.

Table ES-1 - Transfer Facility Performance Capabilities

Shifts per Week	Transfer to Storage (MTU/yr)		Building Staff ^a	
	100% Truck	100% Rail	Base Case	Stand-Alone
5	700	- 1,750	53	61
10	1,400	- 3,500	80	90
15	2,100	- 5,250	107	119
21	2,940	- 7,330	134	148

^aStaff required for Transfer Facility and interim storage only; does not include site support staff.

In addition, the study analyses showed that the stand-alone Transfer Facility could be constructed and put into service in less than 60% of the time required to construct the SFHB (15-17 months versus 28 months), and would cost roughly 75% as much as the SFHB (not including support facilities common to both concepts), as shown in Table ES-2.

Because the stand-alone Transfer Facility can be constructed more quickly, costs less, and has a receiving and storage capability equivalent to the SFHB, the stand-alone Transfer Facility is recommended as the preferred concept for providing the spent fuel receiving and transfer to and from storage operations that are the functions of the MRS facility.

Table ES-2 - Comparison of Stand-Alone Transfer Facility and SFHB Construction Costs (\$ million) and Schedules

Cost Element	Stand-Alone Transfer Facility	Spent Fuel Handling Building
Management and Integration	\$129.5	\$147.0
Cask Operations	\$ 7.0	\$ 7.0
Waste Handling Operations	\$ 66.4	\$ 89.2
Interim Storage Operations	\$ 1.6 ^{a,b}	\$ 9.3 ^b
Balance of Plant	<u>\$125.2^c</u>	<u>\$125.2^c</u>
Total Cost	\$329.7	\$377.7
Construction Period	18-20 months	28 months

^aIf transportable metal casks are to be received and stored, Interim Storage Operations cost is increased by \$4.5 million.

^bCosts include construction of pads for 90 casks, storage cask transporters, and placement equipment. Storage cask costs are assumed to be a consumable item and are not included in these costs.

^cCosts based on original MRS Conceptual Design Report, not adjusted to reflect reduced operational functions at the Transfer Facility.

DESIGN BASIS

The arrangement, cost, schedule, operations, and throughput for the base-case Transfer Facility is based upon an oldest-fuel-first (OFF) allocation and acceptance priority. The OFF allocation established a worst-case fuel distribution of 45 wt% PWR/55 wt% BWR and a modal mix of 88% truck and 12% rail casks for the 500 MTU throughput years. For the 900 MTU throughput years, the worst-case OFF allocation established a fuel distribution of 56 wt% PWR/44 wt% BWR and a modal mix of 88% truck and 12% rail casks. In addition, the facility is configured to accept only the Office of Civilian Radioactive Waste

Management (OCRWM) program-designed casks with a truck cask capacity of 4 FWR or 9 BWR assemblies or a rail cask capacity of 21 FWR or 52 BWR assemblies.

REPORT FORMAT

Cost and operating data were developed and presented in the same format as the Task B Report and the requirements of the Total System Life Cycle Cost Program. The data sheets reflect only those costs associated with the deployment of the base case Transfer Facility and are additive to that shown for Scenario 3, Single Phase Construction, cask storage concept of the Task B Report.

BASE CASE DESIGN

The base case Transfer Facility provides only those functions, spaces, and materials of construction which are essential for a 2-year operation. Therefore, where possible, temporary alternatives are used for operational support until the SFHB is operational for steady-state MRS operations. The temporary alternatives included the storage of liquid and solid radwaste; housing of Transfer Facility operational administrative personnel, conference room, and lunch room in a temporary prefabricated mobile trailer located adjacent to the Transfer Facility; use of other onsite support facilities for laundry services; and the use of special coating in lieu of stainless steel liners in the spent fuel handling areas.

The constructed value (in 1990 dollars) of the base case Transfer Facility is estimated to be \$48 million, including the required enlargement to the SFHB receiving bay and a straddle carrier for storage cask handling. The construction costs were developed from material takeoffs from the preconceptual design, allocations based on facility areas, and historical cost data developed for the MRS CDR and Task B Report.

The design duration of the base case Transfer Facility from design start to initiation of licensing activities is estimated to be 17 months. Since a one-step MRS licensing process has been assumed, the initiation of the licensing process cannot commence until the 27-month SFHB license design phase has been completed. The licensing process is assumed to be completed in 28 months, at

which time the MRS construction activities are initiated. The construction duration of the base case Transfer Facility is estimated to be 17 months, using a single-shift, 5-day/week operation. This schedule can be reduced to 15 months if a two-shift, 5-day/week operation is utilized for concrete placement. Therefore, the total schedule duration of the MRS from start of design to receipt of spent fuel (assuming cold testing to be completed 2 months after construction completion) is estimated to be 72 to 74 months.

To achieve the OFF throughput of 500 MTU/yr, the base case Transfer Facility will require a staff of 53 operations personnel working 5 shifts/week. To achieve the OFF throughput of 900 MTU/yr, the facility will require a staff of 80 operating personnel working ten shifts/week.

ALTERNATIVE EVALUATIONS

In addition to the base case requirements, three other variations to the base case requirements were evaluated. These variations included the impact on Transfer Facility performance if canistered spent fuel was received, feasibility of prefabrication of transfer cell elements to minimize construction duration of the Transfer Facility, and the feasibility of modular expansion of the Transfer Facility to achieve the full spent fuel receiving/handling capability of the MRS.

It was concluded that no modifications to the Transfer Facility arrangement would be required for the receipt and handling of canistered spent fuel, provided the canisters have essentially the same spatial configuration as the spent fuel.

The critical path for construction is controlled by the pouring and curing times for the hot cell concrete. Several alternative ways of assembling the hot cell were considered, but none proved to be viable. Prefabricated building elements are already planned in construction of other portions of the facility, to the extent practicable. Thus, it appears unlikely that any significant construction time could be saved by the use of additional prefabricated building elements.

In addition to the base case transfer facility concept, an evaluation was conducted to determine the feasibility of

utilizing one or more transfer facilities for all MRS waste handling operations. The number of facilities (modules) is contingent upon the maximum receipt/shipping rates, modal mix, transportation cash configuration, and the distribution of the types of assemblies handled. To provide full capability for long term operations, the stand-alone arrangement requires the addition of a liquid and solid radwaste treatment system, and permanent personnel, and administrative support services. Therefore, the proposed modular concept is a pair of transfer facilities, one configured for full operational capability and the other using the base case configuration, sharing a common receiving bay.

The constructed value of the full capability transfer facility module is estimated to be \$66.4 million and an additional \$1.0 million for the storage cask transporter (straddle carrier).

It is estimated that the duration from design start through licensing design is the same (17 months) as required for the base case design. The construction duration for the stand-alone concept is estimated to be 18 to 20 months for single- or two-shift concrete placement operations, respectively.

Depending upon the fuel distribution, modal mix, and number of shifts and assuming the use of the OCRWM designed-casks, the throughput of a single stand-alone facility is capable of handling 700 to 7,330 MTU/yr.

SECTION 1

INTRODUCTION

The Nuclear Waste Policy Amendment Act (NWPAA) instituted a number of changes in The Department of Energy (DOE) commercial nuclear waste management system. After passage of the Act, the DOE initiated and completed a study, MRS Action Plan Task B Report, Analysis of Alternate Designs and Operating Approaches for a Monitored Retrievable Storage Facility, PNL-6770, which presents the designs, costs, and schedules associated with various operating scenarios. Subsequently, the DOE initiated a study to determine the feasibility of a simplified spent fuel transfer facility which can be constructed in minimal time to facilitate spent fuel acceptance in 1998. This report summarizes the results of that study.

1.1 STUDY OVERVIEW

The contract between the DOE and the utilities specifies that the DOE will receive spent fuel from the nuclear utilities in 1998. This study investigates the feasibility of employing a simple Transfer Facility which can be constructed quickly, and operate while the full-scale MRS facilities are being constructed. The Transfer Facility is a hot cell designed only for the purpose of transferring spent fuel assemblies from the Office of Civilian Radioactive Waste Management (OCRWM) transport casks (shipped from the utility sites) into onsite concrete storage casks. No operational functions other than spent fuel assembly transfers and the associated cask handling, opening, and closing would be performed in this facility. Radioactive waste collected in the Transfer Facility during operations would be stored until the treatment facilities in the full-scale MRS Facility became operational, approximately 2 years after the Transfer Facility started operation.

An alternate wherein the Transfer Facility was the only waste handling building on the MRS site was also examined and evaluated.

1.2 FULL-SCALE MRS FACILITY DESIGN

The overall site arrangement and support facilities for this study are derived from the Scenario 3, Single Phase Construction, cask storage concept presented in the referenced Task B Report and summarized in this section. This scenario provided for a Spent Fuel Handling Building (SFHB) for all steady-state waste handling operations and assumed an independent facility which provided all administrative, personnel, security, and utility support required for a stand-alone operation. The cost and operational data for these support facilities contained in the Task B report, when added to the incremental costs associated with the Transfer Facility, provide the life cycle costs of an MRS Facility that includes the Transfer Facility.

The completed store-only MRS Facility design presented in the Task B Report included all infrastructure, facilities, and equipment required to routinely receive, unload, prepare for storage, and store spent fuel, and to externally decontaminate and return shipping casks received by both rail and truck. The MRS facility included all supporting facilities to make it a self-sufficient installation, to be licensed by the Nuclear Regulatory Commission (NRC) under Part 72 of the Code of Federal Regulations (10 CFR 72).

The overall site plan was composed of four distinct areas: the primary limited access area; the facility protected area; the storage area; and an additional limited access industrial area, which was required for the Cask Manufacturing Facility for the sealed concrete storage cask, and was adjacent to the primary limited area and the facility protected area.

The limited access area(s) contained the facilities and services (administration, security, cold maintenance, utilities, emergency response, and industrial) required to support the waste handling and storage operations. It was enclosed within a single fence which provided controlled access, via a manned gatehouse, for personnel, offsite vehicles, and nonradioactive materials. The following is a summary of the limited area buildings provided and their functions:

- (1) Administration Building: Contains offices and support areas for operation, quality assurance, health physics, accountability, State and Federal officials, and general site administration.
- (2) Site Services Building: Contains offices, shop areas for site (cold) maintenance, shielded transfer cell mockup, and redundant process computer.
- (3) Warehouse: Contains nonradioactive bulk materials and equipment.
- (4) Vehicle Maintenance Building: Contains repair facilities for onsite vehicles (trucks, cars, cask transportation, and rail equipment).
- (5) Security Building: Contains security force administration and a redundant hardened alarm monitoring station.
- (6) Main Gate/Badgehouse: Contains security station, including security-related monitoring equipment, for personnel and offsite vehicle access control into the limited area.
- (7) Protected Area Gatehouse: Contains security station for personnel and vehicle access from the limited area to the protected area, the primary alarm monitoring station, and the personnel monitoring station.
- (8) Fire Station: Contains administration, central fire alarm and dispatch station, vehicle storage, and central first-aid station.
- (9) Water Treatment Facility: Contains water supply system and firewater pumps.
- (10) Sewage Treatment Plant: Contains sewage treatment system.
- (11) Cask Manufacturing Facility: Contains bulk cask material storage, concrete batch plant, and cask casting and curing facilities.

The protected area contained the SFHB and other related support services. This area was enclosed within a double fence and was equipped with surveillance and detection devices in accordance with the requirements of 10 CFR 73 and DOE Order 5632, Chapter III. Support buildings in the protected area included:

- (1) Inspection Gatehouse: Contains security/inspection station for shipments of radioactive materials into or out of the protected access area.
- (2) Storage Facility Gate Station: Contains access control from the protected area to the Storage Facility.
- (3) Standby Generator Building: Contains standby generator and normal and standby switchgear.

The storage area was separated from the SFHB and the other support buildings in the protected area by a single fence.

The total facility was designed to limit direct radiation exposure of onsite and offsite personnel within the limits established in 10 CFR 72, 10 CFR 20, 40 CFR 191, DOE Order 5480.1B, and other applicable regulations in force at the time of publication of the MRS Conceptual Design Report (CDR). The design also included the application of As Low As Reasonably Achievable (ALARA) principles to the facility design and the operating philosophy. DOE Order 5480.1B requires, as a design objective, that operating-personnel exposure levels shall be less than one-fifth of the permissible dose equivalent limits promulgated by the order.

Radioactive waste treatment systems were also included for the treatment, solidification, storage, and shipment of radioactive wastes generated at the MRS Facility. All potentially contaminated effluent streams were treated and monitored before release to meet the environmental requirements of 10 CFR 20, 40 CFR 191 (1983) and DOE Order 5480.1B.

Spent fuel storage facilities were capable of attenuating the radiation and dissipating the heat generated by a peak burnup of 55,000 megawatt days (MWD) per metric ton of uranium (MWD/MTU) for PWR fuel. Spent fuel was assumed to be at least 5 years out of reactor. The storage configuration was capable of maintaining

spent fuel cladding surface temperatures below 375°C in an inert-gas environment.

The design life of the SFHB Building was 50 years, maintainable or replaceable to extend life to at least 100 years, irrespective of licensing intervals. The design life of the storage facilities was 100 years. The design life of supporting facilities was normally 30 years.

1.3 REPORT FORMAT

Criteria and assumptions which are specific or which apply to supporting functions for the Transfer Facility are presented in Section 2.

Data developed for the study are typically derived from a common basis. The approach to developing the data for the study is presented in Section 3. This section also addresses the data format, cost data development, and design and construction schedule development.

Section 4 presents a discussion of the operations and design of the Transfer Facility; the associated life cycle cost data; design, licensing, and construction schedule; and long-lead items list.

The preconceptual Transfer Facility and site drawings are included in the appendix.

A description of the construction schedule durations and long-lead item procurement times for the supporting buildings/services required for Transfer Facility operations is presented in Section 5.

Section 6 presents the health and safety considerations applicable to the Transfer Facility operations.

In addition to the base scenario, three analyses were performed to provide modifications to or specific variations in the Transfer Facility design. These studies, included in Section 7, are as follows:

- (1) The impact of canistered fuel receipt on Transfer Facility design performance.
- (2) Feasibility of modular expansion of the Transfer Facility to achieve the full spent fuel receiving/handling capability of the MRS.
- (3) Feasibility of offsite prefabrication of portions of the transfer cell to facilitate rapid construction.

1.4 REFERENCE DOCUMENTS

The following reference documents were used in the development of this study:

- (1) Pacific Northwest Laboratory, MRS Action Plan Task B Report: Analyses of Alternative Designs and Operating Approaches for a Monitored Retrievable Storage Facility, PNL-6770 UC-70, December 1988.

Used for MRS facility baseline configuration.

- (2) The Ralph M. Parsons Company of Delaware, Integral Monitored Retrievable Storage (MRS) Facility Conceptual Design Report, MRS-11, September 1985.

Used for cost and facility configuration data.

- (3) Westinghouse Hanford Company, Conceptual Design Report for a Remotely Operated Cask Handling System, HEDL-7376 TTC-0449 Rev. 1, September 1984.

Used for cask-handling robotics space envelope and cost data.

- (4) The Department of Energy, Richland Operations Office, Statement of Work for Preliminary Concept Development: Considerations for the Preconceptual Design for an MRS Transfer Facility, May 31, 1990.

Used for criteria development and facility requirements.

- (5) The Ralph M. Parsons Company, Procurement Outlook Second Half - 1990, April 1990.

Used for procurement lead times.

- (6) Kaiser Engineers, Hanford, Material and Labor Escalation Study, January 1990.

Used for material escalation rates.

SECTION 2

GENERAL CRITERIA AND ASSUMPTIONS

To provide a basis for the preconceptual design of the Transfer Facility, the following requirements were established for this study.

2.1 CRITERIA

The criteria and assumptions used for this study are based on those contained in the "Statement of Work for Preliminary Concept Development: Considerations for the Preconceptual Design for an MRS Transfer Facility", dated May 31, 1990. Additional assumptions, as presented for the Single Phase Scenario 3 (Spent Fuel Handling Building) of the Task B Report, were also used where applicable.

The following sections contain the criteria used for this study.

2.1.1 REGULATIONS

The Transfer Facility will be licensed as an integral part of the MRS Facility under NRC regulation 10 CFR 72. In addition, the design shall comply with DOE Orders and applicable industry codes and standards.

2.1.2 WASTE CHARACTERISTICS

Waste to be received by the Transfer Facility will fall within the following envelope of characteristics:

- (1) The distribution of PWR/BWR fuel received will average about 60 wt% PWR/40 wt% BWR, with annual receipt distributions ranging from about 70/30 to 45/55 in any given year. However, the receipt distribution shown in Paragraph 2.1.3 shall be used to establish base case facility receipt requirements and staffing.
- (2) Peak fuel burn-up is 55,000 MWD/MTU.

- (3) All spent fuel shall have decayed for at least 5 years.
- (4) Average content per assembly is 0.43 MTU for PWR and 0.18 MTU for BWR.
- (5) All spent fuel is bare, intact; the quantity of at-reactor consolidated fuel is negligible.
- (6) Vitrified defense high level waste (HLW), commercial (West Valley) HLW, or commercial HLW will not be received by the Transfer Facility.

2.1.3 TRANSPORTATION

Transportation interfaces and analyses are based on the following:

- (1) All shipments from an MRS are by rail.
- (2) Spent fuel from reactors to the MRS is shipped in truck or rail casks, depending on the cask handling capability of the specified reactor.
- (3) Truck casks will contain either 4-PWR or 9-BWR intact fuel assemblies.
- (4) Rail casks will contain either 21-PWR or 52-BWR intact fuel assemblies.
- (5) Maximum loaded cask weight, without the lifting yoke, is 150 tons.
- (6) Arriving spent fuel will average about 60 wt% by truck and 40 wt% by rail at the design receipt rate of 500 MTU/yr. Base case receipt rates to be used for design are based on an oldest-fuel-first (OFF) allocation and acceptance priority are shown in Table 2-1.
- (7) BWR fuel assemblies received at the Transfer Facility will be assumed to have flow channels attached.

Table 2-1 - Number of Transport Casks Received Annually
Under the Oldest-Fuel-First Allocation for
Receipt Rates of 500, 500, 900 MTU/yr^a

YEAR	FUEL TYPE	MTU/YR DELIVERED (b)	NO. OF ASSEMBLIES (c)	ANNUAL CASK RECEIPTS		
				TRUCK	RAIL	TOTAL
1998	PWR	227	600	87	12	
	BWR	294	1691	55	23	
	TOTAL	521	2291	142	35	177
1999	PWR	247	670	136	6	
	BWR	299	1650	62	21	
	TOTAL	546	2320	198	27	225
2000	PWR	580	1391	227	23	
	BWR	380	2064	108	21	
	TOTAL	960	3455	335	44	379
2001	PWR	467	1107	152	24	
	BWR	493	2623	147	25	
	TOTAL	960	3730	299	49	348
2002	PWR	651	1537	232	29	
	BWR	288	1501	109	10	
	TOTAL	939	3038	341	39	380
2003	PWR	569	1342	178	30	
	BWR	374	2215	148	17	
	TOTAL	943	3557	326	47	373
2004	PWR	536	1250	197	22	
	BWR	424	2253	129	21	
	TOTAL	960	3503	326	43	369
2005	PWR	498	1173	183	21	
	BWR	445	2393	185	14	
	TOTAL	943	3566	368	35	403
2006	PWR	569	1342	157	34	
	BWR	384	2069	97	23	
	TOTAL	953	3411	254	57	311
2007	PWR	628	1450	184	34	
	BWR	348	1905	125	15	
	TOTAL	976	3355	309	49	358

- (a) Data derived from PNL Spent Fuel Data Base, on reactor-by-reactor basis.
(b) Number of MTUs rounded to nearest integer value.
(c) Number of assemblies in fully loaded cask shipments (cask roundup).

2.1.4 MRS OPERATION

The following criteria relate to the MRS Facility storage capacity, storage mode, operation, and costing:

- (1) Per the NWPAA, the maximum onsite storage capacity is 15,000 MTU.
- (2) The storage mode is ventilated concrete storage casks.
- (3) The concrete storage cask envelope is as presented in the Integral MRS Facility Conceptual Design Report (CDR).
- (4) The minimum receipt rate is 500 MTU/yr., excluding spent fuel received in transportable storage casks, utilizing an operational schedule of a maximum of three shift/day, 5 day/week.
- (5) Only intact spent fuel assemblies and/or canistered fuel that satisfies the definition of Standard Fuel under the 10 CFR 961 contract will be handled in the Transfer Facility. Receiving and shipping may be carried on concurrently; however, the cumulative throughput for both activities shall not exceed the minimum design throughput for receiving alone, i.e., 500 MTU/yr.
- (6) The Transfer Facility shall provide a location where a cask (transport or storage) that showed evidence of some problem with the integrity of the cask seals or of the contained spent fuel could be taken to affect appropriate repairs or other necessary actions to ensure safeguarding the health and safety of the public and the site workers.
- (7) The Transfer Facility hot cell shall provide a dedicated port for storage cask operations.
- (8) The Transfer Facility shall contain bridge cranes for port plug handling and spent fuel transfers. The bridge cranes shall be equipped for remote operations. Provisions shall be made for a shielded area for crane maintenance.

- (9) The cask(s) receiving, preparation, and unloading areas shall be equipped with remote/automated equipment for cask preparation and unloading.
- (10) A in-cell lag storage capability shall be provided to accommodate the contents of one concrete storage cask.
- (11) The Transfer Facility shall provide the capability for decontamination of transport cask interiors, the exteriors of all casks, and for the transfer cell interior.

2.2 ASSUMPTIONS

In addition to the criteria stated in Subsection 2.1, the following assumptions were made to permit timely completion of the study.

2.2.1 MRS OPERATIONS

The following assumptions relate to MRS material handling operations and storage modes:

- (1) Concrete storage cask can accommodate 32-PWR or 80-BWR bare intact assemblies.
- (2) Remote-handled (greater than Class C) waste will not be produced within the Transfer Facility.
- (3) Maximum allowable opening in the Transfer Facility hot cell floor that will maintain the required air zone pressure differential is 100 sq. ft.
- (4) The target value for remotely-operated equipment use is 70%, to allow time for tool changeout, off-normal event recovery, and periodic maintenance and testing.
- (5) Time to perform incremental operations is based on Design Study 2 of the MRS CDR.

- (6) All facilities required to support the Transfer Facility operations (administrative, infrastructure, security, utilities, storage area, maintenance) will be constructed and operational upon initial receipt of waste.
- (7) The Cask Manufacturing Facility will be operational and an adequate supply of storage casks available upon startup of Transfer Facility operations.
- (8) The Receiving, Inspection, and Shipping bay of the SFHB will be constructed and operational upon initial receipt of waste.
- (9) The SFHB will be the primary operating building in the steady-state operation of the MRS Facility.
- (10) The SFHB will be constructed in parallel with the Transfer Facility and be completed and operational within 30 - 40 months following start of construction.
- (11) Any transportable metal storage casks delivered to the MRS site will not be unloaded at the Transfer Facility. The transportable storage casks will be transferred from the transport carrier and loaded onto an onsite trailer for transfer to the storage area.
- (12) All liquid radwaste generated within the Transfer Facility will be stored and transferred to a future onsite radwaste treatment facility. For the purpose of this study, the quantity of liquid radwaste generated within the Transfer Facility will be prorated from that estimated for the 3,600-MTU/yr facility presented in the MRS CDR.
- (13) Upon removal, all contaminated HEPA filters will be placed, without compaction, into containers for temporary onsite storage.
- (14) The facility arrangement and ventilation system will provide for a two-zone confinement system.

2.2.2 MRS COSTS

The following assumptions relate to cost data developed for this study:

- (1) Labor rates, escalated to 1990 dollars, and productivity factors will be as presented in the MRS CDR.
- (2) Subelement costs related to engineering, construction management, program management, etc., will be calculated as a percentage of constructed value.
- (3) A contingency factor of 30% will be applied to all costs for the Transfer Facility.
- (4) Cask handling robotic costs will be obtained from that presented in HEDL-7376 and escalated to 1990 dollars.
- (5) The frequency of HEPA filter changeout to be used for life cycle cost data is presented in Table 2-2.

Table 2-2 - HEPA Filter Changeout Frequency

Filter Location	Frame	Frequency (months)
Contaminated Area (nontestable)	Stainless Steel	12
Zone I and II	Wood	18
General Exhaust	Wood	24

- (6) Decommissioning costs will be a percentage of constructed value. The percentages to be used are 12% for contaminated facilities/items, 5% for potentially contaminated facilities, and 1% for uncontaminated facilities.

- (7) Costs associated with the transportation system and its components and those associated with the disposal of low level waste (LLW) packages will not be included in the cost data presented in this report.
- (8) Only the schedules and costs associated with the Transfer Facility will be considered for this study.
- (9) Cost estimates will be in 1990 dollars, requiring the Task B Report Costs of like equipment items to be adjusted by the following factors:

<u>Cost Estimate Date</u>	<u>Material</u>
1988 to 1989	7.0%
1989 to 1990	6.6%

2.2.3 MRS SCHEDULES

The design, construction, and operating schedules developed for the study are based on the following:

- (1) The Transfer Facility will require the preparation of an advanced conceptual design (ACD) prior to license application (LA) design.
- (2) Sufficient specific site design data will be available 6 months after start of site investigation.
- (3) Construction activities for critical elements of the Transfer Facility (such as concrete placement) can be performed on a two shift/day, 5 day/week basis, if required.
- (4) Adequate construction personnel will be available at the jobsite.
- (5) Labor contracts will be in place for the duration of construction activities.
- (6) No major delays (greater than one week) will be encountered because of weather.

- (7) Long-lead items will be procured prior to start of construction and will be delivered onsite in accordance with installation schedule milestones.
- (8) NRC license application review and approval is assumed to take 20 months.

SECTION 3

STUDY APPROACH

The objective of this study is to develop the cost, schedule, and operational data associated with the addition of a Transfer Facility to the store-only MRS design (Scenario 3) developed in the Task B Report. Similar data is provided for deletions, modifications, or additions to other MRS buildings/ services, if required, to support the Transfer Facility during its operation.

Cost centers are defined relative to major functions. Each cost center is divided into subtier cost centers and/or cost elements to permit a more detailed evaluation of the functional variations. The cost centers used in the study are defined in Subsection 3.1 and are consistent with those established for the Task B Report.

Design, capital construction, and operating costs were developed and were allocated to the appropriate cost centers and, as required, cost elements. The basis of the costs are described in Subsection 3.2.

Schedules reflecting design, licensing, and construction durations were also developed. A discussion of the schedule basis is presented in Subsection 3.5.

3.1 COST CENTER DEFINITIONS

Five major cost centers are used for the allocation of costs:

- (1) Management and integration
- (2) Cask operations
- (3) Waste handling operations
- (4) Interim storage operations
- (5) Balance of plant and support operations

The following sections describe the basic functions and/or buildings associated with these cost centers.

3.1.1 MANAGEMENT AND INTEGRATION

The management and integration cost center encompasses all activities applicable to the Transfer Facility (except construction), prior to the initiation of full operation. The cost elements of the management and integration cost center are:

- (1) Design, including proof-of-principle tests, advanced conceptual design, license application design, licensing support, final procurement and construction design, and engineering support during construction (Title III support).
- (2) Operating contractor support during design and construction.
- (3) Construction management.
- (4) Preoperational testing and personnel training.

The costs shown reflect only those efforts required for the inclusion of a Transfer Facility. These costs are in addition to those presented in the Task B Report.

3.1.2 CASK OPERATIONS

The cask operations cost center includes the buildings or facility areas required to receive, inspect, and inventory incoming waste casks and transporters; provide onsite storage prior to release of empty or filled casks from the site; and to release a shipment from the site.

No additions or deletions from that shown in the Task B Report to this cost center are required for the inclusion of the Transfer Facility.

3.1.3 WASTE HANDLING OPERATIONS

The waste handling operations cost center includes two subtier cost centers, each accommodating the initial and steady-state operations modes of the MRS Facility. Primary functions deleted from or added to the overall MRS operating modes affect one or

more of the subtier cost centers; therefore, these subtier cost centers contain more detailed cost elements.

3.1.3.1 Spent Fuel Handling Building

For this study, it is assumed that the SFHB will be the steady-state operational mode of the MRS Facility. As noted in Table 4-4, the cost elements of this subtier cost center are:

- (1) Cask unloading
- (2) Assembly lag storage
- (3) Processing (fuel handling)
- (4) Interim storage loading and unloading
- (5) Building support facilities

For Transfer Facility operations, the SFHB configuration requires modification to the cask unloading element to:

- (1) Provide sufficient truck cask handling space to accommodate SFHB and Transfer Facility operations
- (2) Provide interim storage of contaminated cask/carrier wash water until the SFHB waste treatment system is operable

The increase in facility cost for the SFHB cask unloading cost element is reflected on Table 4-4. No other modifications to the SFHB or its cost elements are required.

3.1.3.2 Transfer Facility

The Transfer Facility receives casks containing spent fuel for unloading. The spent fuel is transferred directly into concrete storage casks. The following cost elements of the Transfer Facility subtier cost center are:

- (1) Cask unloading
- (2) Assembly lag storage
- (3) Processing (fuel handling)
- (4) Interim storage loading, including the storage cask transporter
- (5) Building support facilities

If a Transfer Facility is utilized as the initial MRS waste handling building, the costs presented for this subtier cost center are in addition to those shown in the Task B Report.

3.1.4 INTERIM STORAGE OPERATIONS

The interim storage operations cost center includes the storage structures and/or site improvements associated with radioactive waste material storage external of the Transfer Facility. If transportable metal storage casks are received at the MRS, they are transferred from their transportation carrier to an onsite transporter, and delivered to the storage yard.

The Task B Report provides unit costs for the cask storage operations. These costs are directly applicable to the Transfer Facility operations; therefore, no additions or deletions to this cost center are required.

3.1.5 BALANCE OF PLANT AND SUPPORT OPERATIONS

The initial and steady-state MRS operations will require support facilities/services for a stand-alone MRS facility. The costs associated with the MRS balance of plant are presented in the Task B Report (Scenario 3, Single Phase Construction, concrete storage cask option).

No additions or deletions from those costs are required for the inclusion of a Transfer Facility.

3.2 COST DATA DEVELOPMENT

This section contains the rationale and basis of the life-cycle cost items reflected in the cost data tables (see Section 4) provided for this study. Each data sheet uses four of the five cost centers described in Subsection 3.1. The management and integration cost center is only presented on the first data sheet, whereas subsequent sheets portray data of the "operations" cost centers as they relate to construction costs, annual operating costs, staffing allocations, and decommissioning costs.

Four of the five data tables present annual cost distribution (%) information. For the Management and Integration Table and the Construction Cost Distribution Table, the distribution is

presented relative to the start of operations. Start of operations is defined as a single point in time between year (-1) and year (1) when the first spent fuel is received onsite. Therefore, the first year of operations (1) also includes the period of hot testing for the Transfer Facility.

The Transfer Facility will be decommissioned concurrently with the SFHB. Therefore, the decommissioning cost distribution is defined relative to the last year of waste handling onsite; e.g., the last shipment is made to the repository during the "last year of operation." The quantity of material handled in the last year and the number of operating years may vary, based on the waste acceptance schedule required to meet the total waste management system (reactor-to-repository). Therefore, the table identifies the years prior to that last year as a negative; the years after the last year are positive. Although decommissioning could be initiated on the Transfer Facility in the last operating year of that facility, it is assumed that decommissioning of this building starts in the +1 year.

The following sections present the data development approach for each of the five cost data tables and the staffing data table.

3.2.1 MANAGEMENT AND INTEGRATION

This cost center consists of the following five elements: site selection and investigation, design, operating contractor support, construction management, and preoperational testing and personnel training. The following paragraphs present the basis for element costing.

3.2.1.1 Site Selection and Investigation

The costs associated with site selection and investigation are presented in the Task B Report. No additions or deletions to those costs are required for the inclusion of the Transfer Facility.

3.2.1.2 Design

The activities associated with architect engineer (A/E) design of the MRS Facility include: A/E support during proof-of-principle tests of the concrete storage cask and the robotics; advanced

conceptual design (ACD); license application (LA) design; A/E licensing support; final procurement and construction (FPC) design; and A/E Title III services. The design cost presented in this report reflects only the effort required for the inclusion of a Transfer Facility. A/E services costs which are common to the Task B scenario and the Transfer Facility (i.e., proof-of-principle tests) are not included. The cost for each design phase is based on the effort required and the duration of the phase (A/E licensing support and A/E Title III services), and the constructed value of facilities (advanced conceptual design, license application design, and final procurement and construction design).

A. Advanced Conceptual Design

Those facilities not presently identified in the MRS CDR will require an ACD. Therefore, an additional cost is identified for the Transfer Facility ACD, and is costed at 5% of constructed value of the facility.

B. License Application and Final Procurement and Construction

To minimize the design schedule, the definitive design phase is divided into two subphases: LA design and FPC design. The LA design will develop the required analysis and documentation required by NRC for license consideration and approval. The FPC design will complete the analysis and documentation for the facilities and systems which are not defined as important to safety.

The Transfer Facility LA and FPC design costs are estimated to be 15% of the constructed value of the facility. It is estimated that the LA design will require 60% of the total design effort and the remaining portion will be required for the FPC phase.

C. License Support

The effort required for A/E licensing support was developed by estimating the additional number of personnel required by the inclusion of the Transfer Facility and the duration of the support activities. In addition to the licensing phase, which requires developing data to support the hearings and other supplemental information, this estimate assumes a 12-month

presubmittal phase for the development of input to the license application.

Except for special data development required for the license application, licensing support is a function of the number of hearings, amount of supplemental data required, and the duration of this phase. For this study, it is assumed that the Transfer Facility is a part of a larger MRS Facility. Therefore, the license application duration and its associated cost are based on an assumed duration of 28 months as required for the larger MRS Facility.

D. Title III Support

Using historical data, the cost associated with the Transfer Facility Title III support is estimated to be 5% of the constructed value of the facility. This effort includes review of vendor drawings, interpretation of design intent, and provision of field engineering support.

3.2.1.3 Operating Contractor Support

This category includes the technical management and overview of the Transfer Facility design and construction activities by the contractor designated to be the operator of the facility. The cost of reviews of the design and of the cost and schedule management are included. Similar activities are included in the construction phase of the facility.

The cost for the design support was estimated by personnel experienced in managing the conceptual design of the MRS facility. The same personnel estimated the cost for the technical overview of the construction phases.

3.2.1.4 Construction Management

The activities associated with construction management include establishment of field construction facilities; subcontract construction management; construction schedule and budget preparation, reporting, and control; field inspection; quality control; and management of procurement for major materials and equipment.

For the Transfer Facility, this cost is derived from a cost/constructed-value relationship of approximately 15%.

3.2.1.5 Preoperational Testing and Personnel Training

The activities associated with preoperational training and personnel testing encompass reviewing the design for operability and maintainability; developing and preparing operations and maintenance manuals and procedures in conjunction with the A/E services; witnessing construction acceptance tests; preparing training manuals and procedures; training the operators; conducting preoperational testing of the facility, systems, and equipment; and training personnel for security and fire protection.

The cost for this activity was estimated by personnel experienced in the startup and operation of nuclear facilities, who understand the type and complexity of the equipment proposed for the Transfer Facility. The cost is affected directly by the number of systems in the facility and indirectly by the duration of the personnel training and the preoperational testing.

3.2.2 CONSTRUCTION

This cost item includes all activities required to construct the Transfer Facility, such as construction of site improvements and utilities to the site interface five feet from the building and all supporting equipment.

Construction costs were derived from material takeoffs from the preconceptual facility arrangements, allocations based on facility area, and historical cost data developed for the MRS CDR and Task B Report.

3.2.2.1 Cask Operations

The Cask Operations cost center elements are categorized by functional activities. This cost center includes the facilities (Inspection Gatehouse) and the site development (roads, parking, and rail spurs) required for normal and off-normal lag storage of incoming casks and their transporters.

The costs associated with these elements are included in the Task B Report data. The inclusion of the Transfer Facility does not require additions to or modification of these functions; therefore, there is no cost impact by the addition of this facility.

3.2.2.2 Waste Handling Operations

This cost item includes those facilities and equipment required for preparation of incoming waste for storage.

The construction costs for all cost elements were developed for the Transfer Facility construction and for equipment procurement and installation. The facility and equipment for the cask/carrier unloading function is not included in this cost center since these operations are performed in the SFHB Receiving, Inspection, and Shipping Area and are included in the cost contained in the Task B Report. The additional costs for the required modifications to this area are shown as SFHB cost data included in this report. Note that the costs associated with the Steam Generator Building and Cooling Tower, which support the SFHB, are included in the building support facilities cost element presented in the Task B Report.

Equipment procurement and installation costs were derived by allocating the costs of specific equipment items associated with the cost element's function. In general, the equipment costs are assigned as follows:

<u>Element</u>	<u>Equipment Types</u>
Cask unloading	Special doors; cask and transport handling and washdown; ventilation; and remote automated handling equipment.
Assembly lag storage	PWR and BWR intact spent fuel racks.

<u>Element</u>	<u>Equipment Types</u>
Processing	Cask transfer; cask shields; shielding doors and windows; plugs and hatches; spent fuel handling equipment; cell ventilation; and remote automated handling equipment.
Interim storage loading	Storage cask handling and transporter; shielding doors and windows; plugs and hatches; automated cask welding and inspection; and area ventilation.
Building support facilities	All equipment required for an operational facility not included above and the temporary facility (trailer) to house the Transfer Facility operations management.

3.2.2.3 Interim Storage Operations

The costs associated with this cost center are presented in the concrete cask storage option of the Task B Report.

No additions or deletions to those costs are required for the inclusion of the Transfer Facility.

3.2.2.4 Balance of Plant and Support Operations

The balance of plant and support operations cost center includes: site preparation, except for the storage yard; transportation system and utility system interfaces; and all other supporting facilities and utility systems. Since the MRS Facility is an independent installation, all functions provided by the balance of plant and support operations cost elements are required for an operating MRS facility. The systems, building, structures, and equipment costs are included in the Task B Report.

No additions or deletions to these costs are required for the inclusion of the Transfer Facility.

3.2.3 ANNUAL OPERATING COSTS

This item provides the yearly cost required to maintain and replace the mechanical, electrical, and instrumentation equipment, components, and consumable items that will be used during Transfer Facility operations.

3.2.3.1 Equipment Maintenance and Replacement

In general, equipment replacement frequencies vary from 10 to 30 years. Since this study assumes a maximum 2-year operational life of the Transfer Facility, no costs have been allocated for replacement of equipment. Labor costs associated with equipment maintenance are included in the staffing allocations shown in Table 4-7.

3.2.3.2 Consumables and Utilities

This cost item provides the consumables and utilities required to operate the Transfer Facility.

A. Consumables

Typically the unit cost of each consumable was furnished by others or was derived from that shown in the MRS CDR (escalated to 1990 dollars). In addition, other miscellaneous consumables; administrative, process, maintenance, and operating supplies; and service fees are allocated to the cost centers requiring their use.

The items and associated unit costs which were used, as appropriate, for this study are presented in Table 3-1.

Table 3-1 - Consumable Costs

Item	Unit Cost (\$)
Spent filter waste boxes	100 (carbon steel)
HEPA filters	350 (stainless steel frames) 230 (wood frames)
Prefilters	60

The cost of onsite (interim) storage is related to the quantity of material stored. In order to provide the capability to evaluate the storage variables, the constructed cost per storage unit was established in the Task B Report. The capacity and cost of the concrete storage casks remain unchanged; no additions or deletions are required for the inclusion of the Transfer Facility. Consequently, the cost presented in Table 4-5 reflects only consumable and utility cost associated with Transfer Facility operations.

A. Utilities

Utilities required for plant operation include electrical power and the fuel oil required for heating.

The electrical consumption costs are based on the operational and stand-by duration required for the Transfer Facility. For this study, the electrical power demand is based on estimates of specific operating equipment requirements and on area allocations for lighting and general power.

Yearly power consumption was derived from the estimated demand loads and the anticipated usage during operational and nonoperational periods. The anticipated usage factors applied for typical connected services are presented in Table 3-2.

Table 3-2 - Power Consumption Anticipated Usage (%)

Connected Service	<u>Period Usage</u>	
	Operating	Nonoperating
Building ventilation	100	70
Steam generation	100	70
Cooling systems	100	70
Process and handling	100	-
Interior lighting	100	50
Exterior lighting	100	50

The MRS Facility assumes the use of fuel oil for heating. Consumption and building demands were developed for the MRS CDR. The total fuel oil consumption of the Transfer Facility was factored from the MRS CDR, based on building volume.

3.3 DECOMMISSIONING

The activities associated with decommissioning are those required to economically restore the site for unrestricted use after MRS operations have been completed.

Decommissioning costs are assumed to be a percentage of the constructed value of the cost center. The percentage applied was 12% of the constructed value of the Transfer Facility.

3.4 STAFFING ALLOCATION

Although the four operations cost centers are retained, the allocation of staff within the cost centers is defined for specific operations, not functional areas as is the case with other cost distributions. Staff requirements vary relative to the quantity and type of waste received, handled, stored, and/or shipped. The requirements also change if functions are added, deleted, or modified. To permit the required flexibility to establish the staff allocation over the operating life of the facility, incremental processing times were developed for each

identified operation within the cost centers or subtier cost centers. Design study of the MRS CDR data was utilized in establishing unit operations and was modified, as required, to reflect the specific functions to be performed.

The annual full-time-equivalent (FTE) cost is the average value of the composite crew (escalated to 1990 dollars) developed for the operating cost analysis of the MRS CDR design.

The FTE per crew is based on the composition of the crew (millwrights, hot cell operators, quality assurance, etc.) required for the specific operation and the number of similar operating elements (process stations, unloading areas, discharge ports, etc.). The FTE/crew and the unit operating time establishes the number of shifts and, therefore, the total staff required for each operation. Facility maintenance, supervisory, and other support staff is independent of the specific operations and is defined only as a total FTE value.

The following paragraphs define the range of operations included for each functional activity presented on the staff allocation data sheet.

3.4.1 CASK OPERATIONS

This cost center includes all functions associated with the receipt of waste shipments at the Inspection Gatehouse and the transfer of the cask and carrier to either onsite lag storage or a waste handling building. Also identified is the time allocation relating to the release of casks, empty or loaded, from the site.

The Inspection Gatehouse must be continuously staffed to permit the receipt of casks at any time. Since the requirements are consistent with the Task B Report, no additions or deletions to this cost center are required.

3.4.2 WASTE HANDLING OPERATIONS

This cost center contains two subtier cost centers, one for each of the major waste handling buildings. Data is provided only for the Transfer Facility. Data for the SFHB remains unchanged from Task B Report.

Cask preparation time varies with the type (truck or rail) of cask processed. The functional activities and associated processing time for a specific cask is identical for incoming casks for unloading or outgoing casks for loading. The processing times shown for cask preparation include all functional activities for cask washdown; incoming/outgoing cask preparation; placement for unloading/loading; and release from the facility.

Cask unloading processing times include all functional activities required for cell port opening and cask lid or shield plug removal, spent fuel removal and placement in a storage cask, and cask lid and cell port closing. The assumption of waste transfer and placement directly into a storage cask (no lag storage step) minimizes the handling time, thus increasing the quantity of spent fuel that can be transferred.

Storage loading/unloading processing times include all functional activities required for cell port and storage cask opening and for cell port and storage cask closing. Since the fuel assemblies are transferred directly into the storage cask from the transport cask, the transfer time is reflected only as part of the cask unloading operation.

As previously stated, the building support staff is shown as a total FTE/crew value. Although the number is presented as a theoretical "single" shift, the quantity of personnel represents a limited staff on multiple shifts to meet maintenance, computer, and support staff requirements.

3.4.3 INTERIM STORAGE OPERATIONS

The functional activities associated with cask preparation prior to cask loading and/or cask unloading relate only to those functions within the Transfer Facility. These functions include alignment with the cask loadout port, operation of the contamination barrier and to those functions required for cover plate welding after loading and cover plate removal prior to unloading.

The storage placement processing time allocation includes all functional activities required to deliver the cask to storage; the placement of the cask on the storage pad; connection of the

monitoring system(s), if required; and the transfer of a new cask from the Cask Manufacturing Facility to the Transfer Facility.

3.4.4 BALANCE OF PLANT AND SUPPORT OPERATIONS

The staff at the Inspection Gatehouse are included in cask operations (see Subsection 3.4.1). The Cask Manufacturing Facility is assumed to be operated by a subcontractor. Except for 11 administrative personnel, all staff costs are labor costs for the concrete cask fabrication and are included in the cost per cask as presented in the Task B Report consumable cost data.

All remaining site personnel are allocated to this cost center. The majority of the personnel are employed on the day shift and provide administrative, maintenance, and training services. Security, emergency response, and some maintenance personnel are required at all times and are included in the total quantity. The quantity from the Task B Report is retained to reflect the total site requirements during full operation. During the first years of fuel receipt at only the Transfer Facility, the number of support operations personnel can be reduced by approximately 50%.

3.5 DESIGN AND CONSTRUCTION SCHEDULE DEVELOPMENT

The overall schedule is dependent on the selection of a site, preparation of LA design documents, the NRC review and approval process (e.g., licensing), and construction of the critical-path facility. Since this study assumes the construction of two waste handling buildings, the critical path milestones are dependent upon the design and construction durations of each facility. It is assumed that the license will be granted for a total MRS Facility that includes the Transfer Facility. Therefore, the milestone for the submittal of the license application is established by the waste handling facility requiring the greater design schedule. After NRC issuance of a license, the milestone for MRS operations will be determined by the facility which requires the shorter construction schedule.

The schedule durations are based on the Task B Report schedules, the assumptions stated in Section 2, and an evaluation of the construction labor and the building design. The durations for proof-of-principle testing; site investigation; and the SFHB design, construction, and testing are in accordance with that

presented in the Task B Report. The schedule durations for the Transfer Facility design and construction were determined from an estimated design effort and from the construction labor requirements and building configuration and access, respectively.

The first year of operation is assumed to include the performance of facility hot testing.

All schedules are based on a logical progression of activities which provide input for the initiation of subsequent activities. To the extent feasible, the schedules utilize concurrent activities to optimize the overall duration. For example, the final site investigation activities are performed simultaneously with ACD; and the FPC design phase is conducted concurrently with the licensing phase to minimize the total preconstruction phase schedule. Similarly, the cold testing of the equipment and components is performed during the last phase of construction, allowing 2 months of system operation tests after construction completion.

Design input data is required from proof-of-principle tests and site evaluation. Therefore, the initiation of these activities must be scheduled so that the resulting data can be incorporated into the LA design documentation prior to submittal to NRC. Based on the MRS CDR and subsequent studies and investigations, tests have been identified which provide the basis for initiation of testing. Therefore, this activity can be initiated prior to and/or concurrent with other site or design activities.

The principal design input resulting from site investigation is the geotechnical data required for the foundation design and the seismic analysis/design. It is assumed that sufficient data to support the ACD can be available 6 months after initiation of site investigation.

LA design is initiated based on the data developed from the Transfer Facility and SFHB ACD and with that presented in the MRS CDR for the support facilities. The completion of the LA documentation requires the incorporation of input from ACD, proof-of-principle tests, and site evaluation. Therefore, these activities are scheduled to be completed prior to completion of LA design.

The FPC Design is initiated at the completion of LA design and its duration is dependent upon the support facilities required. The license duration is assumed to be 28 months. Since the data developed by FPC is not required as input to licensing, this activity is scheduled concurrently with licensing.

In accordance with the federal regulations, MRS construction cannot commence until authorized by NRC. Therefore, construction initiation is scheduled at the completion of the assumed licensing duration. The total construction schedule is determined by the facility which requires the greatest construction time. However, the waste receipt milestone is based on the facility which requires the shortest construction time.

SECTION 4

DESIGN DESCRIPTION

This section presents the operations, design, cost, and schedule data relating to the Transfer Facility.

4.1 OVERVIEW

The Transfer Facility will be constructed as an appendage to the SFHB Receiving, Inspection, and Shipping Bay. The Transfer Facility and the SFHB receiving bay will be constructed and placed in operation while the remaining portion of the SFHB is completed. Figure 4-1 depicts the basic functional flow of the initial and steady-state MRS operational phase.

4.2 WASTE HANDLING OPERATIONS

Only spent fuel will be handled in the Transfer Facility. If transportable metal storage casks are received during the initial operational period, they will be routed directly to onsite storage.

A description of the facility design and operations of the Transfer Facility is presented in the following subsections. For SFHB operations, see the Task B Report. For the arrangement of the proposed Transfer Facility, see Drawings A-1 through A-5 in the appendix of this report.

4.2.1 TRANSFER FACILITY

A Transfer Facility for the receipt and transfer to storage of bare intact spent fuel is required to initiate early operation of the MRS Facility. This facility will be operational for approximately 2 years until the SFHB construction is completed and that building is ready for steady-state spent fuel receipt (see Subsection 4.7 for details). After the SFHB is operational, the Transfer Facility will be placed in a standby mode or may be used for other functions including:

- (1) Receive and transfer to storage nonstandard spent fuel (extra long, high burnup, HTGR, research, etc.)

Figure 4-1 - MRS Operations

- (2) Receive and transfer to storage packaged miscellaneous reactor hardware
- (3) Receive and transfer to storage containerized HLW
- (4) Maintain and/or reconfigure (PWR vs. BWR) transportation casks
- (5) Research and testing of equipment to improve facility operations.
- (6) Train and test hot cell operators

4.2.2 TRANSFER FACILITY OPERATIONS

The major functions required for the Transfer Facility operations are shown in Figure 4-2 and are described herein.

Rail or truck shipments containing spent fuel assemblies enter the site through an Inspection Gatehouse, where the casks and carriers are inspected. Offsite tractors or engines are disconnected from the carriers, an onsite tractor or railcar mover is attached, and the carriers are transported through a fenced corridor to the protected area. Access control for personnel and nonradioactive shipments that enter the protected area from the limited area is provided via the Protected Area Gatehouse. For the arrangement of the MRS Facility site, see Drawing C-1 located in the appendix of this report.

After inspection, the shipments are routed to the SFHB/Transfer Facility receiving bay. If required, rail cask and truck cask storage areas are provided for temporary storage of incoming shipments. The storage yard consists of ten tracks for: incoming spent-fuel cars, outgoing spent-fuel cars, empty incoming repository cars, and full outgoing repository cars, plus spares. This storage yard is connected to the receiving bay of the SFHB/Transfer Facility to provide flexibility for loading and unloading the railcars and for creating the "unit train" shipment to the repository. Similar operations, including onsite storage for trucks, are provided for truck shipments.

LEGEND:

--- Operational Functions by other MRS Elements to Support Transfer Facility Operations

--- Transfer Facility Functional Operations

* Remote

** Automated

Figure 4-2 - Transfer Facility Functional Flow

An off-normal holding area is also provided for a limited number of truck and rail shipments. Shipments are routed to this interim storage area if shipping data is incomplete or a potential shipping cask problem is perceived which requires special handling. Shipments are retained in this area until the material can be handled either in the Transfer Facility or the SFHB.

Upon receipt at the receiving and inspection bay, the cask impact limiters, personnel barriers, and cask restraints are removed. The cask is subsequently removed from its transport vehicle and placed on a Transfer Facility cask cart. The cask and cart are then moved into the cask preparation and decontamination room where the cask is inspected for contamination, the interior gas pressure checked, gas samples taken, the gas vented to the HVAC system, the outer lid removed, and if required, the inner lid bolts loosened. A contamination barrier is then installed, the cask cart is moved into the cask unloading room, and the cask is mated to the transfer cell unloading port. The door of the cask unloading room is closed, thus completing the cask handling operation for unloading.

All operations within the cask preparation and decontamination room are accomplished by a remotely operated cask preparation system.

The spent fuel unloading operation begins with the removal of a transfer cell unloading port shield plug, using the remotely operated cell power mast crane, followed by the replacement of the grapple and the removal of the shipping cask lid bolts, lid, and/or shield plug. The bolts and lid removal grapple are replaced with a spent fuel assembly grapple and the intact fuel assemblies are removed from the shipping cask, identified, and placed into a concrete storage cask. The transfer cell is equipped with two unloading ports, one dedicated for truck casks and one dedicated for rail casks. However, the port plugs, contamination barriers, and cask carts are designed with adaptors or inserts so that each port will accommodate either cask.

After unloading, the shipping cask inner lid or shielding plug and the unloading port shield plug are replaced by the power mast crane and the cask is moved to the cask preparation and decontamination room for final cask closure. After closure, the

cask exterior is surveyed and decontaminated if required. These operations are accomplished prior to the cask removal from the room.

Routine cask maintenance, repair, or internal decontamination will not be conducted within the Transfer Facility. However, if during visual examination seal damage is suspected, it is moved to the cask repair area for seal replacement.

In simultaneous sequence with the initial shipping cask cell port mating operation, a storage cask is mated to the transfer cell loadout port and the loadout port plug and the storage cask shield plug removed. After completion of the fuel transfer, the storage cask shield plug and loadout port plug are replaced and the storage cask is moved from the loadout/decontamination room into the transfer/discharge area, where the cask lid is seal welded and the cask removed from the cart by the straddle carrier and moved to the storage field. In the event that a storage cask requires unloading, an in-cell lag storage area is provided for interim storage of spent fuel until it can be transferred to another storage cask. Due to the differences in spent fuel assembly capacities, multiple shipping casks from the reactors must be unloaded in order to fill each storage cask.

Liquid radwaste generated within the facility is routed to and stored in tanks located in the LLW/HAW vault. Liquid waste generated by decontamination of the transportation casks is routed to the high activity waste (HAW) tank, and all other potentially contaminated waste streams are routed to the LLW tank. If contaminated, cask/carrier washwater is also routed from the receiving bay sump to the LLW tank; uncontaminated cask/carrier washwater is routed to the washwater storage tank prior to release to the MRS service drain system. All liquid radwaste is stored within the LLW/HAW vault until they can be disposed of through the SFHB radwaste treatment system.

In-cell HEPA filters are remotely replaced using the transfer cell power mast crane fitted with a manipulator arm end effector. Spent filters are transferred from the transfer cell through a floor hatch and placed in a filter storage box located in the material/filters transfer/decon room located below the transfer cell.

4.2.3 TRANSFER FACILITY DESIGN

The Transfer Facility is a multilevel reinforced concrete/structural steel structure housing various building functions. All areas containing equipment or systems important to safety are enclosed within a reinforced concrete envelope designed to resist design basis accident events. Areas in which radioactive material is handled or stored are enclosed within a reinforced concrete envelope of sufficient thickness to provide personnel protection.

Shielded areas are provided for fuel transfer, transportation cask unloading, storage cask loading, transportation cask internal decon and seal repair, and concrete storage cask external decon. Tankage for storage of contaminated liquid and space for stored packaged contaminated solid radwaste (filters) are provided.

The first floor of the facility contains the transportation cask preparation/decon, repair, and unloading areas; storage cask loading/decon and discharge areas; personnel support, except administrative areas; control rooms; and electrical and mechanical spaces.

The transportation cask preparation/decon, repair, and unloading areas; the filter transfer and storage areas; and the storage cask loadout/decon area are of concrete construction. The internal surfaces of these areas include special coatings in the transportation cask unloading, storage cask loadout/decon, and material/filters transfer/decon areas. Painted surfaces are provided in the transportation cask preparation/decon and repair areas. All other areas are finished with sealed concrete surfaces.

The personnel support, electrical, and mechanical areas are constructed of reinforced concrete exterior walls, interior structural steel frame, and interior metal stud and gypsum wallboard partitions. Suspended ceilings and painted surfaces are provided in all personnel support areas. Finishes in the electrical and mechanical spaces consist of painted interior partitions and sealed concrete floors and exterior walls.

Two control rooms, transportation cask handling and facility operations, are provided on the first floor level. The control rooms are furnished with acoustical ceilings, a raised floor system, and painted surfaces.

The transfer discharge area is constructed of structural steel and insulated metal panels on the east wall, a sealed reinforced concrete west wall, and a metal roof deck.

The first mezzanine level contains the ventilation equipment areas. The exterior walls are constructed of reinforced concrete with a sealed finish. The floor and roof is of reinforced concrete on a metal deck supported by a structural steel frame. The interior partitions are of metal studs with painted gypsum wall board. Acoustical ceilings are provided in these areas.

The Transfer Facility contains a transfer cell to unload shipping casks, and to transfer spent fuel to a concrete storage cask. The cell is provided with two shipping cask unloading ports and one loadout port to storage. The transfer cell is located on the second level with ports located directly over the transportation cask unloading, and the concrete storage cask loading rooms below. Other functions located on the second level are the operating gallery, the cell access areas, and a maintenance and storage area. The transfer cell crane maintenance rooms are located on the second level mezzanine adjacent to the transfer cell.

Except for the interior partitions, the second mezzanine areas are constructed of reinforced concrete. The interior of the transfer cell and its associated crane maintenance areas are finished with special coatings. Stainless steel liner on all floors and wall surfaces up to the crane rail was considered as an alternative to the special coating and will be installed if the Transfer Facility is to be used for a period greater than 2 years. The operating gallery, cell access spaces, hands-on maintenance/storage, corridors, and interior partitions are finished with a painted surface.

All exterior wall concrete surfaces are insulated and covered with metal panels. All levels are served by stairways and a passenger/freight elevator. Administrative offices, a lunch room,

and a conference area are located in an adjacent trailer, until the SFHB administrative areas are available for occupancy.

The building is provided with normal, standby, and uninterruptible power supply (UPS) electrical systems. Normal and standby power is distributed from the MRS site main substation adjacent to the Standby Generator Building. The UPS system is located within the Transfer Facility.

Water for domestic, process, and fire protection is obtained from the MRS site water supply system. Hot water for the building heating system is provided by the MRS Steam Generator Building.

The heating, ventilating, and air conditioning (HVAC) system is a once-through, cascading system. Ventilation zoning and differential air flow control ensures flow of air from areas of lower potential contamination to areas of higher potential contamination.

The Transfer Facility plans and sections are shown on Drawings A-1 through A-5 in the appendix.

4.3 SPENT FUEL HANDLING BUILDING

As noted on drawing A-1, the SFHB/Transfer Facility receiving bay provides for the receipt of rail cask carriers and truck cask carriers. The rail casks carriers are received, staged, and prepared on a single track located in the center of the receiving bay. To provide a direct transfer of the truck casks to the cask carts and preclude the transfer of truck cask over or around a staged rail cask, each facility has been provided with a loading dock. This arrangement required the enlargement of the width of the stand-alone SFHB receiving bay from 59 to 76 ft.

4.4 CONCRETE STORAGE CASKS

The concrete storage cask system operation and the design of the cask is described in the following subsections.

4.4.1 Operations

The concrete storage casks are fabricated at the Cask Manufacturing Facility located in the industrial area of the MRS

Facility site. When a storage cask is required, it is picked up by a straddle carrier for delivery to the Transfer Facility. A member of the security staff inspects the cask prior to transfer and accompanies the cask and carrier through the gates in the double security fence into the protected area of the site. The cask carrier enters the building through the transfer/discharge area and the cask is placed on a cask cart and moved into the storage cask loadout and decon room. The cart aligns the cask with the loading port and the contamination barrier is remotely lowered to seal with the top of the cask.

The loading operation begins with the removal of the cell port plug by a lifting/transfer mechanism. The in-cell power mast crane removes the cask shielding plug and loads intact spent fuel into the cask. After the cask is filled, the cask shield plug and cell port plugs are replaced and the contamination barrier lifted. The cask cart and cask are moved to the transfer/discharge area where the outer lid is lowered onto the cask and remotely seal-welded to the cask liner.

The carrier delivers the cask to the storage yard via the Storage Facility Gate Station. The carrier places the cask on the previously prepared storage pad and then returns to the Cask Manufacturing Facility for a new cask, and the process is repeated.

4.4.2 Design

The ventilated concrete storage casks provide a double-sealed, self-shielded, dry storage unit for intact spent-fuel assemblies. The storage casks are cylindrical, reinforced-concrete structures with a stepped, carbon-steel-lined cavity, and contain internal grids or racks to maintain proper fuel spacing. A cylindrical concrete shield plug with a mechanized seal fits into the open top of the cavity and a steel cover plate is seal-welded to the liner flange to close the cask. An air annulus is provided between the liner and the concrete in the spent fuel casks to provide additional heat removal capability and to maintain concrete temperatures within acceptable limits. The cask cavity is inerted before sealing. The casks are 22 ft high with a 12 ft outside diameter and 6 ft interior diameter.

The Transfer Facility concrete storage cask transporter is a modification of an existing straddle carrier used for boat handling operations. Similar designs are also used for the transport and handling of slag pots in steel mill operations.

The storage casks can contain 32-PWR or 80-BWR intact spent fuel assemblies. The maximum onsite storage capacity needed for the operation of the Transfer Facility (first 2 years) is 82 concrete storage casks.

Drawing C-1 in the appendix shows the total site arrangement for the concrete storage cask system for the Transfer Facility option.

4.5 COST DATA

The cost data applicable for the inclusion of a Transfer Facility is presented in Tables 4-3 through 4-6 and 4-8 located at the end of this section. Only those costs that are associated with the addition of the Transfer Facility are presented. The cost data associated with the SFHB and other MRS supporting facilities and systems are presented in the Task B Report as single-phase construction of Scenario 3. A summary of the constructed value of a MRS using a SFHB/Transfer Facility complex is shown in Table 4-1.

4.6 STAFFING ALLOCATION

The staffing data applicable for the inclusion of the Transfer Facility, at the maximum receipt rates shown in Table 2-1, is presented in Table 4-7 located at the end of this section. The staffing allocations presented reflect only those required for Transfer Facility operations and for the modification of interim storage operations (straddle carrier versus crawler transporter/crane operations).

In the receiving bay, two crews per shift are required to prepare transport casks for unloading and for return to the transportation system. Each crew is assumed to be comprised of a rigger, two millwrights, and a technician. In addition, the two crews are supported by a foreman, a crane operator, a health physics employee, and two robotics operators.

Table 4-1 - SFHB/Transfer Facility MRS Complex Costs
(\$ million)

Cost Element	Transfer Facility	SFHB
Management and Integration	25 ^a	121
Cask Operations	-	7
Waste Handling Operations	48 ^b	90
Interim Storage Operations	1 ^c	9
Balance of Plant	-	126
Constructed Value	74	353
Total SFHB/Transfer Facility MRS		\$427

^aCost estimated at 52% of constructed value.

^bIncludes \$1.8 million for enlargement of the SFHB receiving bay.

^cIncludes storage field development for 90 casks.

The cask unloading and assembly handling/transfer activities are performed by a common crew per shift, since all operations are within the single transfer cell. It was assumed that the crew consists of a supervisor, a technician (operator), and a representative from quality assurance for verification activities associated with SNM accountability requirements. To minimize the staff requirements for the Transfer Facility, the supervisor would also oversee the robotics operations in cask preparation. Health physics requirements would be fulfilled by the representative in transport cask preparation and/or storage cask preparation.

Storage cask preparation is supported by a single crew per shift comprised of a foreman, two technicians, and health physics. The foreman would perform any accountability/quality assurance verification activities relating to storage cask closure and preparation for transfer from the building.

The operational requirements for the interim storage functions is assumed to require a foreman or supervisor, a technician, and

health physics on the day shift only, since their primary function relates to monitoring and radiation health/safety issues. This functional area also requires the use of a transport operator and a rigger for cask transfer and placement during any operating shift of the transfer cell.

The total of 33 building support staff for a single operating shift is comprised of administrative personnel located in a trailer adjacent to the Transfer Facility and the operations support and maintenance personnel within the facility. Administration includes a manager, two staff members for management support, two staff members for operations support, and one clerical. These six individuals are all assigned to the day shift. Any administrative support activities on other operating shifts, if multiple shifts are required, are assumed to be minimal and could be provided from the Site Services Building. The operations and maintenance support staff would vary by operating shift. Control room, health physics, and a limited number of building support system maintenance personnel must be present at all times, even during nonoperating periods. In addition to the five required on all shifts, each operating shift is assumed to include a seven-person "crew" comprised of building and equipment maintenance supervisors, crane and robotics maintenance personnel, and supplemental health physics and building support system maintenance staff.

4.7 DESIGN AND CONSTRUCTION SCHEDULES

The design and construction schedule for the total MRS Facility which includes the SFHB and Transfer Facility complex is in presented on Figure 4-3.

4.7.1 DESIGN SCHEDULE

The duration of the design and licensing activities is based on an estimate of the manpower required to accomplish each phase. Based on average A/E rates, the cost of the estimated manpower was compared and resolved with that developed using historical percentages of constructed value as noted in Section 3.

Figure 4-3 - MRS Facility - SFHB/Transfer Facility Complex Schedule

As noted in Section 3, the design activities are initiated after sufficient geotechnical data has been obtained to support the foundation design and seismic analysis. This information is assumed to be available 6 months after start of site investigation activities.

The total design duration of the MRS SFHB/Transfer Facility complex includes advanced conceptual, licensing, and procurement and construction design phases. The estimated durations (months) of each is presented in Table 4-2.

Table 4-2 - MRS SFHB/Transfer Design Durations (months)

Design Phase	SFHB	Transfer Facility
Advanced Conceptual Design	9	8
Licensing Design	18	9
Procurement and Construction Design	<u>12</u>	<u>9</u>
Total	39	26

In accordance with the intent of 10 CFR 72, it is assumed that the MRS Facility will utilize a one-step licensing process which cannot commence until all licensing design activities have been completed. Therefore, the initiation of the licensing process is established by the SFHB design, or 27 months after design start.

Figure 4-3 shows the design of the Transfer Facility to be initiated at the same time as the SFHB. However, if desirable, the transfer design activities can be delayed as much as 10 months without delaying the licensing milestone as established by the SFHB license design phase.

Assuming a 28-month duration for the licensing phase, the critical path preconstruction schedule is 61 months. It includes six (6) months for collection of geotechnical design information,

27 months for advance conceptual and licensing designs, and 28 months for the licensing activities.

It has been assumed that all MRS elements which are not defined as important to safety will be included in the procurement and construction design phase. This phase has been estimated to be 12 months and to be conducted concurrently with licensing. If desirable, DOE could commence construction of infrastructure ties, site development, and structure and systems which are not defined as important to safety at the completion of this design phase. However, this early start of construction does not affect the earliest MRS operational start milestone as established by the Transfer Facility construction schedule.

4.7.2 CONSTRUCTION SCHEDULE

The construction schedule was developed from estimated manhours required to construct unit building elements and systems, assumed crew sizes, number of crews that can be effectively employed within the building envelope, and access to the work location.

The critical path of MRS construction is that required to construct and cold test the Transfer Facility. The overall construction schedule, assuming a single-shift/5-day week, is 17 months. It is estimated that if a two-shift/5-day week are employed for central core concrete construction, the schedule can be reduced by 2 months. The use of additional shifts or workdays is restrained by the time required for placement of concrete in the central core portion of the building.

If a stainless steel liner is selected or the interior finish of the Transfer Facility, the overall construction schedule is increased by approximately one month.

In addition to the construction durations, additional schedule time is allocated for completion of cold testing prior to initiation of waste receipt (hot testing). Consistent with the Task B Report, it has been assumed that cold testing can be initiated 2 months prior to the completion of construction and extends 2 months beyond construction completion. It has also been assumed that an adequate supply of construction personnel are available to perform the concurrent construction activities on the MRS site.

The Transfer Facility critical path to building completion includes: 8 weeks for site preparation and excavation; 44 weeks for concrete placement, of which the concrete work required for the "central core" (cask handling areas, transfer cell, and crane maintenance areas) is the critical element; then 18 weeks of mechanical, electrical, and instrumentation installation activities. To minimize the construction time for the central core element, it is assumed that the work will be accomplished using two crews assisted by two tower cranes. The total duration for this work is estimated to be approximately 44 weeks. The other building elements, including finishes, are initiated prior to completion of the central core and require an additional 18 weeks to complete. Equipment and building support systems are scheduled to commence approximately one year after construction start and are estimated to require 5 months to complete.

4.8 LONG-LEAD ITEMS

Items classified as long-lead, as defined herein, are any item which cannot be delivered onsite at, or prior to, its construction/installation scheduled milestone. Therefore, to achieve the construction schedule, the procurement of these items must commence prior to construction start. Table 4-9 presents a listing of major material/equipment and their procurement durations required for the Transfer Facility. The lead times shown include 6 weeks for bid and award and 2 weeks for delivery.

Based on the Transfer Facility construction schedule, the need dates (installation milestones shown as weeks after start of construction) were determined to evaluate long-lead requirements.

Since the construction time to complete the building shell is approximately one year, the majority of the Transfer Facilities materials of construction and its operational equipment can be procured by the contractor. The items which must be procured by the government include the 20-ton power mast cranes and the associated cable management systems (68 weeks), cask handling robotics (104 weeks), port plugs (44 weeks), manipulator ports (36 weeks), waste tanks (32 weeks), and the breathing and plant air systems (68 weeks). In addition, the SFHB Receiving Bay bridge cranes (200T) will also require advanced procurement.

The port plugs and manipulator ports require early delivery for embedment in the concrete element of the transfer cell. It has been assumed that entry into the LLW/HAW vault is by a manhole; therefore, early delivery of the waste tanks are required for installation prior to completion of the vault roof.

Transfer Facility
Storage Concept: Cost

Date: 9/12/90
Revision: 1

Percent of M & I Cost per Year Prior to Operations

COST CENTER/Cost Element	Cost (Millions \$)	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	+1	+2	+3
MANAGEMENT AND INVESTIGATION														
Site Selection/Investigation	N/A													
Design														
Proof-of-Principle Tests (3 Tests)	N/A													
Advanced Conceptual Design	2.3				25	75								
License Application Design	4.2					67	33							
Licensing Support	0.2							50	50					
Final Procurement and Construction Design	2.8						80	20						
Title III Support	10.8									40	60			
Operating Contractor Support														
Design	0.7				14	43	29	14	5					
Construction	0.9									50	50			
Construction Management	5.4													
Preoperational Testing and Personnel Training	7.0								20	30	50			

TABLE 4-3 - MANAGEMENT AND INVESTIGATION

Transfer Facility
Storage Concept: Cask

Date: 9/12/90
Revision: 1

Millions in 1999 \$				
COST CENTER/Cost Element	Building Area	Facility Cost	Equipment Cost	Total Cost
CASK OPERATIONS	N/A			
WASTE HANDLING OPERATIONS				
SPENT FUEL HANDLING BUILDING				
Cask Unloading	5060	1.8	--	1.8
Assembly Lag Storage	N/A	--	--	--
Processing	N/A	--	--	--
Interim Storage Loading/Unloading	N/A	--	--	--
Building Support Facilities	N/A	--	--	--
TRANSFER FACILITY				
Cask Unloading	N/A			
Assembly Lag Storage	260	0.2	6.1	6.3
Processing	11067	10.0*	16.0	26.0
Interim Storage Loading	4637	3.4	1.4	4.8
Building Support Facilities	25171	12.1	2.0	14.1
INTERIM STORAGE OPERATIONS				
Storage Facilities	N/A	\$7500/cask	1.0	--
Storage Units	N/A			
			See Consumables, Table 4-6	
BALANCE OF PLANT AND SUPPORT OPERATIONS	N/A			

*If a stainless steel liner is selected for the transfer cell, the facility cost is increased by \$0.6M

TABLE 4-4 - CONSTRUCTION COSTS

Date: 9/12/90
Revision: 1

TABLE 4-5 - CONSTRUCTION COST DISTRIBUTION

Transfer Facility
Storage Concept: Cask

COST CENTER/Cost Element	Equipment Maintenance/Replacement (\$/Year)			Consumables
	Annual	10 Year	20 Year	
CASK OPERATIONS				
	N/A	N/A	N/A	N/A
WASTE HANDLING OPERATIONS				
SPENT FUEL HANDLING BUILDING				
Cask Unloading	N/A	N/A	N/A	N/A
Assembly Lag Storage				
Processing				
Interim Storage Loading/Unloading				
Building Support Facilities				
TRANSFER FACILITY				
Cask Unloading	N/A	N/A	N/A	\$1.0M/Year Fixed
Assembly Lag Storage				
Processing				
Building Support Facilities				
INTERIM STORAGE OPERATIONS				
Storage Facilities	0.2	N/A	N/A	\$0.050 M/Year Fixed
Storage Units				Cask - \$0.20 M/Unit
BALANCE OF PLANT AND SUPPORT OPERATIONS				
	N/A	N/A	N/A	N/A

TABLE 4-6 - ANNUAL OPERATING COSTS

Date: 9/12/90
Revision: 1

Transfer Facility
Storage Concept: Cask

COST CENTER/Functional Activity by Crew	Processing Time/Unit Processed (in minutes)	FTE/Crew	Annual \$/FTE	Notes
CASK OPERATIONS Receive & inspect transport casks	No change from Task B Report			
WASTE HANDLING OPERATIONS SPENT FUEL HANDLING BUILDING Prepare reactor/HRS transport casks for unloading/shipment (incl. 75 min. for washdown)	No change from Task B Report			Operating time for cask unloading does not reflect new transport cask capacities used for Transfer Facility
Unload transport casks				
Storage loading/unloading				
Building support staff				
TRANSFER FACILITY Prepare reactor/HRS transport casks for unloading (incl. 75 min. for washdown)		6.5	\$53,900	Two crews per shift
Unload transport casks	Truck = 515/cask Rail = 615/cask			
Spent fuel handling: lag storage	PHE = 170 (V); 550 (R) BWR = 270 (V); 1170 (R)	3	\$53,900	Single crew per shift used for all unloading and SF handling operations
storage cask loading	PHE = 695/stor.cask BWR = 1655/stor.cask	N/A		Add 130 min. if lag storage baskets require replacement
Building support staff	55/cask N/A	N/A		Fuel transfer/loading included in transport cask
INTERIN STORAGE OPERATIONS Storage cask preparation & closing Storage placement (incl. 30 min. to obtain new cask)	N/A 255/cask 85/cask	33	\$53,900	Includes admin. functions housed in adjacent trailer (OPFE)
BALANCE OF PLANT AND SUPPORT OPERATIONS Site support staff (excl. Cask Htg. Facility of 11)	No change from Task B Report	4 5	\$53,900 \$53,900	One crew per shift

TABLE 4-7 - STAFFING ALLOCATIONS BY FUNCTIONAL ACTIVITIES

Date: 9/12/90
Revision: 1

Transfer Facility
Storage Concept: Cask

Percent of Decommissioning Cost by Year After Last Year of Operations

COST CENTER/Cont Element	% of Total Constr. Cost	Last Year					
		-2	-1	0	+1	+2	+3

N/A

CASK OPERATIONS

Receiving

Cask Lag Storage

WASTE HANDLING OPERATIONS

SPENT FUEL HANDLING BUILDING

Cask Unloading

Assembly Lag Storage

Processing

Interim Storage Loading/Unloading

Building Support Facilities

TRANSFER FACILITY

Cask Unloading

Assembly Lag Storage

Processing

Interim Storage Loading/Unloading

Building Support Facilities

INTERIM STORAGE OPERATIONS

N/A

BALANCE OF PLANT AND SUPPORT OPERATIONS

N/A

TABLE 4-8 - DECOMMISSIONING COSTS AND DISTRIBUTION

Table 4-9 - Transfer Facility
Major Materials/Equipment Procurement

Item	No. Req.	Lead Time (weeks)	Need Date (weeks)	Long Lead
<u>Construction Materials</u>				
Reinforcing	N/A	20	8	Yes
Structural Steel	N/A	24	34	No
Metal Decking	N/A	20	15	Yes
Pipe Fabricated	N/A	28	52	No
Valves	N/A	28	52	No
Vessels (Pressure)	N/A	32	52	No
Pipe (Plain)	N/A	16	52	No
Fittings	N/A	10	52	No
<u>HVAC System</u>				
Final HEPA Filter Plenum (4 x 4) w/in-place DOP, 2-stage HEPA + Carbon, and Spray chamber	2	18	51	No
Final HEPA Filter Plenum (4 x 3) w/in-place DOP, 2-stage HEPA, and spray chamber	1	18	51	No
Inter Zone HEPA Filter (3 x 3) w/in-place DOP and 1-stage HEPA	2	18	51	No
In Cell HEPA Plenum (4 x 2) manipulator actuated 1-stage	2	18	51	No
Exhaust Fan, 14,000 cfm	2	22	51	No
Exhaust Fan, 13,000 cfm	1	22	51	No
Air Handling Unit w/filter 8,300 cfm	1	20	51	No

Table 4-9 (Contd)

Item	No. Req.	Lead Time (weeks)	Need Date (weeks)	Long Lead
<u>HVAC System (Contd)</u>				
Air Handling Unit w/filter 13,000 cfm	1	20	51	No
Air Handling Unit w/filter 6,500 cfm	1	20	51	No
Air Handling Unit w/remote condensing unit (UPS standby)	1	20	51	No
Air Handling Unit w/remote condensing unit (control room standby)	1	20	51	No
Water Chillers - 200 ton w/remote air-cooled condenser	2	18	51	No
<u>Electrical System</u>				
Motor Control Centers	2	33	51	No
Unit Substation - double-ended	2	38	51	No
UPS System	1	12	51	No
<u>Instrumentation</u>				
Distributed Control System	1	34	51	No
Instruments	Lot	18-30	51	No
Control Valves	Lot	16	51	No
CCTV Cameras	11	24	51	No
<u>Material Handling System</u>				
Transport Cask Cart	3	44	52	No
Transport Cask Cart Rails	3 pr	24	52	No
Transport Cask Cart Adaptor - Truck	3	32	52	No
Transport Cask Cart Adaptor - Rail	3	32	52	No

Table 4-9 (Contd)

Item	No. Req.	Lead Time (weeks)	Need Date (weeks)	Long Lead
<u>Material Handling System (Contd)</u>				
Storage Cask Cart	1	32	52	No
Storage Cask - Rail	1 pr	24	52	No
Monorail - 3 ton	3	24	52	No
Monorail - 5 ton	3	24	52	No
Power Mast Crane	2	68	43	Yes
Cask Lid Grapple - Truck	5	24	60	No
Cask Lid Grapple - Rail	5	24	60	No
Cask Lid Grapple - Storage	1	36	60	No
Spent Fuel Grapple - PWR	2	24	60	No
Spent Fuel Grapple - BWR	2	24	60	No
Grapple Rack	1	32	52	No
Lid Rack - Truck	5	20	52	No
Lid Rack - Rail	5	20	52	No
Lid Rack - Storage	1	32	52	No
Contamination Barrier				
Transport Cask	2	44	52	No
Storage Cask	1	44	52	No
Adaptor - Truck	2	44	52	No
Adaptor - Rail	2	44	52	No
Shadow Shield - Transport Cask	2	44	52	No
Shadow Shield - Storage Cask	1	44	52	No
Shielding Doors (16 x 24 ft)	2	N/A	Site Fab	-
Shielding Doors (16 x 25 ft)	1	N/A	Site Fab	-
Shielding Doors (34 x 18 1/2 ft)	2	N/A	Site Fab	-
Handling Robotics - Cask Prep	2	104	52	Yes
Handling Robotics - Cask Repair	1	104	52	Yes
Handling Robotics - Storage Cask	1	104	52	Yes
Remote Welder - Storage Cask	1	32	52	No
Lag Storage Rack - PWR	1	36	60	No
Lag Storage Rack - BWR	1	36	60	No
Shielding Window Frames	3	21	26	No
Shielding Windows	3	56	60	No
Manipulator Ports	3 pr	36	26	Yes

Table 4-9 (Contd)

Item	No. Req.	Lead Time (weeks)	Need Date (weeks)	Long Lead
<u>Material Handling System (Contd)</u>				
Manipulator	1	40	52	No
Unloading Port Plug	2	44	23	Yes
Loading Port Plug	1	44	23	Yes
Unloading Port Plug Grapple	4	32	52	No
<u>Mechanical Systems</u>				
Loading Port Plug Operator	1	44	52	No
Work Station	1	68	70	No
Crane Cable Management System	2	68	52	Yes
Lag Storage Cover	1	36	52	No
Decon System	4	34	52	No
Tools	Lot	20	70	No
Work Platform	5	36	52	No
Drum Rack	1	28	52	No
Fork Lift	1	20	60	No
Freight Elevator	1	30	60	No
Waste Tank (LLW)	1	32	22	Yes
Waste Tank (HAW)	1	32	52	Yes
Waste Pump (LLW)	1	36	52	No
Waste Pump (HAW)	1	36	52	No
Breathing Air System	1	60	52	Yes
Plant Air System	1	60	52	Yes
<u>SFHB Mechanical Handling Systems</u>				
Cask Handling Crane	2	68	43	Yes

SECTION 5

SUPPORT FUNCTIONS

As a stand-alone independent facility, the MRS requires buildings and services for the administrative, maintenance, security, and safety of the plant, and operating personnel. Similar support services will be required for the operation of the Transfer Facility.

Although not part of this study, the requirement for and availability of these supporting services must be considered to ensure Transfer Facility operations. The MRS CDR construction schedules, subsequent analysis (where required), and the procurement lead times (Parsons Procurement Outlook, Second Half - 1990 and vendor quotes) were utilized to determine potential construction schedule and long-lead item concerns associated with the Transfer Facility operational support.

5.1 FACILITIES

Section 1 presented a brief description of the support facilities included for the steady-state MRS operations. Table 5-1 presents the need for, services provided, and the estimated construction durations of the various support buildings/services to support the Transfer Facility operations.

5.2 LONG-LEAD ITEMS

Table 5-2 presents a list (and the estimated procurement durations) of the general building material/equipment required for support facility construction/operations.

As noted in Table 5-1, the maximum construction duration of any support facility is estimated to be 12 months. Based on a single-shift/5-day week Transfer Facility construction schedule of 17 months, the construction of the support facilities, except for the Cask Manufacturing Facility, need not be initiated until month five of the MRS construction phase. This provides a procurement window of approximately 22 weeks. If the second half 1990 procurement outlook lead times are valid at the start of MRS

Table 5-1 - MRS Support Facilities

Building/System	Construction Duration (months)	Transfer Facility Support Required
Administration Building	12	The site administrative support functions must be operational (at a reduced scale) at the startup of the Transfer Facility.
Site Services Building	12	The maintenance support and redundant process computer capability is required to support the Transfer Facility operations. Therefore, this building must be operational at the startup of the Transfer Facility.
Warehouse	8	Bulk storage space has not been included in the Transfer Facility. Therefore, this building should be provided for Transfer Facility Operations.
Vehicle Maintenance	10	Onsite transporters, trucks, and other vehicles are required to support Transfer Facility Operations. Therefore, the capability for onsite vehicle maintenance is required.

Table 5-1 (Contd)

Building/System	Construction Duration (months)	Transfer Facility Support Required
Security Building	11	To comply with NRC regulations and DOE Orders, a security force and systems are required upon onsite receipt of radioactive materials.
Inspection Gatehouse	7	
Protective Area Gatehouse	12	
Fire Station	6	This facility is required to provide physical plant protection and first-aid services for operating personnel.
Water Treatment Facility	9	These facilities will be required for operating personnel support, fire protection, and plant operations.
Sewage Treatment Plant	12	
Cask Manufacturing Facility	12	A supply of concrete storage casks is required for the start of Transfer Facility operations.
Standby Generator Building	12	To maintain the Transfer Facilities Ventilation System pressure differentials and to provide safe shutdown of fuel transfer operations, an alternate power supply is required if the site power supply is interrupted.

Table 5-2 - General Building Material/Equipment Lead Times

Item	Lead Time ^a (weeks)
Reinforcing Steel	20
Structural Steel	24
Metal Decking	20
Pipe, Fabricated	28
Pipe, Plain	16
Fittings	10
Valves	28
Compressors	60
Cranes, Standard	34
Heat Exchangers	40
Vessels, Pressure	32
Instruments	18-30
Control Valves	16
Motor Control Centers	32
Motors	48
Switchgear	32
Transformers	38
Pumps, Centrifugal	36
Boilers, Packaged	60
Air Handling Units	20

^aGFE bid and award cycle assumed to be 6 weeks; GFE delivery time assumed to be 2 weeks.

construction, all building shell elements can be procured by the contractor and delivered to the site to meet their installation schedule milestones.

For this evaluation it has been assumed that the support facility equipment installation milestones are a minimum of 6 months (26 weeks) after the start of the facility(s) construction. Therefore, the equipment procurement window is approximately 48 weeks after start of MRS construction. Based on the lead times presented in Table 5-2, all support facility equipment, except compressors and packaged boilers, can be procured by the construction contractor.

The Cask Manufacturing Facility must be operational, with an adequate supply of materials and fabricated items, approximately 3 months prior to Transfer Facility startup to ensure a supply of storage casks; therefore, the procurement window for materials of construction is approximately 9 weeks (plus their installation need date) after start of construction. Assuming a 6-month equipment installation milestone, the need date for facility equipment installation is 34 weeks after construction start. Consequently, long-lead procurement is required for reinforcing steel, motors, compressors, packaged boilers, and may be required for structural steel.

SECTION 6

HEALTH AND SAFETY EVALUATION

The design of the Transfer Facility is based on the public, personnel, and environmental health and safety design parameters used in the MRS CDR and subsequent studies such as the Task B Report. Although this section summarizes these parameters and related design features, the primary purpose is to identify new health and safety features incorporated and any concerns (either security, radiological or industrial) which are unique to the interim operation of the Transfer Facility prior to the completion and startup of the full MRS Facility.

6.1 DESIGN PARAMETERS

The predecessor design parameters and methodology relate to the identification of radiation sources, radiation protection, criticality prevention, contamination control, and radiation monitoring.

6.1.1 RADIATION SOURCES

The dominant radiation source within the Transfer Facility is the spent fuel assemblies prior to, during, and after the in-cell transfer from a transport cask to a concrete storage cask. The nominal spent fuel burnup is 55,000 MWD/MTU and the spent fuel is at least 5 years out of the reactor. The location and quantity of the assemblies establish the requirements for shielding and for equipment and operations. The three locations of multiple spent fuel assemblies are: 1) in the transport cask, 2) in the storage cask, and 3) in in-cell lag storage, when used.

Radioactive contamination is anticipated in the transfer cell, especially from BWR fuel, as loose crud is dislodged from the spent fuel assemblies during the transfer. Similarly, the fuel grapples will become contaminated due to the direct contact with the spent fuel. The contamination levels in the cell will not significantly influence the shielding design and should be reasonably confined to the cell floor, lag storage (if used), and the fuel grapples. Any airborne constituents, should they be

present, will be deposited on the HVAC filters (nontestable in-cell and possibly the first-stage HEPAs) and on other cell and in-cell equipment surfaces. The decontamination collection system components will contain radioactive materials as a result of cell and equipment decontamination during and/or at the conclusion of the Transfer Facility operations.

Residual radioactive contamination will also be present in the transport casks after the spent fuel is removed. The primary source of this contamination should be crud dislodged during transport, unless a failed fuel assembly is shipped or a fuel rod cladding breach occurs during shipment. The contamination internal to the transport casks should only impact facility operations and personnel exposure if cask repair operations are required. Repair operations will result in additional radioactive constituents in the decontamination system and potential contamination of handling equipment and end effectors during cask decontamination. A potential also exists for airborne contamination deposit on the cask repair room surfaces and HVAC filters.

6.1.2 RADIATION PROTECTION

Radiation protection for operating personnel and the public is based on ALARA principles in the design of the radiation shielding and of the facility layout and equipment selection. The increased use of robotics in the Transfer Facility as compared to predecessor designs further reduces the potential for personnel exposure.

6.1.2.1 Shielding

Reduction of radiation exposure is one of the major design objectives of the facility design. As such, the facility design and the equipment selected have included the design considerations for operation, maintenance, and replacement to meet the ALARA design criteria for radiation exposure. The shielding provided permits operation without exposing personnel to radiation levels greater than that recommended by DOE Order 5480.1B and ALARA Guide DOE/EV 1830-T5. The quantity of spent fuel exposed or stored in the transfer cell, plus the potential for accumulated contamination in the cell, are reduced from that presented in the MRS CDR because of the comparatively simple

handling operations. However, the thickness of shielding for cell walls and floor, doors, and windows has been retained from the MRS CDR since no analyses were performed specifically for this facility design and operation.

The Transfer Facility utilizes air locks, air control vestibules, and operating galleries similar to predecessor designs to provide radiation zones consistent with the DOE ALARA guidelines. Table 6-1 presents the radiation zoning definitions and exposure limits.

6.1.2.2 Remote Equipment

In addition to the use of a remotely operated power mast crane for the in-cell transfer of spent fuel, transport cask handling operations include the utilization of robotics for the removal of the outer cover and inner cover bolts, if required. The cask repair area also employs a remotely operated system. The two latter applications were not present in the MRS CDR or Task B designs.

A. In-Cell Crane

Although used in MRS CDR designs, the 20-ton power mast crane in the Transfer Facility does not include a separate servomanipulator system mounted on the crane trolley. Routine operations utilizing a manipulator are not required in the transfer of the spent fuel; however, a single manipulator arm is proposed as an end effector for the crane to facilitate changing of in-cell filters and for possible maintenance functions such as cell decontamination. This change in design/operations approach maximizes the operating envelope of the crane and minimizes cell space requirements. Contact maintenance of the crane and associated end effectors is performed in the crane maintenance bay after semiremote decontamination is completed.

Although only one crane is required in order to meet the initial throughput requirements, a second crane is provided to preclude extended downtime of in-cell operations during maintenance. The spare crane is housed in its maintenance bay when not in use in order to reduce radiation damage and potential contamination of crane components.

Table 6-1 - Radiation Zoning

Zone	Definition	Design Dose Limit (mrem/hr)	Annual Dose ^a (rem/yr)	Remarks
<u>Uncontrolled Area</u>				
1	Unlimited Access Area	Background	0.25	Public access areas
<u>Controlled Area</u>				
2	Contingent Zone	0.125	0.25	Corridors adjacent to areas containing radio- active materials Locker rooms Emergency decon
3	General Operation & Labs Zone	0.25	0.375	Working areas with small or moderate inventories of radioactive mate- rials
4	Process Operation Zone	0.75	0.75	Working areas involving more radioactivity than general operation zone
5	Intermittent Operation Zone	2.5	1.25	Liquid radwaste Remote equipment maintenance Equipment decon
6	Remote Operation Zone	10.0	5.0	Areas of high hazard and forbid- den occupancy
7	Isolation Zone	-	-	Inside hot cell (not normally accessible)

^aThe annual dose is calculated on the following basis:

- o 1 yr = 50 weeks
- o Average weekly working time:

Zone 1: 40 hr	Zone 3: 30 hr	Zone 5: 10 hr
Zone 2: 40 hr	Zone 4: 20 hr	Zone 6: 10 hr

Through-wall master/slave manipulators have also been included in the design and cost estimate. Although not required for routine operations, provisions have been made to install units at any of the three transfer cell shielding windows. The cost estimate reflects the cost of standard, single-unit manipulators, although units with demountable master and slave arms are available. The standard units cost approximately 40% of the more elaborate demountable units and can have a greater lifting capacity. The demountable units can be installed more quickly and have less potential for contamination during removal, but the limited use currently anticipated for the manipulators does not warrant the increased cost.

B. Cask Cover Robotics

Space and support systems have been provided for robotic equipment in each of the transport cask preparation and decontamination rooms. The proposed equipment is based on operating requirements presented in the 1984 report by HEDL. The system is mounted on an elevated platform near the top of the transport cask and is used to loosen the captive bolts of the cover. Controls for the robotics are installed in the robotics control room in the receiving bay, with supervisory monitoring of the system from the Transfer Facility control room. The robotics system is contact maintained after semiremote decontamination is performed.

The addition of the cask robotics is in response to previous radiation exposure analyses that identified these cask preparation operations as a major source of personnel exposure.

C. Cask Repair

After the completion of the MRS CDR and the Task B Report, the potential need to replace transport cask seals at the MRS Facility was identified. The Transfer Facility includes a separate area and required equipment for this added operation. After unloading, the seal is inspected using the in-cell crane CCTV system. If the seal is to be replaced, the empty cask is closed and transferred to the cask repair room. A bridge-mounted servomanipulator and crane system is used to:

- (1) Reopen the cask.
- (2) Remotely decontaminate the cask interior to minimize the potential for contamination spread.
- (3) Replace the seal.
- (4) Close the cask.

The manipulator operators and controls are in the robotics control room used for the cask cover robotics. As with the previous systems, contact maintenance methods will be used after the system is semiremotely decontaminated.

6.1.3 CRITICALITY PREVENTION

Because of the presence of fissionable material in the spent fuel assemblies, the potential for criticality exists. As in predecessor designs, spent fuel in storage (lag storage or storage cask) is maintained in a subcritical array by fuel baskets or racks. Note that in-cell lag storage has been provided as an operations contingency and is not normally in use. The storage racks are designed to hold the equivalent of the contents of one concrete storage cask.

As shown by calculations in the MRS CDR, criticality can only occur if a moderator is present. No source of water is present in either the transfer cell or the casks during normal operations. The decontamination piping into the cell includes spool pieces which must be installed prior to any decontamination operation. Before cell decontamination is initiated, all spent fuel assemblies would be removed from the cell and all loading/unloading port plugs closed.

A low probability exists for fissionable products to be in the liquid radwaste storage tank since only fuel transfer (no disassembly or fuel rod handling) is performed in the Transfer Facility. Receipt of breached fuel or the dropping of an assembly are possible, but the quantity of released fission product which would be removed by decontamination of the cell should be subcritical. However, future design efforts will include accident and criticality analyses to verify this premise. If the potential for significant quantities of fissionable products in the waste

stream does exist, the liquid radwaste storage (and the future processing system) will be designed to ensure criticality safety.

6.1.4 CONTAMINATION CONTROL

Contamination control is provided by a combination of:

- (1) Physical containment of the nuclear materials within established barriers such as the casks, the cell, or liquid radwaste system components.
- (2) Use of ventilation confinement zoning.

6.1.4.1 Containment

The facility is designed to contain radioactive contamination and to restrict the spread of contamination. As stated in Subsection 6.1.1, radioactive materials will be routinely present in transport casks, the transfer cell, storage casks, and the decontamination collection and storage system. The greatest potential for contamination spread is during the transfer of radioactive materials between the major containment systems, with a lesser potential present at sealed penetrations/openings into these systems.

The unloading and loading ports of the transfer cell are equipped with contamination barriers to minimize the potential for the spread of contamination during cask unloading/loading. The contamination barriers interface with shipping cask adapters designed to present a common interface to the cell port. Based on data received on the current designs for the transport casks, the unloading ports and cask adapter size variations have been reduced to one each for the rail and truck casks. The cell ports for transport cask unloading are also modified from previous designs. Each port will use a two-piece port plug (a "dough-nut") which can better accommodate the specific sizes of the two cask configurations. These features provide better assurance that contamination spread will be minimized in the loading/unloading rooms where the casks are present.

Utility piping systems are kept to a minimum in the operating areas, and are arranged to facilitate decontamination. Because of the limited years of operation, the decontamination system uses

mobile carts in lieu of permanently installed tankage, piping, and other chemical make-up systems. All piping systems that contain contaminated liquids are isolated from uncontaminated (clean) systems. Drains from the shielded cell and other potentially radioactive waste streams are routed through doubly encased lines (original line inside a secondary encasing line) to the liquid radwaste storage tanks. Sample drains will be installed in the secondary encasing pipe to monitor leaks in the original pipe. Effluent from personnel decontamination sinks and showers, and other similar streams, are connected to the radwaste system.

Surfaces of contaminated and potentially contaminated areas in the facility have finishes to accommodate easy decontamination. The selected finishes reflect the projected short duration of operation, rather than the more typical finishes such as stainless steel and epoxy coatings extensively used in nuclear installations which require routine and frequent decontamination during an operating life of ten years or more.

Another important aspect of the containment design is the ability to withstand a design basis accident (DBA) such as an earthquake or tornado-generated missiles. As with the predecessor design efforts, areas which contain exposed nuclear materials or which must remain operational during the DBA have been designed as Category I structures. These areas include the cask loading/unloading rooms, cask repair, the transfer cell and its associated crane maintenance bays, and the exhaust filter and fan rooms.

6.1.4.2 Confinement

The HVAC systems provide an environment necessary for personnel comfort and safety, and for protection of personnel and the public during normal, abnormal, and accident operating conditions.

All areas containing radioactive materials are equipped with a ventilation system designed to maintain internal air pressure negative with respect to atmospheric pressure. These systems include high-efficiency particulate air (HEPA) filters, both nontestable (in the transfer cell) and testable (first and second stage exhaust), to limit the release of contaminants to the

environment at the point of release within the constraints of 10 CFR 20. Building areas are divided into ventilation-control zones based on the relative potential for exposure of personnel to airborne radionuclides. To limit contamination spread, air-control vestibules, backdraft dampers, and other barriers are provided to separate ventilation control zones from one another. The control room is maintained at a slightly higher positive pressure by a separate HVAC system.

6.1.5 RADIATION MONITORING

Site monitoring systems are capable of detecting releases of radioactive material greater than 0.1% of 10 CFR 20, Appendix B, Table II. Operating personnel and the public are protected by the containment and confinement systems from releases of radioactive particulate material and gases that would cause exposure of operating personnel and the public (as measured at the site boundary) to doses greater than those defined in 10 CFR 20, and applicable DOE regulations.

Area radiation monitors are located throughout the facility to alert operations personnel to changes in (or unusual) radiation levels. Audible and visual alarms are automatically activated at the control room. Air monitors and samplers are provided to collect samples of airborne particulates to be analyzed for radioactivity that might be released from operating areas or storage receptacles. All potentially contaminated work areas are equipped with personnel monitoring equipment to be used in checking all personnel for contamination upon leaving the work areas.

All monitoring systems are capable of measuring the process parameters related to system integrity, radiological safety, and retrievability over the full range of levels anticipated during normal or credible abnormal conditions. Systems are provided to monitor:

- (1) Loss of fuel integrity
- (2) Loss of ventilation
- (3) Loss of filtration
- (4) Gaseous and liquid effluent releases

6.1.6 FIRE PROTECTION

The Transfer Facility is constructed of noncombustible materials; contains no supplies of flammable gases or liquids, except that contained on or in transportation cask carriers; and performs no processing operations which produces flammable materials. Therefore, the only potential fire hazard present in the facility are paper and cloth products and cleaning solvents used by operations personnel and the potential for electrical fires.

Costs have been allocated for a fire protection system which includes an automatic wet-pipe sprinkler system throughout the facility, except in electrical equipment rooms and transfer cell. Areas of high value or of high program importance (e.g., computer areas/control rooms and electrical equipment rooms) are provided with a total-flooding Halon 1301 system. In addition, portable extinguishers are installed throughout the facility.

A facility fire alarm system consisting of an alarm annunciator panel, located in the control room; smoke detectors; fire sensors; manual fire alarm stations; and a local and audible alarm is provided in the facility. The Transfer Facility fire-alarm system is connected to the MRS central fire-alarm computer and event/recorder/printer of the plantwide fire alarm system. The fire alarm computer is UL-listed. A repeater system is located in the Security Building. All fire-alarm systems are connected to the radio dispatch room at the Fire Station and at the Security Building.

6.2 INTERIM OPERATION

Security, industrial safety, and radiological safety concerns may arise during the interim operation of the Transfer Facility since construction activities will be in-progress on the MRS site. Although a majority of the buildings must be completed and operational to support the Transfer Facility, construction will continue in the cask storage area and in the immediate vicinity of the spent fuel transfer operations.

The 2 years of MRS Facility operation require a storage capacity for approximately 82 concrete storage casks from the Transfer Facility. Assuming that the primary operating building of the MRS Facility will be the SFHB, spent fuel received in the second year

will be handled in the Transfer Facility while the SFHB hot testing is completed and the facility brought online for full production.

6.2.1 SECURITY

With the presence of special nuclear materials onsite, construction personnel must be cleared for access. Since the SFHB is connected to the operating Transfer Facility, it is not possible to provide separate, double-fenced access corridors to the construction site. As can be seen on the site plan, the SFHB is surrounded by activities involving spent fuel handling or storage. Providing clearances to a construction crew of approximately 200 will:

- (1) Place a burden on the site security staff or may require additional security personnel not currently shown in the study.
- (2) Adversely affect construction productivity due to delays at security checkpoints of both personnel and material deliveries.

6.2.2 STORAGE FACILITY CONSTRUCTION

In order to ensure that construction personnel do not compromise the security requirements for spent fuel handling and storage, enough storage pads must be constructed to maintain a 100-meter separation between the casks and the construction crew. This same separation distance maintains the personnel exposure of the construction crew included in storage pad additions to below the acceptable limits for operating personnel defined in 10 CFR 20. Defining the crew as operating personnel modifies the exposure duration to a typical work day rather than the 24-hour duration used for calculating public exposure.

Concurrent activities of storage placement and construction are not unique to this study, since storage pads will be constructed during MRS operation until the maximum onsite storage capacity can be accommodated.

6.2.3 CASK MANUFACTURING FACILITY

As stated in Section 5, the Cask Manufacturing Facility (CMF) must be operational in time to start producing storage casks prior to the start of the Transfer Facility operations. Assuming the batch plant (and potentially portions of the steel fabrication area) of the manufacturing facility will be used by the construction force, the delivery of construction materials from this facility to the SFHB and the storage area have both logistic and security access implications.

It may be desirable to require the construction contractor to have a separate batch plant area external to the CMF, with construction access to the SFHB via the support facility, limited access area, or a dedicated access route. The offsite plant would be of a smaller capacity since the majority of the large concrete pours will have been completed. The concrete requirements for the storage area would still be met by the CMF since this is an intermittent, yet frequent, requirement until the full storage area capacity is completed. Although batch plant capacity and delivery of concrete to the construction location can be resolved, the security access issue still remains.

6.2.4 TRANSFER FACILITY

The operation of the Transfer Facility during completion of SFHB construction also poses a challenge to minimize security, radiological, and industrial safety concerns. The receiving bay and related equipment is a common element between the two buildings. A majority of the building construction for the SFHB which abuts the receiving bay is completed when the first spent fuel is received; however, some third-floor and roof concrete placement and a majority of the equipment for the building support systems must still be completed in the SFHB.

Radiation protection for a limited duration of exposure of the operating and construction personnel is provided by the shielding design of the Transfer Facility building elements. Although an increase in exposure is possible during transport cask preparation activities, construction personnel will be precluded from entering the receiving bay when casks are present.

Areas adjacent to the construction site will also contain heavy construction equipment. Vehicular traffic in and around the area will have a mixture of construction material delivery and spent fuel cask deliveries.

SECTION 7

OTHER EVALUATIONS

The Transfer Facility design and/or operation was evaluated to determine the impact from:

- (1) Receiving canistered spent fuel
- (2) Modular expansion of the facility
- (3) Additional use of prefabricated building elements

7.1 CANISTERED SPENT FUEL

This section presents the modifications or additions to the Transfer Facility, as described in Section 4, required for receipt and handling of spent fuel canistered at the reactor.

7.1.1 ASSUMPTIONS

In addition to the criteria and assumptions presented in Section 2, the following assumptions were made for this operational mode:

- (1) Each canister contains one bare intact spent fuel assembly.
- (2) The canisters are slightly larger than an intact spent fuel assembly.
- (3) Canistered spent fuel transport casks are of the same configuration as the bare intact spent fuel transport casks.
- (4) The canisters are either inerted at the waste generator site or are vented so that the contained air can be replaced with inert gas during storage cask inerting, if required.

7.1.2 TRANSFER FACILITY MODIFICATIONS

As designed for spent fuel transfer, the Transfer Facility arrangement and dimensions can handle canistered spent fuel. However, the following modifications and/or additions to the operational equipment are required:

- (1) The addition of a grapple designed for canister handling.
- (2) The lag storage rack modules modified to accept the canister configuration.
- (3) The concrete storage cask basket structures modified to suit the canister configuration.

If the canisters contain consolidated fuel in lieu of a single intact assembly (Assumption 1), the storage cask capacity will be impacted. The PWR intact assembly capacity of the storage cask is restrained by the cask thermal capacity and the BWR intact assembly capacity is restrained by the cask internal dimension. Based on a canister capacity of either 2-PWR or 5-BWR consolidated assemblies, the storage cask capacity is limited by its thermal capacity for either type of fuel. Due to this thermal restraint, the cask can be loaded with 16-PWR or 20-BWR canisters without exceeding Task B Report thermal constraint of 18 kW. Further analysis of the ventilated storage cask design may result in a larger thermal capacity and, therefore, a larger capacity for canisters of consolidated fuel.

7.1.3 COST

It is estimated that the Transfer Facility modifications and/or additions required to accommodate canistered, consolidated spent fuel would increase the cost of construction by less than \$100,000. The storage cask basket reconfiguration should not require additional construction materials and, therefore, will not impact the cost per storage cask presented in the Task B Report.

7.2 MODULAR EXPANSION

This section describes the modification or addition to the base case Transfer Facility arrangement, as discussed in Section 4, to

accommodate a modular expansion of the facility to achieve the full spent fuel receiving/handling capability required for MRS operations. The modular expansion concept assumes that a Transfer Facility(s) similar to that described in Section 4 will replace the SFHB for all MRS cask and spent fuel handling functions. The number of Transfer Facility modules will be contingent upon the maximum receipt/shipping rates, modal mix, transportation cask configuration, and the distribution of the types of assemblies handled. For the purpose of this study, the criteria and assumptions of Section 2 were used to determine the configuration of the modular Transfer Facility.

7.2.1 FACILITY ARRANGEMENT

As shown in Figure 7-1 and 7-2, the proposed modular expansion of the MRS Facility can be one or more Transfer Facilities using a common receiving bay. To fulfill the functional operating requirements of an MRS, the initial module (TF-1) must provide a liquid and solid radwaste treatment and packaging system, a sample analysis capability, administrative and personnel support services, and a laundry as provided within the SFHB. The addition of these systems/services will require additional building space to that identified for the base case Transfer Facility (TF-2) described in Section 4. However, all cask and spent fuel handling functions, operations, and associated building spaces for each module is identical to that described for the TF-2 arrangement. If a pair of transfer facilities are required, the common receiving bay is identical to that required for the SFHB/Transfer Facility arrangement.

As provided in the SFHB concept, the common receiving bay will require the necessary cask handling cranes, handling fixtures, car pullers, and other cask/carrier handling/moving equipment. Therefore, the additional capital costs are included in the TF-1 cost account.

It should be noted that the Transfer Facility includes operational functions and associated costs which are not provided for the SFHB. These functions include a transportation cask seal repair and internal decontamination capability, in addition to a transportation cask robotic handling capability, both of which are included in the base case facility costs.

Figure 7-1 - Transfer Facility (perspective view)

Figure 7-2 - Transfer Facility Modular Expansion

If the modular concept is used for MRS operations, it is recommended the epoxy coatings used for the surface finish of the base case transfer cell and crane maintenance areas be replaced with a stainless steel liner. The liner will provide a more durable surface which will reduce long-term maintenance requirements.

The Task B Report SFHB concept (Scenario 3) requires a concrete storage cask transporter, cask handling fixtures, and a crawler crane for cask transfer and placement in storage. Since the Transfer Facility concept uses a straddle carrier for concrete storage cask handling, the SFHB storage cask handling equipment can be deleted from the Task B Report Interim Storage Operations Cost Account. If transportable metal storage cask are to be received at the MRS, the Transfer Facility Storage Cask Straddle Carrier will be used for transportable metal storage cask handling in the storage yard.

7.2.2 COST

Unit costs associated with the modular concept(s) are presented in Table 7-1. Total system cost data for a stand-alone single unit Transfer Facility (TF-1) is provided in Tables 7-2 through 7-7.

7.2.3 SCHEDULE

As noted in Section 4, the single-shift construction schedule for the base case TF-2 facility arrangement is 17 months, plus an additional month if a stainless steel liner is installed. All additions to the TF-2 arrangement to achieve the TF-1 configuration, except the radwaste treatment and packaging system and its associated building spaces, can be constructed within the 18-month schedule. The radwaste building addition is located adjacent to and depends upon the central core for support of its structural elements, thus determining the initiation of radwaste equipment and supporting system installation. This schedule restraint will require an additional 2 months to construct the TF-1 facility. Therefore, the single or pair Transfer Facility module will require 20 months on a single-shift schedule or 18 months on a two-shift concrete placement schedule. The design and construction schedule for a stand-alone single unit Transfer Facility (TF-1) is presented in Figure 7-3.

Table 7-1 - Modular Concept Costs

Element	Unit Cost (\$ million)
<u>Stand-Alone Transfer Facility TF-1 Costs</u>	
Base Case Facility	45.2
Receiving Bay (46 ft wide)	5.0
Receiving Bay Equipment	2.9
Radwaste Treatment and Packaging	10.0
Personnel and Administrative Support Areas, including laundry and sample laboratory	2.7
Stainless Steel Liners	<u>0.6</u>
Subtotal	66.4
<u>Transfer Facility TF-2 Costs</u>	
Base Case Facility	45.2
Receiving Bay Enlargement (30-ft-wide addition)	3.2
Stainless Steel Liners	<u>0.6</u>
Subtotal	49.0
<u>Interim Storage Operations Costs</u>	
Storage Cask Equipment	(8.9)
Transportable Metal Cask Equipment	(4.5)
TF Cask Transporter	1.0

Transfer Facility
Storage Concept, CostDate: 9/12/90
Revision: 0

Percent of M & I Cost per Year Prior to Operations

COST CENTER/Cost Element	Cost (Millions \$)	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	+1	+2	+3
MANAGEMENT AND INTEGRATION														
Site Selection/Investigation	8.6					100								
Design														
Proof-of-Principle Tests (3 Tests)	0.5					100								
Advanced Conceptual Design	9.3					50	50							
License Application Design	16.8					90	90	10						
Licensing Support	4.2							50	40	10				
Final Procurement and Construction Design	11.2							100						
Title III Support	9.3									40	60			
Operating Contractor Support														
Design	4.0					15	46	39						
Construction	5.0									40	60			
Construction Management	27.9									40	60			
Preoperational Testing and Personnel Training	32.7						7	11	17	24	41			

TABLE 7-2 - MANAGEMENT AND INTEGRATION COST DISTRIBUTION

Date: 9/12/90
Revision: 0

Transfer Facility
Storage Concept: Cask

Millions in 1990 \$				
COST CENTER/Cost Element	Building Area	Facility Cost	Equipment Cost	Total Cost
CASK OPERATIONS				
Receiving	N/A	3.7	--	3.7
Cask Lag Storage	N/A	3.3	--	3.3
WASTE HANDLING OPERATIONS				
TRANSFER FACILITY				
Cask Unloading	21160	5.0	2.9	7.9
Assembly Lag Storage	200	0.2	0.1	0.3
Processing	11067	10.6	16.0	26.6
Interim Storage Loading/Unloading	4637	3.4	1.4	4.8
Building Support Facilities	48397	17.7	9.1	26.8
INTERIM STORAGE OPERATIONS				
Storage Facilities	N/A	\$7506/cask	1.0	--
Storage Units	N/A			
BALANCE OF PLANT AND SUPPORT OPERATIONS				
Onsite Preparation	N/A	35.8	--	35.8
Offsite Preparation	N/A	18.1	--	18.1
Administration	N/A	2.9	0.5	3.4
Other Support Facilities	N/A	46.9	21.0	67.9

See Consumables, Table 7-5

TABLE 7-3 - CONSTRUCTION COSTS

Date: 9/12/90
Revision: 0

Transfer Facility
Storage Concept: Cask

COST CENTER/Cost Element	Percent of Facility/Construction Cost by Year Prior to Start-up					
	-6	-5	-4	-3	-2	1st Year -1 Operations
CASK OPERATIONS						
Receiving						
Cask Lag Storage					40	60
WASTE HANDLING OPERATIONS						
TRANSFER FACILITY						
Cask Unloading					40	60
Assembly Lag Storage						
Processing						
Interim Storage Loading/Unloading						
Building Support Facilities						
INTERIM STORAGE OPERATIONS						
Storage Facilities					40	60
Storage Units						
BALANCE OF PLANT AND SUPPORT OPERATIONS						
Onsite Preparation					40	60
Offsite Preparation						
Administration						
Other Support Facilities						

TABLE 7-4 - CONSTRUCTION COST DISTRIBUTION

Transfer Facility
Storage Concept: Cask

COST CENTER/Cost Element	Equipment Maintenance/Replacement (1/Year)			Consumables
	Annual	10 Year	20 Year	
CASK OPERATIONS				
Receiving				\$0.014 M/Year Fixed
Cask Lag Storage				
WASTE HANDLING OPERATIONS				
TRANSFER FACILITY				\$2.140 M/Year Fixed
Cask Unloading	2.0			
Assembly Lag Storage	1.0			
Processing	1.5	1.0		
Interim Storage Loading/Unloading	1.2		24.0	
Building Support Facilities	1.2	4.3	12.3	Brans - \$100/Unit
INTERIM STORAGE OPERATIONS				
Storage Facilities	2.0	0.8	95	\$0.050 M/Year Fixed
Storage Units				Cask - \$0.200 M/Unit
BALANCE OF PLANT AND SUPPORT OPERATIONS				\$1.550 M/Year Fixed
Onsite Preparation				
Offsite Preparation				
Administration	3.1	35.4	37.3	
Other Support Facilities	1.6	55.9	24.0	

TABLE 7-5 - ANNUAL OPERATING COSTS

Date: 9/12/90
Revision: 0

Transfer Facility
Storage Concept: Cask

COST CENTER/Functional Activity by Crew

Processing Time/Unit Processed
(in minutes)

FTR/Crew

Annual \$/FTR

Notes

CASK OPERATIONS

Receive & inspect transport casks

Receive - 95/cask

4

\$53,900

WASTE HANDLING OPERATIONS

TRANSFER FACILITY

Prepare reactor/HWR transport casks for
unloading (incl. 75 min. for washdown)

Truck - 515/cask
Rail - 615/cask

6.5

\$53,900

Two crews per shift

Unload transport casks

FTR - 170(F); 550(R)
HWR - 270(F); 1170(R)

3

\$53,900

Single crew per shift used for all
unloading and SF handling operations

Spent fuel handling,
log storage

FTR - 695/otor.cask
HWR - 1655/otor.cask

N/A

Add 130 min. if log storage baskets
require replacement

storage cask loading

55/cask

N/A

Fuel transfer/loading included in
transport cask

Building support staff

N/A

Includer admin. functions housed in
adjacent trailer (6 FTR); add 2 FTR for
each op. shift

INTERIM STORAGE OPERATIONS

Storage cask preparation & closing

255/cask

4

\$53,900

One crew per shift

Storage placement (incl. 30 min. to obtain new cask)

85/cask

5

\$53,900

BALANCE OF PLANT AND SUPPORT OPERATIONS

Site support staff (excl. Cask Mfg. Facility of 11)

N/A

264

\$53,900

TABLE 7-6 - STAFFING ALLOCATIONS BY FUNCTIONAL ACTIVITIES

Date: 9/12/90
Revision: 0

Transfer Facility
Storage Concept: Cask

COST CENTER/Cost Element	% of Total Constr. Cost	Percent of Decommissioning Cost by Year After Last Year of Operations					
		-2	-1	0	+1	+2	+3
CASK OPERATIONS	5						
Receiving							
Cask Lag Storage							
WASTE HANDLING OPERATIONS							
TRANSFER FACILITY	12						
Cask Unloading							
Assembly Lag Storage							
Processing							
Interim Storage Loading/Unloading							
Building Support Facilities							
INTERIM STORAGE OPERATIONS	12						
Storage Facilities							
Storage Units							
BALANCE OF PLANT AND SUPPORT OPERATIONS	1						
Onsite Preparation							
Offsite Preparation							
Administration							
Other Support Facilities							

TABLE 7-7 - DECOMMISSIONING COSTS AND DISTRIBUTION

Figure 7-3 - MRS Facility - Stand Alone Transfer Facility Schedule

If the radwaste system is included in a building adjacent to (but separated from) the Transfer Facility, it can be constructed concurrently with the Transfer Facility, which will shorten the Transfer Facility construction schedule to 18 months.

7.2.4 STAFFING

The base case Transfer Facility, described in Section 4, was designed for an interim operation prior to the completion of the SFHB. The basis for the operating shifts and related staff was the data presented in Table 2-1.

Staff requirements vary, based on the number of modules and/or the number of operating shifts required to accommodate a projected throughput. To determine the fuel receipt and handling capability of the base case Transfer Facility (one module), the average transportation modal mix and spent fuel distribution presented in Section 2 were used. The results of the evaluation, and the total FTE staff and shifts for the Transfer Facility and interim storage operations, are presented in Table 7-8.

7.3 OFFSITE PREFABRICATION

This section presents the evaluations conducted to determine the feasibility of offsite prefabrication of Transfer Facility building elements.

7.3.1 TRANSFER FACILITY DESIGN

The Transfer Facility design includes building elements which are commonly fabricated in offsite shops; therefore, the following items are assumed to be prefabricated and delivered to the jobsite for installation:

- (1) All reinforcing steel, except that required for the central core (cask handling and transfer cell areas) mat foundation and the cask handling area slab-on-grade, which are scheduled for installation during the early weeks of construction. It is assumed that the reinforcing for these elements can be obtained from warehouse stock and cut to length at the jobsite.

Table 7-8 - Annual Fuel Receipt Capability

	Operating Shifts (per week)			
	<u>5</u>	<u>10</u>	<u>15</u>	<u>21</u>
<u>Base Case</u> ^a	546 MTU	976 MTU	N/A	N/A
<u>Modal Mix</u> ^b				
100% Truck	700 MTU	1,400 MTU	2,100 MTU	2,940 MTU
100% Rail	1,750 MTU	3,500 MTU	5,250 MTU	7,330 MTU
<u>Fuel Mix</u> ^c				
70% PWR/30% BWR	810 MTU	1,620 MTU	2,430 MTU	3,400 MTU
45% PWR/55% PWR	820 MTU	1,640 MTU	2,460 MTU	3,440 MTU
<u>Staff (FTE)</u>				
Transfer Facility	57	82	107	132
Interim Storage	4	8	12	16

^aReceipt per Table 2-1.

^bFuel mix of 60% PWR/40% BWR.

^cModal mix of 60% truck/40% rail.

- (2) All structural steel required for the support area framing.
- (3) All-metal deck for the support area floors and roof and for the discharge area roof. It is assumed that the support area concrete floors and roof would be installed on self-supporting metal deck to reduce the time required for forming, shoring, and stripping wood forms and to provide early access to the constructed areas.
- (4) The Transfer Cell floor and roof is assumed to be installed on precast concrete planks to reduce the time for forming, shoring, and stripping wood forms, and to provide early access to constructed areas.
- (5) All insulated metal wall panels.

7.3.2 OTHER CONSIDERATIONS

In lieu of poured exterior concrete walls, the use of precast concrete panels attached to a structural frame was evaluated for use to affect a reduced construction schedule. Since the Transfer Facility construction schedule considered concurrent construction activities wherever possible, the exterior walls are scheduled to be constructed concurrently with the central core, since the critical path during the concrete construction phase is the completion of the central core. Sufficient schedule time is available for construction of poured-concrete exterior walls, thus eliminating the need for an exterior structural frame.

In addition to the precast exterior wall panels, offsite precast concrete was evaluated as an alternative to the 5 ft poured-concrete shield walls. The evaluation included the use of precast concrete panels with a poured-concrete in-fill; and precast wall elements.

The precast shield wall construction must:

- (1) Provide protection from radiation streaming through the joints
- (2) Provide an equivalent of 5 ft of thickness

- (3) Be easily decontaminated
- (4) Minimize air leakage into the cell
- (5) Be of a size and weight which can be transported from offsite and handled onsite

Based on the precast shield wall requirements, the use of precast panel with poured-concrete in-fill was evaluated. The results of the evaluation follow:

- (1) The poured-concrete shield wall construction duration assumed the installation of large wood form panels with integral walers constructed onsite and prior to installation. When required, the forms would be installed with the necessary bracing and shoring to ensure alignment and support during concrete placement. The use of precast concrete panels as a form for concrete in-fill also requires shoring and bracing to ensure panel alignment and support during in-fill placement.

Except for a minimal schedule reduction (the time to strip the wood forms), the use of precast concrete panels as a wall form and subsequently as a permanent element of the shield wall requires the same construction duration as a poured-concrete shield wall.

- (2) The presence of joints between adjacent precast panels provides a potential path for radiation streaming. To ensure the required radiation equivalent, the in-fill thickness is the same (5 ft) as the poured shield wall. Therefore, no construction schedule reduction results from the concrete placement activity.
- (3) To preclude collection of contamination in the precast panel joints on the interior face of the transfer cell, cover plates would be required. The inclusion of cover plate installation would increase the construction duration of the shield walls.
- (4) The monolithic poured-concrete in-fill provides the same protection from air leakage as the poured-concrete shield wall with no impact on construction duration.

- (5) Precast panels can be obtained in the size and weight limits imposed by offsite transportation and onsite handling requirements.

Since the precast panel with a poured-concrete in-fill alternative did not provide a construction schedule reduction from that estimated for a poured shield wall, it was not considered for incorporation into the Transfer Facility construction costing or scheduling.

Based on the precast shield wall requirements, the precast wall elements were evaluated. The results of this evaluation follow:

- (1) To preclude radiation streaming through the joints of adjacent elements, a stopped joint was assumed. The steps of the joint was assumed to be on 1-ft intervals. Therefore, to achieve the 5 ft shielding equivalent, each element must be 6 ft in thickness. Since the elements were assumed to be prefabricated offsite prior to installation, the increase in thickness had no impact on the construction schedule.
- (2) The presence of joints between adjacent elements provides a potential space for contamination accumulation. In addition, the joints provide a potential path for air leakage in or out of the potentially contaminated process areas. Therefore, cover plates would be required over all joints, which would increase the construction duration of the shield wall.
- (3) For transport from offsite, the element is limited by the 36-ton allowable highway loading. This restriction limits the wall element to approximately 64 sq ft or approximately 211 elements for the Transfer Facility shield walls. The installation of elements, their mechanical interties, and the installation of supporting structures to ensure a stable and force resistant structural element will increase the construction duration of the shield walls.
- (4) In addition, this alternative was considered not to be feasible due to the problems associated with the

installation of windows, manipulator ports, and other embeds; quality control of the joint configuration; and the interconnection details to align and hold the elements in position.

Since the precast wall element alternative did not provide a construction schedule reduction from that estimated for a poured-concrete shield, it was not considered for incorporation into the Transfer Facility construction costing or scheduling.

APPENDIX A

TRANSFER FACILITY SITE AND BUILDING DRAWINGS

The appendix presents the following drawings:

- C-1 MRS Facility Transfer Facility
Site Plan
- A-1 MRS Facility Transfer Facility
First Floor Plan
- A-2 MRS Facility Transfer Facility
First Mezzanine Plan
- A-3 MRS Facility Transfer Facility
Second Floor Plan
- A-4 MRS Facility Transfer Facility
Second Mezzanine Plan
- A-5 MRS Facility Transfer Facility
Building Sections

- NOTE:
1. THE STORAGE AREA SHOWN IS FOR A CAPACITY OF 15,000 MTU.
 2. FACILITIES NOT REQUIRED FOR TRANSFER FACILITY OPERATIONS (FIRST TWO YEARS).

REFERENCE DRAWINGS
NEXT USED ON

REV.	DATE	BY	CHK.	DESCRIPTION
1	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
2	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
3	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
4	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
5	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
6	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
7	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
8	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
9	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION
10	10/1/68	JOP	JOP	ISSUED FOR CONSTRUCTION

U.S. Department of Energy Richland Operations Office PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE THE RALPH W. PARSONS COMPANY OF DELAWARE MRS FACILITY TRANSFER FACILITY SITE PLAN	
SCALE 1" = 200' CLASSIFIED BY NOT RECD CLASSIFICATION NONE	JOP# C-1

DESIGN FILE: 44171 11/40/00/MPV/BA
BY: 44171/00/MPV/BA

COMBINED VESTIBULE/RECEIVING
TRANSFER FACILITY SPENT FUEL HANDLING BLDG

1" = 10'-0"

JQP#

DATE	BY	DESCRIPTION
10/1/77	SA	REVISED
10/1/77	SA	REVISED
10/1/77	SA	REVISED
10/1/77	SA	REVISED
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10/1/77	SA	REVISED

U. S. Department Of Energy National Operations Office	
PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE	
THE RALPH M. PARSONS COMPANY OF DELAWARE	
MRS FACILITY TRANSFER FACILITY FIRST FLOOR PLAN	
SCALE: 1/16" = 1'-0"	NOT RECD
DATE: 10/1/77	BY: SA
APPROVED: NONE	REVIEWED: NONE

NO.	DATE	BY	DESCRIPTION
1	10/1/77	SA	REVISED
2	10/1/77	SA	REVISED
3	10/1/77	SA	REVISED
4	10/1/77	SA	REVISED
5	10/1/77	SA	REVISED
6	10/1/77	SA	REVISED
7	10/1/77	SA	REVISED
8	10/1/77	SA	REVISED
9	10/1/77	SA	REVISED
10	10/1/77	SA	REVISED

A-1

UPPER PART OF
VESTIBULE

FREIGHT
PA SENGLE
ELEVATOR

VESTIBULE

EXHAUST FAN
ROOM

MAIN
FLOOR

UTILITY CH.

SUPPLY FAN
ROOM

EXHAUST
FAN

134' 0"

7' 6"

1st of Inspection

ROOM

HANDS ON MAINTENANCE STORAGE

OPERATING GALLERY

TRANSFER CELL (3.0' x 7.4 0')

TRANSFER HATCH

HEPA FILTERS

AIR STORAGE

CHANGE ROOM

AIR LOCK

DOOR TO CRANE MAINT

114'-0"

158'-0"

1 2 3 4 5 6 7 8 9 10 11 12 INCHES 1 2 3 4 5 6 7 8 9 10 11 12 CM 1 2 3 4 5 6 7 8 9 10 11 12 CM		JQP #	
APPRO FOR DISTRIBUTION (C) WITH SOURCE OFFICIALS BY _____ PAGE _____ 04 APPRO _____ DATES _____ OFFICE NAME _____ ADDRESS _____ COUNTRY _____ TELEPHONE _____ 116° 1'-0'		U. S. Department of Energy <i>Residual Operations Office</i> PACIFIC NORTHWEST LABORATORY OPERATED BY BATTLES MEMORIAL INSTITUTE THE RALPH M PARSONS COMPANY OF DELAWARE MRS FACILITY TRANSFER FACILITY SECOND FLOOR PLAN	
CLASSIFICATION OF NOT RECD CLASSIFICATION SYMBOL NONE		SCALE 1/8" = 1'-0" NORTH ARROW NORTH ARROW A-3

JQP:af

U. S. Department Of Energy National Operations Office PACIFIC NORTHWEST LABORATORY OPERATED BY BAYTELLE INDUSTRIAL INSTITUTE THE RALPH M. PARSONS COMPANY OF DELAWARE	
MRS FACILITY TRANSFER FACILITY SECOND MEZZANINE PLAN	
DATE: 10-1-67 SCALE: 1/8" = 1'-0" DRAWN BY: JQP CHECKED BY: JQP APPROVED BY: JQP NOTED BY: JQP CLASSIFICATION: NONE	JQP:af A-4

NO.	DATE	BY	DESCRIPTION
1	10-1-67	JQP	ISSUED FOR CONSTRUCTION

SECTION A-A

SECTION C-C

SECTION D-D

SECTION B-B

JQP# U. S. Department Of Energy Pacific Northwest Laboratory OPERATED BY BATTELLE MEMORIAL INSTITUTE THE RALPH M. PARSONS COMPANY OF DELAWARE	
MRS FACILITY TRANSFER FACILITY BUILDING SECTIONS	
SCALE: 1/4" = 1'-0" NOT RECD NONE	
45	

END

DATE FILMED

11 / 14 / 90