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Alternative Configurations for the Waste-Handling Building at the Yucca Mountain Repository

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ALTERNATIVE CONFIGURATIONS FOR THE
WASTE-HANDLING BUILDING
AT THE YUCCA MOUNTAIN REPOSITORY

by

Bechtel National, Inc.
P.O. Box 3965
San Francisco, CA 94119

for

Sandia National Laboratories
Albuquerque, NM 87185

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ABSTRACT

Two alternative configurations of the waste-handling building have been developed for the proposed nuclear waste repository in tuff at Yucca Mountain, Nevada. One configuration is based on criteria and assumptions used in Case 2 (no monitored retrievable storage facility, no consolidation), and the other configuration is based on criteria and assumptions used in Case 5 (consolidation at the monitored retrievable storage facility) of the Monitored Retrievable Storage System Study for the Repository. Desirable waste-handling design concepts have been selected and are included in these configurations. For each configuration, general arrangement drawings, plot plans, block flow diagrams, and timeline diagrams are prepared.

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All work in this report was performed under DIM 54 at Quality Assurance Level 1, WBS 1.2.4.3.2.

EXECUTIVE SUMMARY

Two alternative configurations for the waste-handling building (WHB), Cases A and B, have been developed for the proposed nuclear waste repository at Yucca Mountain, Nevada, based on Cases 2 and 5 of the "MRS System Study for the Repository" (BNI, 1989).

The design criteria and assumptions from the MRS System Study along with other assumptions identified in this study have been used in designing the WHBs for Cases A and B, respectively. In addition, improved waste-handling concepts have been evaluated for incorporation in the building layouts.

In Case A, there is no monitored retrievable storage facility. All spent fuel assemblies are shipped directly from the reactor to the repository, where they are placed intact in containers for emplacement. There is no spent fuel consolidation at the repository. Defense high-level waste (DHLW) and West Valley high-level waste (WVHLW) arrive at the repository in canisters that are then placed in containers for emplacement.

In Case B, spent fuel assemblies (except those from western reactors) are consolidated and placed in canisters at the monitored retrievable storage facility, stored, and then shipped to the repository, where they are placed in containers for emplacement. Spent fuel assemblies from western reactors are shipped directly to the repository where they are

placed in containers and emplaced underground. There is no spent fuel consolidation at the repository. DHLW and WVHLW arrive at the repository in canisters that are then placed in containers for emplacement.

The system engineering approach of iterative design has been used in developing the alternative configurations for the WHB. In this approach, the design criteria and assumptions are developed first, followed by the block flow diagrams, which identify the major sequence of waste-handling operations. Then, the alternative configurations are developed using the established design criteria, assumptions, and block flow diagrams, along with improved waste-handling concepts. As these configurations are developed, the designs are continuously evaluated and revised to meet the design criteria and to conform to design assumptions. The designs are also evaluated for adequacy in providing proper system interfaces, minimizing radiation exposure to operating personnel, minimizing the spread of contamination, and providing for equipment maintenance.

Timeline diagrams have been prepared on the basis of the WHB configurations. These configurations are then revised and equipment is added until the required waste throughput rates have been achieved and are verified by the timeline diagrams.

The design of the Case A WHB is similar to the design of the Case B WHB in many respects. The Case B WHB area is smaller, however, because fewer casks are received. Following is a list of the major differences between the Case A and the Case B WHBs.

- o The Case A WHB has five truck and three rail cask receiving and shipping bays; the Case B WHB has three rail cask receiving and shipping bays. The Case B design is based on the fact that all spent fuel assemblies from the monitored retrievable storage facility are shipped by rail and that the relatively small amounts of spent fuel shipped by truck from western reactors can be received in one of the rail cask shipping bays. Because rail casks can hold more canisters than truck casks, fewer casks are received in the Case B WHB.
- o For the same reason, there are nine cask preparation area access hatches, nine cask preparation stations, and nine cask-unloading ports for the Case A WHB, as compared with only five cask preparation area access hatches, five cask preparation stations, and five cask-unloading ports for the Case B WHB.
- o For Case A, only intact bare spent fuel and DHLW/WVHLW canisters are received at the WHB. Eight unloading hot cells are used for unloading spent fuel, and one hot cell is used for unloading DHLW and WVHLW.
- o For Case B, intact spent fuel and consolidated spent fuel rods in canisters from the monitored retrievable storage facility, hardware cages from the monitored retrievable storage facility, intact bare spent fuel from western reactors, and DHLW/WVHLW canisters are received at the WHB. There are three unloading hot cells for

unloading the canistered intact spent fuel, canistered consolidated spent fuel rods, and hardware cages; there is a separate hot cell for unloading the intact bare spent fuel from western reactors; and there is another separate hot cell for the DHLW/WVHLW canisters.

- o The timeline diagrams and throughput analyses indicate that the required amount of waste (3,000 MTU per year of spent fuel and 400 MTU per year of DHLW/WVHLW) can be processed by using either the Case A WHB or the Case B WHB. The maximum waste throughput rates of the Case A WHB and the Case B WHB are about 18% and 11% higher, respectively, than the required rate. These maximum rates are based on 6 productive hours/shift, 2 shifts/day, 250 days/yr, and an equipment availability of 90% of the productive hours.

Major features that differ from the WHB concepts presented in previous published Yucca Mountain Project reports, such as the "Site Characterization Plan Conceptual Design Report" (SNL, 1987) and "An Analysis of Repository Waste-Handling Operations" (Dennis, 1990) have been incorporated in the Case A and Case B WHBs. These features and their advantages are as follows:

- o Drive-through cask receiving and shipping bays permit easier entry of the facility transfer vehicle and cask carrier than do back-in cask receiving and shipping bays, as shown in the WHB arrangements given by Sandia National Laboratories (SNL) (1987) and Dennis (1990). This feature also reduces the span of the large-capacity crane used for lifting the casks off the carrier.

- o Ventilation barriers separate the potentially contaminated cask preparation areas from the cask receiving and shipping area. As a result, the potential for contamination in the latter area is insignificant.
- o Modular waste-unloading and welding hot cells facilitate design changes, allow waste unloading to continue even if one or more of the hot cells is down for maintenance, eliminate potential crane interferences, and help contain the spread of contamination.
- o Inertia welding is used for the closure weld of the waste container. This welding method offers good quality and consistent welds.
- o Through the use of passive cooling in the surface storage vault, the decay heat is removed from the stored waste containers without using active equipment, such as fans. Passive cooling also results in greater reliability (no equipment failure) and lower operating costs from lower energy consumption and less maintenance.
- o Nonroutine repairs (e.g., replacement of seals and baskets) and decontamination of the exteriors and interiors of the casks are performed in the cask maintenance area. The layout facilitates the transfer of casks from the cask preparation stations to the cask maintenance area by minimizing travel distance and thus minimizing the potential spread of contamination.

- o The waste is loaded into the container located in a separate area under the unloading hot cell. This feature reduces the potential spread of contamination from the unloading hot cell to the container's exterior surfaces.
- o Waste containers are loaded in several hot cells, thus allowing loading to continue even if a hot cell is down for maintenance.
- o The use of robotics to perform some operations in the cask receiving and the cask preparation areas reduces radiation exposure to the operators.

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this study is to review design concepts for the surface waste-handling facilities at the repository and to incorporate the desirable features of these concepts into two configurations for a waste-handling building (WHB): Case A, one with no monitored retrievable storage facility (MRS), and Case B, one with an MRS. These two cases are based on the design criteria and assumptions in the "MRS System Study for the Repository" (BNI, 1989) for Cases 2 and 5, respectively, and other applicable assumptions.

1.2 Scope

In this study, criteria, assumptions, and concepts from the MRS Systems Study (BNI, 1989) are used in the development of the Case A and Case B WHB configurations. The design criteria and assumptions are developed first, followed by the block flow diagrams, which identify the major sequence of waste-handling operations. Then, the alternative configurations for the WHB are developed using the established design criteria, assumptions, and block flow diagrams, along with improved waste-handling concepts. Timeline diagrams, based on the developed WHB configurations, are prepared to verify that the required waste throughput rates can be achieved. Plot plans are also prepared to reflect the WHB configurations developed.

2.0 WASTE-HANDLING FEATURES COMMON TO BOTH CASES A AND B

2.1 General Design Criteria and Assumptions

Case A is based on Case 2 of the MRS System Study (BNI, 1989). In Case A, there is no monitored retrievable storage (MRS) facility. All spent fuel (SF) assemblies are shipped directly to the repository, where they are placed intact in containers for emplacement. No SF is consolidated at the repository. Defense high-level waste (DHLW) and West Valley high-level waste (WVHLW) are received in canisters at the repository, where the canisters are packaged in containers for emplacement underground.

Case B is based on Case 5 of the MRS System Study (BNI, 1989). Spent fuel assemblies (except those from western reactors) are consolidated, placed in canisters, and stored at the MRS facility; the canisters are then shipped to the repository, where they are packaged for emplacement. Spent fuel assemblies from western reactors are shipped to the repository intact where they are placed in containers and emplaced underground. No SF is consolidated at the repository. Defense high-level waste and WVHLW are received in canisters at the repository, which are packaged in containers for emplacement.

Where criteria and assumptions from the MRS System Study (BNI, 1989) conflict with criteria and assumptions from other documents, the criteria and assumptions from Bechtel National, Inc. (BNI) (1989) govern. Where the same design criteria and assumptions appear in BNI (1989) and other

documents, only BNI (1989) is cited here. Additional specific design assumptions for each case are listed in Subsections 3.1 and 4.1.

The following design criteria and assumptions pertain to WHB for both configurations.

2.1.1 Design Criteria

Reference

- o The repository is designed to accommodate 70,000 metric tons of uranium (MTU) of waste: 63,020 MTU of SF, 6,340 MTU of DHLW, and 640 MTU of WVHLW. BNI, 1989
- o The receipt rate of SF increases from 400 MTU/yr, in the years 2003 through 2005, to a maximum of 3,000 MTU/yr, beginning 2008. DHLW and WVHLW are received at a constant (combined) rate of 400 MTU/yr, beginning in 2008 and ending in 2025. BNI, 1989
- o Measured on an MTU basis, 66.7% of the SF received at the repository is from pressurized water reactors (PWR) and 33.3% is from boiling water reactors (BWR). BNI, 1989

Design Criteria (Concluded)

Reference

- o Each DHLW canister contains the equivalent of 0.5 MTU; each WVHLW canister contains the equivalent of 2.13 MTU. BNI, 1989
- o The uranium content of the PWR fuel is 0.43 MTU/assembly. BNI, 1989
- o The uranium content of the BWR fuel is 0.18 MTU/assembly. BNI, 1989

2.1.2 Assumptions

The general assumptions listed in this subsection that are not identified by a reference are assumptions that apply to this study only.

- o All DHLW and WVHLW is shipped to the repository in rail casks that hold five canisters. The design of the DHLW and WVHLW cask-unloading facilities, however, does not preclude acceptance of truck casks. BNI, 1989
- o The thermal power of all DHLW and WVHLW containers is 200 W/container at the time of emplacement. BNI, 1989

Assumptions (Continued)

Reference

- o The total thermal power of a container is limited to 3,500 W. BNI, 1989
- o The container material is low-carbon austenitic stainless steel. Dennis, 1990
- o The container closure is welded using the inertia welding method.
- o The interior of all containers must be filled with an inert gas before disposal.
- o Nondestructive examination (NDE) of the closure weld of the waste container by ultrasonic inspection is required.
- o Spent fuel assemblies and HLW canisters are inspected remotely for identification.
- o A queue of casks is always available for processing.

Assumptions (Continued)

Reference

- o There are 6 productive hours/8-hr shift. BNI, 1989
The remaining time is nonproductive based on changes in workers from shift to shift, breaks, and end-of-day interruptions.
- o Operations are conducted on a 2-shift/day basis. BNI, 1989
The remaining shift is used for maintenance.
- o Operations are conducted on a 5-day/wk basis. BNI, 1989
- o Operations are conducted on a 250-day/yr basis. BNI, 1989
- o Equipment is available 90% of the productive hours. BNI, 1989
- o The exterior and internal configurations of the DHLW and WVHLW container are as shown in Figures 2-1 and 2-2.
- o One container is used for intact SF assemblies, SF in canisters, and hardware cages, as shown in Figure 2-3. The internal structure of this container varies with the type of waste it holds.

Figure 2-1. Configuration and External Dimensions of the DHLW and WVHLW Container

Figure 2-2. Configuration and Internal Dimensions of the DHLW and WVHLW Container (BNI, 1989)

Figure 2-3. Configuration and External Dimensions for the Intact Spent Fuel, Canistered Spent Fuel, and Hardware Container

Assumptions (Concluded)

Reference

- o Cask characteristics and features are listed in DOE, 1986
Tables 2-1 and 2-2, and are shown in Figures 2-4
and 2-5.
- o The cask transportation vehicle data are listed
in Table 2-3 and features are shown in Figures 2-6 DOE, 1986
through 2-9.

2.2 Description of the Design

In this subsection, the major waste-handling features common to both configurations are discussed. The system engineering approach is used in developing the alternative WHB configurations. During the course of developing the WHB configurations, the designs are continuously evaluated and revised for conformance with the established design criteria and assumptions. The designs are also evaluated and revised to make sure the arrangements and equipment provided can permit the required waste throughput rates to be achieved. In addition, the designs are continuously evaluated and revised to provide proper system interfaces, minimize radiation exposures, minimize the spread of contamination, meet safety requirements, and provide for equipment maintenance.

TABLE 2-1
FEATURES COMMON TO ALL TRANSPORTATION CASKS^a

Personnel barrier	Nonremovable (sliding) ^b
Impact limiters	Removable
Closure configuration	Separate outer and inner bolted closure heads (lids)
Trunnions	Four near the closure end and two at the opposite end
Coolant	Inert gas
Maximum temperature of accessible cask surfaces	180 F
Dose rate	
At accessible surface	50 mrem/hr
6.6 ft from vehicle	10 mrem/hr

^aSource: U.S. Department of Energy (DOE) (1986), except as noted otherwise.

^bSource: Griesmeyer (1988).

TABLE 2-2
SUMMARY CHARACTERISTICS OF THE CASKS
ARRIVING AT THE REPOSITORY^a

Type	Diameter x Length (in.)	Weight (tons)	Capacity ^b
Truck			
PWR	72 x 216	25	3 assemblies
BWR	72 x 216	25	7 assemblies
Rail			
DHLW	100 x 151	95	5 canisters
PWR	102 x 216	100	21 assemblies
BWR	102 x 216	100	48 assemblies
PWR	120 x 216	150 ^c	28 assemblies (56 consolidated assemblies)
BWR	120 x 216	150 ^c	61 assemblies (140 consolidated assemblies)

a. Source: DOE (1986).

b. The cask capacities given in this table are from BNI (1989).

c. The rail cask from the monitored retrieval storage facility is assumed to weigh 150 tons.

Figure 2-4. Lid Design for a Postulated Spent Fuel Shipping Cask

Figure 2-5. Postulated Personnel Barrier (Sliding Type) (Griesmeyer, 1988)

TABLE 2-3

CHARACTERISTICS OF THE TRANSPORT VEHICLES^a

<u>Characteristic</u>	<u>Truck with Trailer</u>	<u>Railroad Car^b</u>
Height	13.5 ft	15.1 ft
Width	8 ft	10 ft 2 in.
Length	60 ft	55 ft 9 in.
Weight (loaded)	40 tons	132 tons
Turning Radius	50 ft	105 ft
Position of Cask on Vehicle	Horizontal	Horizontal
Tie-down Feature	Tie-down cradle integrated with trailer; cask clamped to cradle	Tie-down cradle integrated with railroad car; cask clamped to cradle

^aSource: Pacific Northwest Laboratory (PNL) (1987).

^bThe dimensions for a four-axle railroad car are rounded off. (See Figure 2-9 for eight-axle railroad car dimensions.)

2.2.1 Cask Receiving and Shipping Area

The cask receiving and shipping area is the entry point for loaded casks and the departing point for empty casks. A drive-through concept is used for this area, which is arranged so that the facility transfer vehicle can pull the cask carrier (either rail or truck) into and out of the cask receiving bays in one direction. The drive-through arrangement allows easier ingress and egress for the facility transfer vehicle than does the back-in cask receiving and shipping concept used by SNL (1987) and Dennis (1990) and reduces the span of the large-capacity crane.

For the back-in concept, the facility vehicle pushes the cask carrier into the cask receiving and shipping bay. This may be difficult for the

Figure 2-6. Five-Axle Legal Weight Truck (DOE, 1986)

- * This is a typical value. The overall length of the overweight cask tractor/trailer combination shall be designed to allow overweight permits to be obtained in most of the 48 contiguous states.

Figure 2-7. Seven-Axle Overweight Truck (DOE, 1986)

Figure 2-8. Four-Axle Railroad Car (DOE, 1986)

Figure 2-9. Eight-Axle Railroad Car (PNL, 1987)

truck cask carrier, which has a pivot point. Although the back-in concept may have some advantages, such as shorter crane-handling distances, the easier maneuverability and reduced crane span favor the drive-through concept as used in the alternative WHB layouts.

The cask receiving and shipping bays are sized to accommodate the facility transfer vehicle and cask carrier so that only one door needs to be open in one bay at a time.

The cask receiving and shipping area has bridge cranes for upending and unloading the shipping cask from the cask carrier. Two separate areas for crane maintenance allow one of the two cranes to offload casks when the other crane is being repaired. Gantry cranes are also provided to remove the cask impact limiters. Each gantry crane is equipped with an electromechanical (ELMCH) manipulator to perform the radiological surveys of the cask. The use of an ELMCH manipulator reduces radiation exposure to the workers.

The cask receiving and shipping area is separated from the cask preparation area by cask access hatches that act as ventilation barriers, thus preventing the spread of potential contaminants from the cask preparation area to the cask receiving and shipping area. This feature is different from that shown in the SNL (1987) and Dennis (1990) WHB layouts, where the cask preparation stations are located in the cask receiving and shipping area. The cask receiving and shipping area could become potentially contaminated by the cask preparation operations. The large volume of exhaust air would need to be high-efficiency particulate

air (HEPA) filtered, which is an expensive operation. For this reason, separating the cask preparation area from the cask receiving and shipping area is a desirable feature and is incorporated in this study. Under each cask access hatch, there is a transfer car to receive the cask and then move it either to the cask preparation area (the routine operation) or to the cask maintenance area, if required (a nonroutine operation).

2.2.2 Cask Preparation Area

The cask preparation area consists of individual cask preparation stations separated from one another by physical barriers. Laydown spaces are provided in each station for the cask outer lid, the cask seal adapter, and the lifting fixture. In each of these stations, a robotic arm prepares the cask (e.g., unbolting the lids of the cask), thereby reducing potential radiation exposure to the plant operators. A monorail hoist lifts the cask seal adapter. The functions that cannot be performed by the robotic arm (such as taking samples of cask cavity gas) are performed by operators working from platforms.

The cask preparation area has a gas sampling and purging system.

Each cask transfer car is equipped with a compressed air supply to inflate the cask seal adapter while the cask is under the waste unloading port and to maintain the seal while the waste is unloaded from the cask and transferred to the unloading hot cell.

The cask preparation area is accessible to plant operators, but, because of the functions being performed (such as opening the cask outer lid, swiping, and sampling of cask cavity gas), there is a potential for the ventilation air to be contaminated. Therefore, doors that act as radiation shields and ventilation barriers separate each cask preparation station from the corresponding cask unloading station under the unloading hot cell.

2.2.3 Waste-Unloading Hot Cell

The WHB layouts given in SNL (1987) and Dennis (1990) use a common hot cell for unloading the waste from the casks. Because of the required throughput rates, several cranes are needed to perform the many operations in the same hot cell. This could cause crane interferences and inefficient handling operations.

As a result of the lessons learned in the previous WHB layouts, modular hot cells are provided for unloading the waste from the casks. Designed with standardized dimensions and equipment to handle similar functions, these cells facilitate expansion or reduction to meet design requirements, allow waste-handling operations to continue even if one or more of the cells is down for maintenance, eliminate crane interferences, and help contain the spread of contamination. In each unloading hot cell, there is a 20-ton bridge crane equipped with an ELMCH manipulator. Each unloading hot cell has a cask-unloading port and can be used to unload either truck or rail casks. The transfer car that moves the casks

to the unloading hot cell is designed for the heaviest cask. The floor shield plug over the waste-unloading station is designed in two concentric pieces: an inner shield plug and an outer shield plug. The inner shield plug is removed for unloading truck casks, and both the inner and outer shield plugs are removed for unloading rail casks.

Laydown spaces are provided in each unloading hot cell for the inner shield plug, the outer shield plug, the cask inner lid, and the lifting fixtures.

In each unloading hot cell, there are fixed racks to hold the waste unloaded from a cask. The racks in the hot cells for bare intact SF are sized to accommodate the assemblies from 1.5 PWR rail casks and 1.5 BWR rail casks. This permits a full cask to be unloaded even if there are still some SF assemblies left in the racks. For the hot cells unloading canistered SF from the MRS facility, the racks are sized for 1.5 rail casks of 6 x 6 canisters, 1.5 rail casks of 9 x 9 canisters, and two rail casks of hardware cages. For the hot cells unloading DHLW canisters, the racks are sized for four rail casks. The racks allow the waste to be unloaded quickly, so that the cask may be returned to the transportation fleet for reuse. By temporarily storing the waste in racks rather than packaging directly in containers (which may not be available), quicker cask turnaround is achieved.

Each unloading hot cell has a container-loading port equipped with a shield valve. The container-loading port is used for loading the waste

into an empty container positioned below the port. Container transfer cars move the empty containers to the container-loading ports and transfer the loaded containers from the loading ports to the welding hot cell entrance ports.

Each unloading hot cell has a crane maintenance area. A common shield door mounted on rollers protects the maintenance personnel in this area from radiation.

2.2.4 Welding Hot Cells

The WHB layouts given in SNL (1987) and Dennis (1990) show container closure weld operations being performed in the unloading hot cell. The welding method was not defined, and space allocation for the welder was very limited.

For the alternative WHB configurations, three modular welding hot cells are used. The welding method for the container closure weld has not been selected for the repository program, but for this study it is assumed that inertia welding is used. Studies conducted by Lawrence Livermore National Laboratory have indicated that welds produced by the inertia welding method are consistent and of high quality.

There are three welding hot cells for welding the container lid to the waste container. Each welding hot cell has a 10-ton bridge crane, two master-slave manipulators, and an inertia welding machine. The container is welded in the vertical position. Most of the inertia welder

components, including the rotating flywheel, are located in a separate shielded area above the welding station for safety and ease of maintenance.

In addition to the welding station, each welding hot cell includes additional stations for preparing the containers for storage, a welder-loading station consisting of a car riding on circular tracks, and an inerting station that purges and inerts the container before the closure weld is made. A container lid stand provides storage for a supply of lids.

Two cutting stations are also located in each welding hot cell. In one station the weld flash, produced by the inertial welding process, is removed from the container; in the other station the flange is cut from the container after successfully completing NDE. For this study, it is assumed that the container has a flange that serves as a gripping surface for the inertia welder and that is also used to lift the container until the integrity of the weld has been demonstrated. A test is performed in which a load 1-1/2 times the weight of the container pulls down on the container flange while the overhead crane pulls up on the pintle. If this test is successful, the container can be lifted by the pintle. Further evaluation is needed during the ACD to determine whether a load test is required.

A chamber and associated equipment are provided to test the container for leakage. It is assumed that a partial vacuum is created in the

chamber and that sensors are used for mass-spectrometer trace-gas monitoring and/or residual radioactivity detection.

An NDE station is installed in each welding hot cell to test for weld integrity. The ultrasonic test method is assumed for this study.

2.2.5 Container Decontamination Cells

A portable container decontamination concept was used in the Dennis (1990) WHB layout. This concept involves a movable decontamination chamber, which travels between the two ports. The flexible hose connections and liquid waste collection make this concept undesirable.

For the alternative WHB configurations, there is a fixed container decontamination cell below each welding hot cell. A transfer car moves the container from the exit port of the welding hot cell to the transfer port. A shield valve separates the welding hot cell area from completed container transfer area. After the container has been inspected and swipe tests performed, it is decontaminated, if necessary, in a spray booth using a master-slave manipulator. The container is then lifted out of the decontamination cell by a monorail hoist through an exit port. A shield valve separates the decontamination cell from the completed container transfer area. The water used to decontaminate the container is collected and transferred to the waste treatment building for processing.

2.2.6 Surface Storage Vault Transfer Tunnel

Two transfer tunnels, each equipped with a transfer car, permit the completed container to be transferred to the loading port of the surface storage vault. One transfer car is provided in each tunnel for redundancy.

2.2.7 Surface Storage Vault

The previous WHB layouts given in SNL (1987) and Dennis (1990) use active cooling systems to remove the heat generated by the waste containers in the surface storage vault. Fans supply the cooling air and backup HEPA filters treat the exhaust air if high levels of radiation are detected.

For this study, a surface storage vault with passive cooling is shown in Figures 2-10 and 2-11. A passive ventilation system effectively cools the containers in the surface storage vault without the use of exhaust fans or other energy-consuming components. Such a system offers several advantages, including lower operating costs, lower energy consumption, less maintenance, and greater reliability (no equipment failure).

The storage vault consists of three below-grade modules; each module can store 96 containers in sleeves arranged in an 8 x 12 array. The three modules provide temporary storage for 1-1/2 months of waste throughput. Each module is self-contained, with its own air supply and air exhaust. Above the three modules is a common operating area equipped

Figure 2-10. General Arrangement for Passive Ventilation in the Surface Storage Vault, Plan

0	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121
122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143
144	145	146	147	148	149	150	151	152	153	154
155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176
177	178	179	180	181	182	183	184	185	186	187
188	189	190	191	192	193	194	195	196	197	198
199	200	201	202	203	204	205	206	207	208	209
210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231
232	233	234	235	236	237	238	239	240	241	242
243	244	245	246	247	248	249	250	251	252	253
254	255	256	257	258	259	260	261	262	263	264
265	266	267	268	269	270	271	272	273	274	275
276	277	278	279	280	281	282	283	284	285	286
287	288	289	290	291	292	293	294	295	296	297
298	299	300	301	302	303	304	305	306	307	308
309	310	311	312	313	314	315	316	317	318	319
320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341
342	343	344	345	346	347	348	349	350	351	352
353	354	355	356	357	358	359	360	361	362	363
364	365	366	367	368	369	370	371	372	373	374
375	376	377	378	379	380	381	382	383	384	385
386	387	388	389	390	391	392	393	394	395	396
397	398	399	400	401	402	403	404	405	406	407
408	409	410	411	412	413	414	415	416	417	418
419	420	421	422	423	424	425	426	427	428	429
430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451
452	453	454	455	456	457	458	459	460	461	462
463	464	465	466	467	468	469	470	471	472	473
474	475	476	477	478	479	480	481	482	483	484
485	486	487	488	489	490	491	492	493	494	495
496	497	498	499	500	501	502	503	504	505	506
507	508	509	510	511	512	513	514	515	516	517
518	519	520	521	522	523	524	525	526	527	528
529	530	531	532	533	534	535	536	537	538	539
540	541	542	543	544	545	546	547	548	549	550
551	552	553	554	555	556	557	558	559	560	561
562	563	564	565	566	567	568	569	570	571	572
573	574	575	576	577	578	579	580	581	582	583
584	585	586	587	588	589	590	591	592	593	594
595	596	597	598	599	600	601	602	603	604	605
606	607	608	609	610	611	612	613	614	615	616
617	618	619	620	621	622	623	624	625	626	627
628	629	630	631	632	633	634	635	636	637	638
639	640	641	642	643	644	645	646	647	648	649
650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671
672	673	674	675	676	677	678	679	680	681	682
683	684	685	686	687	688	689	690	691	692	693
694	695	696	697	698	699	700	701	702	703	704
705	706	707	708	709	710	711	712	713	714	715
716	717	718	719	720	721	722	723	724	725	726
727	728	729	730	731	732	733	734	735	736	737
738	739	740	741	742	743	744	745	746	747	748
749	750	751	752	753	754	755	756	757	758	759
760	761	762	763	764	765	766	767	768	769	770
771	772	773	774	775	776	777	778	779	780	781
782	783	784	785	786	787	788	789	790	791	792
793	794	795	796	797	798	799	800	801	802	803
804	805	806	807	808	809	810	811	812	813	814
815	816	817	818	819	820	821	822	823	824	825
826	827	828	829	830	831	832	833	834	835	836
837	838	839	840	841	842	843	844	845	846	847
848	849	850	851	852	853	854	855	856	857	858
859	860	861	862	863	864	865	866	867	868	869
870	871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890	891
892	893	894	895	896	897	898	899	900	901	902
903	904	905	906	907	908	909	910	911	912	913
914	915	916	917	918	919	920	921	922	923	924
925	926	927	928	929	930	931	932	933	934	935
936	937	938	939	940	941	942	943	944	945	946
947	948	949	950	951	952	953	954	955	956	957
958	959	960	961	962	963	964	965	966	967	968
969	970	971	972	973	974	975	976	977	978	979
980	981	982	983	984	985	986	987	988	989	990
991	992	993	994	995	996	997	998	999	1000	1001

with two 100-ton container transfer machines (CTM). Each CTM has a shielded cask for transferring the waste container from the container transfer tunnel to the temporary storage sleeve and for retrieving the container from the temporary storage sleeve and returning it to the container transfer tunnel. The same transfer cars in the transfer tunnels move the containers to the loading area for the underground transporter. There are two areas for loading the container into the underground transporter. These areas allow two transporters to be loaded simultaneously, if this is needed, to facilitate the underground emplacement operation (such as at the beginning of the day).

Because of the modular design, the capacity of the storage vault can be increased by adding up to three more modules if the surface storage requirement is revised.

2.2.8 Cask Maintenance Area

U.S. Department of Energy (DOE) (1986) requires that decontaminating operations, changing seals, and replacing the cask removable components such as baskets and sleeves be performed in the WHB. Also, provisions for lag storage of casks and interchangeable cask components should be included.

Previous WHB layouts in SNL (1987) and Dennis (1990) showed a decontamination building separate from the WHB. Moving a contaminated cask between these buildings is undesirable because of the potential spread of contamination. As required by DOE (1986), a cask maintenance

area integral to the WHB is provided to reduce the distance traveled, thereby minimizing the potential spread of contamination.

The cask maintenance area, as described by BNI ("Shipping Cask Decontamination Maintenance," SAND89-7007, Sandia National Laboratories, Albuquerque, NM, in preparation) is used to decontaminate the exterior and interior of the casks and also to perform nonroutine repairs on cask components. Ventilation barriers separate the cask maintenance area from the cask receiving and shipping area. The cask is moved into the cask maintenance area where a bridge crane lifts it off the cask transfer car and places it on one of two maintenance transfer cars. The cask is moved to one of two cask exterior decontamination stations and then to one of two cask interior decontamination stations. The cask maintenance area has cask basket emplacement stations, basket storage areas, a cask spacer and basket decontamination cell, a cask spacer transfer station, three 5-ton bridge cranes, and supporting equipment for leak testing and flushing. The water used to decontaminate the cask is collected and transferred to the waste treatment building for processing.

2.2.9 Administration Area

An administration area in the WHB includes the offices, health physics rooms, change rooms, laboratories, and control room. Waste-handling operations are monitored and major remote-handling equipment is controlled from the control room. An access control point is also included for all operating personnel entering or exiting the WHB.

2.2.10 HVAC Systems

The main objective of this study is to develop a design for a WHB in which waste is handled and packaged efficiently. General requirements for heating, ventilating, and air conditioning systems have been considered in the conceptual design. Space is included for HVAC equipment and duct routing, but a detailed analysis of HVAC systems is not performed. The HVAC systems provide controlled atmospheric conditions for personnel comfort, maintain proper temperatures for equipment, and control the spread of potential airborne radioactive contaminants as well as releases from the buildings.

To control the potential spread of airborne contamination and reduce the amount of radioactivity released to the environment, HEPA filters are provided in the ventilation exhaust systems of all potentially contaminated areas. Areas that could contain radioactive contamination are maintained at pressures lower than ambient pressure to prevent potential contamination from spreading. Differential pressures are maintained between areas with different potential levels of contamination so that airflow is directed from areas with lower levels of radioactive contamination to areas of progressively higher levels of contamination. In potentially contaminated areas, ventilation air is circulated by once-through systems. Redundant ventilation exhaust filter assemblies and associated fans allow continuous ventilation either during filter replacement or in the event of individual equipment failure or shutdown for maintenance. In areas with no potential for contamination, air is recirculated to reduce heating and cooling load requirements.

The preliminary pressure zones in the major areas of the WHB are shown in Figure 2-12 and are defined in Table 2-4. These pressure zones are similar for the WHBs in both cases. The ventilation exhaust from all of the potentially contaminated areas passes through two stages of HEPA filters. Ventilation exhaust from hot cells that handle bare SF assemblies is directed to first-stage HEPA filters located as close to these hot cells as possible. This minimizes the length of contaminated ducting. The exhaust air outlet is located at the bottom of the hot cell so that air flows downward in the hot cell to reduce the spread of contamination. A shielded area is provided for the first-stage HEPA filters so that filters can be replaced and dioxyd phthalate testing can be performed away from the SF unloading hot cell.

The first-stage HEPA filters for hot cells that handle waste other than bare SF assemblies and all second-stage HEPA filters are located in HEPA filter rooms. The exhaust air from hot cells not handling bare SF assemblies is significantly less contaminated than the exhaust air from the hot cells handling bare SF. This is because waste other than bare SF is contained in canisters or drums and is significantly less contaminated than bare SF assemblies, which have radioactive crud on their exterior surfaces.

A preliminary single-line diagram depicting the ventilation system and the flow of air for the Case A WHB is shown in Subsection 3.2.6. The ventilation system for the Case B WHB is similar.

Note: HEPA filter equipment rooms are shown for pressure zones only. Locations of HEPA filter equipment need to be further evaluated, along with the HVAC equipment.

Figure 2-12. Heating, Ventilation, and Air Conditioning Pressure Zones

TABLE 2-4

HEATING, VENTILATING, AND AIR CONDITIONING PRESSURE ZONES

<u>Zone</u>	<u>Potential Contamination Level</u>	<u>Gage Pressure Ranges (in wg)</u>
I	High	-2 to -3
II	Moderate	-1.0 to -1.5
III	Low	-0.25 to -0.75
IV	None	+0.1 to -0.1

2.2.11 Fire Protection

The WHB includes fire protection systems consisting of a combination of the following features:

- o portable fire extinguishers,
- o standpipe hose system,
- o fixed automatic sprinkler system,
- o fire extinguishing system for special hazards (Halon),
- o fire detection and alarm system, and
- o fire barriers and doors.

2.2.12 Support Facilities

The design of the support facilities is based on the design in the "Site Characterization Plan Conceptual Design Report" (SCP-CDR) (SNL, 1987). The surface facilities occupy an area of about 82 acres. The area is divided by security fences into three functional areas dedicated to waste receipt and inspection, general repository support, and waste operations.

Rail or truck casks containing radioactive waste enter the repository gate at the northeast end of the surface facilities where incoming casks and empty casks awaiting return to the shippers are stored temporarily.

The general support area consists of the administration building; medical, health physics, fire, and plant security facilities; the food service area; the central warehouse; the motor pool; and shops. The waste operations area encompasses all the buildings associated with handling radioactive waste, including site-generated waste. Only the WHBs for both cases are discussed in this report because the designs of the other facilities are assumed to be the same as in the SCP-CDR (SNL, 1987), except for the decontamination building and the vehicle wash facility. A separate decontamination building is not included in this study because casks are decontaminated in the cask maintenance area of the WHB.

A separate vehicle wash facility is not included because cask carriers are not routinely washed in existing operating nuclear

facilities. A survey of nuclear facilities indicates that a manual spray is sufficient to wash the road dirt off the cask carrier. At each entrance to the WHB, there is a concrete pad with a hose station. The cask carrier can be sprayed to wash off the road dirt, if needed. The water is collected and sampled before discharge.

2.3 Description of the Operation

Waste handling at the repository can be categorized into six general functions: receive waste, unload waste, return empty cask, package waste, store waste containers, and transfer containers underground.

The general sequence of these functions is shown in Figure 2-13. Each function is divided into more specific elements, called "tasks," and each task comprises several more detailed operations. The requirement allocation sheets (RAS) in Appendix A list the tasks and associated operations and identify the equipment and facility requirements for each operation. The RASs also identify which operations are performed or controlled remotely and which are performed using contact-handling methods. Most of the remote-handling operations are controlled from the control room in the administrative area of the WHB.

The general waste-handling tasks and operations applicable to both Case A and Case B are described below.

Figure 2-13. Block Flow Diagram for Waste Handling

2.3.1 Receive Waste

The sequence of tasks for receiving waste at the repository is shown in Figure 2-14.

SF and HLW are shipped to the repository in truck and rail casks. Upon arrival at the repository gate, the shipments are inspected and moved into the admitting and inspection area, where more detailed inspections are performed, including radiological and security-related surveys. The commercial rail engine or truck tractor is uncoupled from the cask carrier and then attached to an empty cask carrier, if appropriate, for a return shipment offsite.

Onsite facility transfer vehicles move the cask carriers to the waste operations area for interim storage (or parking) and to the WHB for unloading. The cask carriers may be washed at the entrance to the building, if necessary, to remove road dirt and/or ice and are then moved into the receiving and shipping bays.

In the receiving and shipping bays, personnel barriers, which keep personnel away from the cask surface, are opened, and impact limiters are removed from the cask by a gantry crane equipped with an ELMCH manipulator that is used primarily for radiological surveys. Each cask is surveyed to determine the radiation levels and concentrations of contamination on the cask surface.

Figure 2-14. Block Flow Diagram for Function 1.0--Receive Waste

2.3.2 Unload the Waste

The sequence of tasks for unloading waste in the WHB is shown in Figure 2-15. After a cask has been transferred into the WHB and surveyed, the cask tie downs are released so the cask can be removed from the carrier.

An overhead bridge crane with a lifting yoke upends the cask, removes it from the carrier, and transfers it to a hatch, through which it is lowered and placed on a cask transfer car in a below-grade tunnel. The cask is then secured to the transfer car, and the hatch is closed.

Normally, the cask is transferred to the cask preparation area; however, if major decontamination is required (e.g., lengthy efforts that could delay cask unloading), the cask is moved on the transfer car to the cask maintenance area for corrective action (nonroutine). This makes the cask transfer car and cask preparation area available for handling other casks. After the cask has been decontaminated, it is transferred to the cask preparation area.

Each cask has an inner lid and an outer lid. To prepare for unloading, the pressure in the outer cavity of the cask (e.g., the space between the inner and outer lids) is initially checked to determine whether the inner lid seal has maintained its integrity. If a high pressure is detected, the outer cavity gas is vented to the filtered ventilation exhaust system. The gas is also sampled and analyzed.

Figure 2-15. Block Flow Diagram for Function 2.0--Unload Waste

The outer lid is then removed and stored in the cask preparation area. The surfaces of the outer cavity are surveyed and decontaminated, if necessary. Sampling the inner cavity determines the general condition of the SF and characterizes any airborne radioactive particulates that could be released into the unloading hot cell when the inner lid is removed. Pressure in the inner cavity of the cask is checked, and a gas sample is obtained and analyzed. If the pressure is high, the inner cavity is vented to the filtered ventilation exhaust system. If high concentrations of radioactivity are detected in the gas sample, the inner cavity is also purged (with clean air) to the filtered ventilation exhaust system.

The inner lid fasteners of the cask are loosened, and an inflatable cask-to-hot-cell seal adapter is installed on the top of the cask. At this point, the cask is moved by the transfer car to the unloading station, where the seal adapter is inflated to provide a ventilation barrier between the cask and the underside of the hot cell port. A shield door is then closed to separate the unloading station from the cask preparation area.

The hot cell port contains two concentric shield plugs. One or both of these plugs are removed from the port (one plug is removed for truck casks, and two plugs are removed for rail casks), and the inner lid of the cask is lifted and placed on a storage stand in the unloading hot cell. A cask seal surface protector is then installed on the top of the cask.

An appropriate waste-handling tool is attached to the unloading hot cell bridge crane to transfer the waste from the cask to a storage rack in the unloading hot cell. During unloading, the waste is visually inspected and identified.

2.3.3 Return the Empty Cask

After the waste has been unloaded from a cask, the empty cask is prepared for shipment offsite. The sequence of tasks for returning an empty cask is shown in Figure 2-16.

While the cask is under the hot cell port of the unloading station, radiological conditions in the cask cavity are surveyed (including measurements of radiation and contamination levels). The results of this survey are used to determine the radioactivity content in the unloaded cask and to verify regulatory compliance for offsite shipments. The cask is also visually inspected using closed-circuit television cameras to check for damage or other offnormal conditions.

The cask seal surface protector is removed and stored in the unloading hot cell. Then, the inner lid is replaced on the cask, and the shield plug(s) replaced in the hot cell port. The seal adapter between the cask and unloading hot cell floor is deflated, and the shield door is opened to transfer the cask to the cask preparation area.

Figure 2-16. Block Flow Diagram for Function 3.0--Return Empty Cask

In the cask preparation area, the seal adapter is surveyed, decontaminated, if necessary, and removed from the top of the cask. The outer cavity of the cask is then surveyed and decontaminated, if necessary, before the inner lid fasteners are tightened. The inner lid seals and inner cavity containment are leak tested to verify the integrity of the seals. Then the outer lid is replaced and fastened to the top of the cask.

If no major cask maintenance is needed (or after major maintenance has been completed), the outer cavity of the cask is leak tested and its seals reemplaced, if necessary. The contamination levels on the exterior surface of the cask are surveyed, and decontamination is performed, if necessary, to comply with U.S. Department of Transportation limits. The cask is then transferred from the cask preparation area to the cask transfer tunnel by the cask transfer car.

If major cask maintenance or decontamination is required, the cask is transferred to the cask maintenance area either before or after the outer cavity is leak tested. This separate area allows for nonroutine maintenance and decontamination of the casks, such as inner lid seal replacement, repair or replacement of cask interchangeable parts, reconfiguration of the cask internal structures, or major decontamination of the cask interior and/or exterior. After the cask is repaired or decontaminated, it is returned to the cask transfer tunnel, where it is lifted from the car and transferred to the cask carrier by the bridge crane in the receiving and shipping area. The cask is placed on the

cradle of the carrier, and the tie downs are reinstalled. The impact limiters are then replaced on the cask ends, and the personnel barrier is closed over the cask. The facility transfer vehicle moves the unloaded cask and carrier to the admitting and inspection area for shipment offsite.

2.3.4 Package the Waste

After the waste has been unloaded from the casks, it is packaged in containers. The sequence of tasks for packaging the waste is shown in Figure 2-17.

Empty containers and lids are transferred by a monorail hoist from a storage area through the operating gallery adjacent to the unloading hot cells. The empty containers are transferred to the container-loading stations under the unloading hot cells; the lids are transferred to the welding hot cell transfer position under the welding hot cells and are lifted into the welding hot cell through the entrance port.

Next, waste is transferred by the bridge crane from the storage racks in the unloading hot cell to the container.

After the container has been loaded with waste, a diaphragm is inserted into the top of the container to help confine any contamination from the waste in the container and to facilitate rendering the container inert. The container is then transferred to a station under the welding

Figure 2-17. Block Flow Diagram for Function 4.0--Package Waste

hot cell. The bridge crane in the welding hot cell lifts the container through a shield valve into the cell and transfers it to the welder loading station. The waste container is moved by a car riding on circular tracks to the inerting station, where the container is purged with an inert gas. A container lid is picked up from the lid stand and placed on top of the container. The container and lid are transported to a position under the welding machine, where the lid is welded to the container. The excess metal from the welding process is machined to a smooth surface in the flash removal station. At this point, a load test is conducted on the weld. Next, the container is transferred to the leak test station, where it is leak tested and then returned to the NDE station for visual examination and ultrasonic testing of the weld.

If any defects are found during leak testing or NDE, the container is transferred to the cutting station, where the weld is cut and the lid removed (nonroutine). The container is then returned to the welding station, where another lid-welding operation is performed and the NDE repeated. When satisfactory NDE results are obtained, the container is transferred to the cutting station, and its flange is removed by machining (routine). The container is then transferred to the decontamination hot cell.

At the decontamination station, the container is surveyed for radioactive contamination and decontaminated by remote wiping, as necessary. If major contamination is detected, the container may be moved on a container transfer car to an adjacent spray chamber for

extensive decontamination (nonroutine). After decontamination, the container is surveyed again to confirm that the levels of contamination are acceptable. The container transfer car then moves the container under the exit port.

A container monorail hoist lifts the container from the decontamination hot cell and transfers it to a car in the container transfer tunnel. The transfer car then moves the container to the surface storage vault.

2.3.5 Store the Waste Container

The tasks for storing waste containers in the surface storage vault are performed as follows and are shown in Figure 2-18. A loaded transfer car is positioned under a transfer port in the vault. CTM is positioned over the transfer port, and shield valves in the CTM and transfer port are opened to lift the container into the CTM.

After the container has been placed in the CTM, the shield valves are closed, and the CTM moves over a preselected container storage sleeve in the vault. The shield plug on top of the storage sleeve is lifted into the CTM, which then realigns the container and lowers it into the storage sleeve. The CTM then realigns and reinstalls the shield plug over the container storage sleeve.

The container remains in the storage vault until the underground facility is ready to receive it.

Figure 2-18. Block Flow Diagram for Function 5.0--Store Waste Containers

2.3.6 Transfer the Waste Container Underground

When the underground facility and waste transporter are available, a waste container is transferred from the surface storage vault to the waste ramp and moved into the underground repository for emplacement. The sequence of tasks for transferring waste underground is shown in Figure 2-19.

Operations to retrieve a container from the storage vault are basically the reverse of operations to store the container in the vault. The CTM moves over the container storage sleeve and removes the shield plug. The CTM is realigned for retrieval, lifts the container out of the sleeve, and then repositions and reinstalls the plug over the (empty) storage location.

The CTM moves the container to the container transfer port and lowers it onto the transfer car, which moves it to the loading port in the transporter loading area. The underground transporter is positioned over the loading port, and the cask on the transporter is raised to the vertical position. The container is lifted into the transporter cask, the shield valves closed, and the cask lowered to the horizontal position. The loaded transporter then moves out of the storage vault and transfers the container underground for emplacement.

Figure 2-19. Block Flow Diagram for Function 6.0--Transfer Containers Underground

3.0 CASE A: WASTE-HANDLING BUILDING WITH NO MONITORED RETRIEVABLE STORAGE FACILITY

In addition to the general assumptions stated in Section 2, the specific assumptions listed in this section have been used to develop the WHB configuration based on Case 2 of the MRS System Study (BNI, 1989).

3.1 Assumptions

The assumptions, grouped under Waste Throughput Rates, Waste and Waste Container Characteristics, and Cask Capacities and Shipment Ratios, pertain to developing the WHB configuration for Case A.

3.1.1 Waste Throughput Rates

Reference

- o The year-by-year receipt rates for SF and HLW and the total repository throughput are shown in Table 3-1. BNI, 1989
- o The annual required throughput of SF and HLW in MTUs, the number of shipping casks, and the number of waste containers received are shown in Figure 3-1. This figure shows the the annual steady-state waste throughput starting in the year 2008, which is the sixth year of repository operation. BNI, 1989

TABLE 3-1

TOTAL POSSIBLE REPOSITORY THROUGHPUT
FOR CASE A*

Year	MTU - First Repository			HLW Containers		MTU	Spent Fuel					Disposal Containers	
	Spent Fuel	HLW	Cum.	DHLW	WVHLW		MTU	BWR		PWR		Hybrid	PWR Only
								Assemblies	Intact	Assemblies	Intact		
2003	400	0	400	0	0	400	133	741	267	620	185	16	
2004	400	0	800	0	0	400	133	741	267	620	185	16	
2005	400	0	1200	0	0	400	133	741	267	620	185	16	
2006	900	0	2100	0	0	900	300	1667	600	1389	417	36	
2007	1800	0	3900	0	0	1800	600	3333	1200	2791	833	73	
2008	3000	400	7300	800	0	3000	1000	5556	2000	4651	1389	121	
2009	3000	400	10700	800	0	3000	1000	5556	2000	4651	1389	121	
2010	3000	400	14100	800	0	3000	1000	5556	2000	4651	1389	121	
2011	3000	400	17500	800	0	3000	1000	5556	2000	4651	1389	121	
2012	3000	400	20900	800	0	3000	1000	5556	2000	4651	1389	121	
2013	3000	400	24300	800	0	3000	1000	5556	2000	4651	1389	121	
2014	3000	400	27700	800	0	3000	1000	5556	2000	4651	1389	121	
2015	3000	400	31100	800	0	3000	1000	5556	2000	4651	1389	121	
2016	3000	400	34500	800	0	3000	1000	5556	2000	4651	1389	121	
2017	3000	400	37900	800	0	3000	1000	5556	2000	4651	1389	121	
2018	3000	400	41300	800	0	3000	1000	5556	2000	4651	1389	121	
2019	3000	400	44700	800	0	3000	1000	5556	2000	4651	1389	121	
2020	3000	400	48100	800	0	3000	1000	5556	2000	4651	1389	121	
2021	3000	400	51500	800	0	3000	1000	5556	2000	4651	1389	121	
2022	3000	400	54900	800	0	3000	1000	5556	2000	4651	1389	121	
2023	3000	400	58300	800	28	3000	1000	5556	2000	4651	1389	121	
2024	3000	400	61700	0	188	3000	1000	5556	2000	4651	1389	121	
2025	3000	180	64880	0	84	3000	1000	5556	2000	4651	1389	121	
2026	2700	0	67580	0	0	2700	900	5000	1800	4186	1250	109	
2027	2420	0	70000	0	0	2420	807	4481	1613	3752	1120	98	
TOTALS	63020	6980	70000	12880	300	63020	21007	116704	42013	97705	29176	2544	

Notes: Hybrid: 4 BWR +
3 PWR = 1 container

PWR only: 4 PWR = 1 container

DHLW: 0.5 MTU = 1 container

WVHLW: 2.12 MTU = 1 container

Figure 3-1. Repository Annual Throughput for Case A (BNI, 1989)

3.1.2 Waste and Waste Container Characteristics

Reference

- o There are four intact PWR assemblies per PWR container. BNI, 1989
- o There are four intact BWR assemblies and three intact PWR assemblies per hybrid container. BNI, 1989
- o Thermal power values for SF containers are as follows: BNI, 1989
 - four intact PWRs - 2,104 W
 - three intact PWRs plus four intact BWRs - 2,246 W
- o The hybrid container is preferred. After all of the BWR and PWR assemblies have been packaged in the hybrid containers, the remaining PWR assemblies are packaged in PWR containers. (Hybrid containers can accommodate all of the BWR assemblies but not all of the PWR assemblies.) BNI, 1989
- o The internal configuration of an intact SF container is shown in Figure 3-2. BNI, 1989

3 PWRs + 4 BWRs

FIGURE A

NOTE:
PREFERRED
CONFIGURATION
WHEN THE SUPPLY
OF PWR'S AND
BWR'S ALLOW.

**4 PWRs
FIGURE B**

Figure 3-2. Internal Configuration of an Intact Spent Fuel Container
(BNI, 1989)

3.1.3 Cask Characteristics and Shipment Ratios

Reference

- o Forty-eight intact BWR assemblies per rail cask are shipped from the reactors to the repository. BNI, 1989
- o Seven intact BWR assemblies per truck cask are shipped from the reactors to the repository. BNI, 1989
- o Twenty-one intact PWR assemblies per rail cask are shipped from the reactors to the repository. BNI, 1989
- o Three intact PWR assemblies per truck cask are shipped from the reactors to the repository. BNI, 1989

Cask Capacities and Shipment Ratios

- o Fifty-five percent of SF is shipped from the reactors to the repository by rail and 45% by truck on an MTU basis. BNI, 1989

3.2 Description of the Design

3.2.1 Introduction

This subsection describes those design features that are specific to the WHB facility for Case A, as shown in Figures 3-3 and 3-4. Intact SF assemblies are received at the repository, where they are placed in containers for emplacement underground. High-level vitrified waste, which includes DHLW and WVHLW, is received in canisters at the repository, where the canisters are placed in containers for emplacement. No consolidation of fuel takes place at the repository.

The surface facilities for Case A are shown in Figure 3-5 and described briefly below. With the exception of the WHB, the decontamination building, and the vehicle wash facility, all other surface and underground facilities are assumed to be the same as described in the SCP-CDR (SNL, 1987).

3.2.2 Cask Receiving and Shipping Area

The cask receiving and shipping area for the Case A WHB consists of five truck bays and three rail bays (which can also receive truck casks) connected by a common cask offloading area that has nine cask unloading ports. Two 5-ton gantry cranes, each with a robotic arm, are provided, one for the truck bays and one for the rail bays. The gantry crane lifts the impact limiters off the cask. The robotic arm is used to perform radiological surveys on the cask.

Figure 3-3. General Arrangement of the Waste-Handling Building Plan, Case A

Figure 3-5. Plot Plan for the Central Surface Facilities, Case A

Two 150-ton bridge cranes riding on the same rails are provided for upending and lifting the cask from the carrier to the cask loading ports. Both cranes are sized to handle the heavier 100-ton rail cask, and one crane can be used while the other crane is being maintained. The heaviest rail cask to be received at the repository for Case A is assumed to weigh 100 tons.

3.2.3 Cask Preparation Area

The cask preparation area consists of nine separate bays, each of which is separated from the cask receiving and shipping area by a ventilation barrier door. These ventilation barriers prevent the spread of potential contaminants from the cask preparation area to the cask receiving and shipping area.

3.2.4 Waste-Unloading Hot Cells

There are nine waste-unloading hot cells--A through J--for unloading the waste from the casks. Five of the hot cells--A through E--are dedicated to SF assemblies from truck casks, and three hot cells--F, G, and H--are dedicated to SF assemblies from rail casks. High-level waste canisters are unloaded in Hot Cell J.

Although the unloading hot cells can handle either truck or rail casks, each cell is designated to handle either truck casks or rail casks, for more efficient operation. As a result, just one cask seal

adapter, for either a truck cask or a rail cask, is needed in each cask preparation bay, and the robotic arm for each hot cell can be programmed to unbolt either a truck or a rail cask. In addition, each cask transfer car is designed to carry either type of cask.

3.2.5 Welding Hot Cells

Three hot cells--A, B, and C--are provided for welding the lid to the waste container. Hot Cells A and B are dedicated to SF containers; Hot Cell C is dedicated to HLW containers.

3.2.6 HVAC Systems

A conceptual ventilation system for the Case A WHB is shown in Figure 3-6. Based on the configuration of the building, waste-handling operations, and the need for contamination control, four separate systems are used.

- o System 1 serves the unloading hot cells, welding hot cells, operating galleries, and the HVAC/HEPA filter rooms for these areas.
- o System 2 serves the cask receiving and shipping area, cask maintenance area, and the HVAC/HEPA filter rooms for these areas.
- o System 3 serves the offices, laboratories, and change areas.

- o System 4 serves the control room.

Because detailed heat loads are not known at this time, airflow rates and equipment selection are based on

- o six air changes per hour for the hot cells;
- o three air changes per hour for the operating galleries, cask receiving and shipping bay, maintenance area, and the HVAC/HEPA filter rooms;
- o air changes of 2 cfm/ft² for the offices, laboratories, and change areas; and
- o air changes of 5 cfm/ft² for the control room.

Figure 3-6 is a concept only. Detailed calculations, HVAC duct routing, and alternative concepts need to be evaluated in future studies.

3.2.7 Equipment

Major pieces of waste-handling equipment for the Case A WHB are listed in Appendix B. The equipment sizes, capacities, and power ratings are estimated values only.

3.3 Description of the Operation

In Case A, SF is shipped to the repository in truck and rail casks, and HLW is shipped to the repository in rail casks. Truck casks are moved into the receiving and shipping bays on the south side of the WHB and unloaded in Hot Cells A through E. Rail casks are moved into the bays on the north side of the WHB and unloaded in Hot Cells F, G, and H. The HLW canisters are unloaded in Hot Cell J.

A stationary hoist lifts the empty container off the container transfer car and lowers it to a batching transfer car, which moves the empty container to the container-loading station under the desired hot cell. Each SF unloading hot cell (A through H) accommodates both PWR and BWR assemblies so that a hybrid container can be fully loaded from one hot cell. After loaded with waste, a diaphragm is inserted in the top of the container, and it is moved back to a position where the stationary hoist can transfer it from the batching transfer car to the container transfer car. The loaded container is then moved to a station under the welding hot cell.

Lids are welded on the SF containers in Welding Hot Cells A and B. Welding Hot Cell C is used for welding lids on DHLW containers.

3.4 Timelines

3.4.1 General

Timeline diagrams are used to analyze and graphically represent the waste-handling operations. The waste-handling operations are listed on the left side of the diagram, and the times needed for these operations are indicated by horizontal bars in the appropriate sequence. Separate bars are shown for each cask or container. Equipment utilization, shown at the bottom of the diagram, demonstrates whether the indicated waste throughput rate can be achieved with the equipment and facilities provided in the design.

The waste-handling tasks are numbered in the same manner as the block flow diagrams presented in Section 2. The RASs in Appendix A give a more detailed breakdown of times for these operations and identify the equipment requirements for each waste-handling task and operation. This information provides a basis for development of the timeline diagrams.

Separate timeline diagrams have been developed for several major functions performed in the WHB: cask unloading, container loading, welding hot cell operations, and surface storage vault operations.

Each diagram indicates the maximum rate of waste throughput in the associated area of the WHB (e.g., unconstrained by limitations in throughput rates in other areas, such as those for preceding and

succeeding operations). Also, the equipment utilization chart at the bottom of each diagram shows which items are fully utilized during waste-handling operations at the maximum throughput rate. These fully utilized items determine the maximum waste throughput rate in each area. Other items are used for only a portion of the time available for productive equipment operations. Low utilization of certain equipment may occur when redundant items are provided for reliability or safety, when an item is required to perform a function that is needed only periodically or infrequently, and in other situations.

Assuming that operations are conducted for 6 productive hours/shift, 2 shifts/day, and 250 days/yr (as discussed in Subsection 2.1.2), there are 3,000 productive hours/yr for waste-handling operations. If equipment is available 90% of the productive hours, then there are 2,700 hr/yr available for productive equipment operations. The overall duration or time frame of each timeline diagram corresponds to the number of hours of productive equipment operations that are needed to accomplish all tasks listed on the left side of the diagram for the specific number of casks or containers shown on the diagram. The maximum achievable throughput rates for each area of the WHB can be determined by multiplying the processing rates shown on each timeline diagram (e.g., casks/hr or containers/hr) by 2,700 hr/yr.

Note that durations shown on the equipment utilization portion of the diagram may be different from the durations indicated for the corresponding waste-handling tasks because of the following reasons.

- o Additional time may be needed for the equipment to travel to and from the location where the task is performed.
- o Not all operations in a particular task necessarily require the use of an item of equipment.

3.4.2 Cask Unloading

Figure 3-7 shows the timeline diagram for truck cask handling for Case A. The diagram indicates that the waste from five truck casks can be received, unloaded, and stored in 11 hr and 20 min, and that five unloading and empty cask return cycles can be performed every 9 hr and 20 min. The timeline analysis indicates that the maximum throughput rate of about 1,450 truck casks/yr can be achieved in the Case A WHB. Therefore, the required throughput rate of 1,055 truck casks/yr (as shown in Figure 3-1) can be satisfied. The maximum possible throughput rate for truck casks in the Case A WHB is about 37% higher than is required.

The equipment utilization chart in Figure 3-7 indicates that the cask transfer cars are almost fully utilized during waste-handling operations at the maximum throughput rates. The indicated utilization of cask transfer cars cannot be increased because of the time required to remove an empty cask from a car and to transfer an incoming cask to the car (e.g., the car must be idle from the time an empty cask is removed to the time an incoming cask can be moved to and loaded onto the car). Other equipment is idle or available for maintenance during a portion of the

operating time, indicating that the maximum throughput rates of truck casks are governed by the cask transfer cars. Because they are reliable, the cask transfer cars should not become a bottleneck during normal waste handling.

Figure 3-8 shows the timeline diagram for rail cask handling for Case A. The timeline diagram indicates that the receiving and unloading tasks for three SF rail casks and three HLW rail casks can be accomplished in 29 hr and 30 min.

The timeline analysis indicates that maximum throughput rates of about 275 SF rail casks and 275 HLW rail casks per year can be achieved in the Case A WHB. Therefore, the required throughput rates of 186 SF rail casks and 160 HLW rail casks (as shown in Figure 3-1) can be satisfied. The maximum throughput rate of SF rail casks is about 48% higher than the required throughput rate.

The equipment utilization chart in Figure 3-8 indicates that the cask transfer car for HLW is almost fully utilized during waste-handling operations at the maximum throughput rates.

3.4.3 Container Loading

Figure 3-9 shows the timeline diagram for container loading operations for Case A. The diagram indicates that loading tasks for four SF containers and two HLW containers can be carried out in 5 hr and 40 min.

Figure 3-8. Timeline Diagram for Rail Cask Handling, Case A

The timeline analysis indicates that maximum throughput rates of about 1,900 SF containers and 950 HLW containers/yr can be achieved in the Case A WHB. Therefore, the required throughput rates of 1,510 SF containers/yr and 800 HLW containers/yr (as shown in Figure 3-1) can be satisfied. The maximum container loading throughput rate in Case A WHB is about 18% higher (for HLW containers) than the required throughput rate.

The equipment utilization chart in Figure 3-9 indicates that the batching transfer cars are almost fully utilized during waste-handling operations at the maximum throughput rates. The indicated utilization of batching transfer cars cannot be increased because of the time required to remove a container from a car and to place another container on the car (e.g., the batching transfer car must be idle from the time a container is removed to the time another container can be placed on the car). Other equipment items are idle or available for maintenance during a portion of the operating time.

3.4.4 Welding Hot Cell Operations

Figure 3-10 shows the timeline diagram for welding hot cell operations. The diagram was developed to show operations for one welding hot cell. The diagram indicates that the welding hot cell tasks for five containers can be carried out in 9 hr and 50 min (for each welding hot cell).

Figure 3-10. Timeline Diagram for Welding Hot Cell Operations

The timeline analysis indicates that maximum throughput rates of about 1,370 containers/yr can be achieved in each welding hot cell. Therefore, the required throughput rates of 1,510 SF containers/yr (755 containers/yr in each of the two SF container welding hot cells) and 800 HLW containers/yr (as shown in Figure 3-1) can be easily satisfied. The maximum SF container throughput rate in the Case A welding hot cells is about 71% higher than is required.

The equipment utilization chart in Figure 3-10 indicates that the 20-ton bridge crane in the welding hot cell is fully utilized during waste-handling operations at the maximum throughput rates. Other equipment are idle or available for maintenance during a portion of the operating time.

3.4.5 Surface Storage Vault Operations

Figure 3-11 shows the timeline diagram for surface storage vault operations. The diagram indicates that the storage, retrieval, and transporter-loading tasks for seven containers can be carried out in 5 hr and 52 min.

The timeline analysis indicates that maximum throughput rates of about 3,200 containers/yr can be achieved in the surface storage vault. Therefore, the required throughput rates of 1,510 SF containers/yr and 800 HLW containers/yr (as shown in Figure 3-1) can be easily satisfied. The maximum container throughput rate in the Case A surface storage vault is about 38% higher than the required throughput rate.

Figure 3-11. Timeline Diagram for Surface Storage Vault Operations

The equipment utilization chart in Figure 3-11 indicates that the CTMs are fully utilized during waste-handling operations at the maximum throughput rates. Other equipment items are idle or available for maintenance during a portion of the operating time.

3.4.6 Summary

On the basis of the timeline analysis for each major area of the Case A WHB, the maximum achievable throughput rates are greater than the required throughput rates for all major areas, with the following spare capacity for each area:

<u>Area</u>	<u>Spare Capacity</u>
Truck cask unloading	37
Rail cask unloading	48
Container loading	18
Welding hot cell operations	71
Surface storage vault operations	38

Because the container loading hot cells have the smallest spare capacity for the Case A WHB, these hot cells determine the maximum achievable throughput rate for the building (18% higher than the minimum required throughput rate of 3,000 MTU/yr of SF and 400 MTU/yr of HLW). This spare waste-handling capacity is desirable because some logistical difficulties and nonroutine operations may be expected during actual operations.

4.0 CASE B: WASTE-HANDLING BUILDING WITH A MONITORED RETRIEVABLE STORAGE FACILITY

In addition to the general assumptions stated in Section 2, the specific assumptions listed in this section have been used to develop the WHB configuration based on Case 5 of the MRS System Study (BNI, 1989).

4.1 Assumptions

The assumptions, grouped under Waste Throughput Rates, Waste and Waste Container Characteristics, and Cask Characteristics and Shipment Ratios, pertain to developing the WHB configuration for Case B.

4.1.1 Waste Throughput Rates

Reference

- o The year-by-year receipt rates for SF and HLW and the total repository throughput are shown in Table 4-1. BNI, 1989
- o The annual required throughput of SF and HLW in MTUs, the number of shipping casks, and the number of waste containers received are shown in Figure 4-1. BNI, 1989

TOTAL POSSIBLE REPOSITORY THROUGHPUT FOR
CASE B (BNI, 1989)

Notes:	SWFs:	9 Intel = 1 container 20 conventional = 1 container
	PMs:	4 Intel = 1 container 8 conventional = 1 container
	Hardware:	7 assemblies = 1 drum 5 drums = 1 container
	D4L W:	9 MTU = 1 container
	WW4 W:	2 13 MTU = 1 container

Figure 4-1. Repository Annual Throughput for Case B (BNI, 1989)

4.1.2 Waste and Waste Container Characteristics

Reference

- o Ninety-five percent of all the SF received at the MRS facility is consolidated at the MRS facility; the other 5% is placed in canisters as intact fuel assemblies. BNI, 1989
- o At the MRS facility, all intact and consolidated SF is placed in square canisters before being shipped to the repository. As shown in Figure 4-2, there are two types of square canisters used for intact and consolidated BWR and PWR assemblies: a 9.1- x 9.1-in. canister for packaging one intact PWR assembly, two consolidated PWR assemblies, or five consolidated BWR assemblies and a 6.0- x 6.0-in. canister for packaging one intact BWR assembly. (The maximum length of the canisters will fit the assumed container length of 188 in.) BNI, 1989
- o Ninety percent of the SF received at the repository is in canisters shipped from the MRS facility; the remaining 10% is in the form of bare intact assemblies shipped from reactors located in the western part of the United States. BNI, 1989

**FIGURE A - PWR - INTACT & CONSOLIDATED, AND
BWR - CONSOLIDATED**

FIGURE B - BWR INTACT

Figure 4-2. Canisters for the Monitored Retrievable Storage
(BNI, 1989)

Waste and Waste Container Characteristics (Continued)

Reference

- o The hardware from the consolidation of seven BWR and/ or PWR assemblies at the MRS facility is collected in a 55-gal drum. Five of the drums are then loaded into a hardware cage that has a lifting pintle and is 26 in. diameter by 180 in. long.

BNI, 1989
- o At the repository, four intact PWR assemblies (bare assemblies from western reactors and canisters from the MRS facility) are placed in a container for emplacement. Six consolidated PWR assemblies (three canisters) are placed in a container for emplacement (Figure 4-3).

BNI, 1989
- o At the repository, nine intact BWR assemblies (bare assemblies from western reactors and canisters from the MRS facility) are placed in a container for emplacement. A total of 20 consolidated BWR assemblies (five canisters) are placed in a container for emplacement (Figure 4-3).

BNI, 1989
- o At the repository, each hardware cage is overpacked in a 28-in. diameter by 188-in.-long container for emplacement.

BNI, 1989

4 INTACT PWRs
OR
6 CONS. PWRs (POWER LIMITED)
OR
20 CONS. BWRS

FIGURE A

9 INTACT BWRS

FIGURE B

Figure 4-3. Internal Configuration of a Spent Fuel Container for Canisters From the Monitored Storage Facility (BNI, 1989)

Waste and Waste Container Characteristics (Concluded)

Reference

- o The thermal power values for SF containers are as follows:

BNI, 1989

4 intact PWRs	2,104 W
6 consolidated PWRs	3,156 W
9 intact BWRs	1,503 W
20 consolidated BWRs	3,340 W
Hardware waste	negligible.

4.1.3 Cask Capacities and Shipment Ratios

- o For BWR assemblies from the MRS facility, one intact assembly is placed in each square canister, and 61 canisters (61 intact assemblies) are loaded into one shipping cask; five consolidated assemblies are placed in each square canister, and 28 canisters (140 consolidated assemblies) are loaded into one shipping cask.

BNI, 1989

- o For PWR assemblies from the MRS facility, one intact assembly is placed in each square canister, and 28 canisters (28 intact assemblies) are loaded into one shipping cask; two consolidated assemblies are placed in each square canister, and 28 canisters (56 consolidated assemblies) are loaded into one shipping cask.

BNI, 1989

Cask Capabilities and Shipment Ratio (Continued)

Reference

- o All SF from the MRS facility is shipped to the repository in rail casks. BNI, 1989
- o Shipments from the MRS facility are in five- or six- cask dedicated trains. (Six-cask trains include one cask containing only the hardware waste.) BNI, 1989
- o Four hardware cages are placed in a cask for shipment to the repository. BNI, 1989
- o Spent fuel is shipped from the MRS to the repository in 150-ton rail casks. BNI, 1989
- o Fifty-five percent of SF is shipped from western reactors to the repository by rail and 45% by truck on an MTU basis. BNI, 1989
- o Forty-eight intact BWR assemblies/rail cask are shipped from western reactors to the repository. BNI, 1989
- o Seven intact BWR assemblies/truck cask are shipped from western reactors to the repository. BNI, 1989

Cask Capabilities and Shipment Ratio (Concluded)

Reference

- o Twenty-one intact PWR assemblies/rail cask are shipped from western reactors to the repository. BNI, 1989
- o Three intact PWR assemblies/truck cask are shipped from western reactors to the repository. BNI, 1989

4.2 Description of the Design

4.2.1 Introduction

This subsection describes design features that are specific to the Case B WHB facilities, as shown in Figures 4-4 and 4-5. For Case B, except assemblies from western reactors, intact SF assemblies and consolidated SF rods are placed in canisters at the MRS facility and then shipped to the repository, where the canisters are placed in containers for emplacement. Spent fuel assemblies from western reactors are shipped directly to the repository for packaging in containers and emplacing underground. No SF is consolidated at the repository. DHLW and WVHLW are received in canisters at the repository, where the canisters are packaged in containers for emplacement.

The surface facilities for Case B are shown in Figure 4-6 and are described briefly below. With the exception of the WHB, the decontamination building, and the vehicle wash facility, all other

Figure 4-4. General Arrangement of the Waste-Handling Building Plan, Case B

Figure 4-5. General Arrangement of the Waste-Handling Building Sections, Case B

Figure 4-6. Plot Plan for the Central Surface Facilities, Case B

surface and underground facilities are assumed to be the same as described in the SCP-CDR (SNL, 1987).

4.2.2 Cask Receiving and Shipping Area

The cask receiving and shipping area consists of three rail bays (which can also receive truck casks) connected to a cask offloading area that has five unloading ports. A 5-ton gantry crane with a robotic arm is provided for the rail bays. There are fewer receiving and shipping bays and unloading ports in Case B than in Case A because the cask receipt rate is lower. All SF assemblies shipped to the repository from the MRS facility are in rail casks that hold more SF assemblies than the truck casks. A portion of the intact SF assemblies from western reactors, however, is shipped to the repository in truck casks; however, this is a small percentage of the total amount of SF received. A truck cask carrier can be received in one of the rail cask receiving and shipping bays when the bay is not being used for rail casks.

Two 200-ton bridge cranes riding on the same rails are provided for upending and lifting the casks from the carrier and transferring them to the cask-loading ports. The crane capacity is greater for the Case B WHB because the rail casks from the MRS are heavier (about 150 tons). Although one crane can handle the cask throughput, a second crane is provided for redundancy.

4.2.3 Cask Preparation Area

The cask preparation area consists of five separate bays. Only five cask preparation bays are required for the Case B WHB because fewer casks are received.

4.2.4 Waste-Unloading Hot Cells

Five hot cells--A through E--are provided for unloading the waste from the casks. Hot Cell A is dedicated to bare intact SF assemblies from the western reactors. Three hot cells--B, C, and D--are dedicated to intact and consolidated SF canisters and hardware cages from the MRS facility only. HLW canisters are unloaded in Hot Cell E. Both truck and rail casks are unloaded in Hot Cell A. Only rail casks are unloaded in Hot Cells B through E. However, each unloading hot cell is designed to handle either truck or rail casks.

4.2.5 Welding Hot Cells

Three hot cells--A, B, and C--are also provided for welding the lid on the container. Welding Hot Cell A is dedicated to containers that contain bare, intact SF from western reactors. Welding Hot Cell B is dedicated to intact and consolidated SF and hardware containers from the MRS facility. Welding Hot Cell C is dedicated to HLW containers, which are smaller than SF containers.

4.2.6 HVAC Systems

The HVAC systems for the Case B WHB are similar to those for the Case A WHB, as described in Subsections 2.2.10 and 3.2.6.

4.2.7 Equipment

Major pieces of waste-handling equipment for the Case B WHB are listed in Appendix C. The equipment sizes, capacities, and power ratings are estimated values only.

4.3 Description of the Operation

In Case B, most of the SF and all of the HLW are shipped to the repository in rail casks. A small fraction of the SF is shipped from western reactors in truck casks.

The bare SF assemblies from western reactors are unloaded in Hot Cell A. Spent fuel canisters and hardware cages from the MRS are unloaded in Hot Cells B, C, and D. High-level waste canisters are unloaded in Hot Cell E.

For Case B, the container transfer car moves the empty containers directly to the container-loading station below the desired hot cell. After the canister has been loaded, it is then moved to a station under the welding hot cell by the container transfer car.

Lids are welded on western reactor fuel containers in Welding Hot Cell A. Welding Hot Cell B is used for welding lids on containers of SF and hardware from the MRS facility. High-level waste containers are welded in Welding Hot Cell C.

4.4 Timelines

4.4.1 General

Timeline diagrams are used to analyze and graphically represent the waste-handling operations, as in Case A.

4.4.2 Cask Unloading

Figure 4-7 shows the timeline diagram for cask-unloading operations for Case B. Because only a few truck casks are received from western reactors, they are not assessed. The diagram indicates that the receiving and unloading tasks for two SF casks, two HLW casks, and one hardware cask can be carried out in 25 hr and 25 min.

Assuming that there are 2,700 hr/yr available for productive equipment operations (see Subsection 3.4.1), the timeline analysis indicates that maximum throughput rates of about 210 SF casks, 210 HLW casks, and 105 hardware casks/yr can be achieved in the Case B WHB. Therefore, the required throughput rates of 116 SF casks, 160 HLW casks, and 63 hardware casks/yr (as shown in Figure 4-1) can be easily

Figure 4-7. Timeline Diagram for Cask Handling, Case B

satisfied. The maximum throughput rate in the Case B WHB is about 31% higher for HLW casks than is required.

The equipment utilization chart in Figure 4-7 indicates that the 20-ton bridge cranes in SF Unloading Hot Cells B and C are fully utilized during waste-handling operations at the maximum throughput rates. Other equipment items are idle or available for maintenance during a portion of the operating time.

4.4.3 Container Loading

Figure 4-8 shows the timeline diagram for container-unloading operations for Case B. The diagram indicates that loading tasks for nine SF containers, six HLW containers, and two hardware containers can be carried out in 8 hr and 25 min.

The timeline analysis indicates that maximum throughput rates of about 2,880 SF containers, 1,920 HLW containers, and 640 hardware containers/yr can be achieved in the Case B WHB. Therefore, the required throughput rates of 1,158 SF containers, 800 HLW containers, and 250 hardware containers/yr (as shown in Figure 4-1) can be easily satisfied. The maximum hardware container-loading rate in the Case B WHB is about 140% higher than is required.

The equipment utilization chart in Figure 4-8 indicates that the container transfer monorail is fully utilized during waste-handling

LEGEND

- TASKS IDENTIFIED ON THIS TIMELINE DIAGRAM
- TASKS IDENTIFIED ON ANOTHER TIMELINE
- LAG TIME

NOTES

- THIS TIMELINE DIAGRAM COVERS THE ROUTINE OPERATIONS FOR LOADING SPENT FUEL (SPL) HARDWARE (HWR) AND HIGH LEVEL WASTE (HLW) CONTAINERS IN THE UNLOADING HOT CELLS
- THIS TIMELINE DIAGRAM REPRESENTS THE MAXIMUM ACHIEVABLE THROUGHPUT RATE FOR LOADING CONTAINERS IN THE UNLOADING HOT CELLS
- EACH TIMELINE CORRESPONDS TO THE PROCESSING OF A CONTAINER, AS DENOTED BY A NUMBER
- THE TIME FRAME OF THE DIAGRAM IS 8 HRS 25 MIN
- LETTERS REPRESENT THE EQUIPMENT PROVIDED FOR SERVICING THE CORRESPONDING UNLOADING HOT CELL
- CONTAINER TRANSFER CART TIME IS SHOWN FOR LOADING CONTAINERS AND FOR TRANSFERRING THE CONTAINERS INTO THE WELDING HOT CELL

Figure 4-8. Timeline Diagram for Container Loading, Case B

operations at the maximum throughput rates. Other equipment items are idle or available for maintenance during a portion of the operating time.

4.4.4 Welding Hot Cell and Surface Storage Vault Operations

The timeline diagrams for the welding hot cell and surface storage vault operations are the same in both Case A and Case B.

As discussed in Subsection 3.3, each welding hot cell has a maximum throughput rate of 1,370 containers/yr. In Case B, Welding Hot Cell B is dedicated to welding SF containers and hardware from the MRS facility and must accommodate the highest throughput rate of containers. The required throughput rate of 1,230 containers/yr in Welding Hot Cell B can be satisfied. The maximum container throughput rate in Welding Hot Cell B is about 11% higher than is required.

Also, as discussed in Subsection 3.3, the surface storage vault has a maximum throughput rate of 3,200 containers/yr. In Case B, the required rate of 2,208 containers/yr (as shown in Figure 4-1) can be easily satisfied. The maximum container throughput rate in the Case B surface storage vault is about 45% higher than is required.

4.4.5 Summary

On the basis of the timeline analysis for each major area of the Case B WHB, the maximum achievable throughput rates are greater than the

required throughput rates for all major areas, with the following spare capacity for each area:

<u>Area</u>	<u>Spare Capacity (%)</u>
Cask unloading	31
Container loading	140
Welding hot cell operations	11
Surface storage, vault operations	45

Welding Hot Cell B has the smallest spare capacity for the Case B WHB, and determines the maximum achievable throughput rate for the building (11% higher than the minimum required throughput rate of 3,000 MTU/yr of SF and 400 MTU/yr of HLW). This spare waste-handling capacity is desirable because some logistical difficulties and nonroutine operations may be expected during actual operations.

5.0 SUMMARY

5.1 Recommended Waste-Handling Building Features

5.1.1 Drive-Through Cask Receiving and Shipping Bays

Drive-through cask receiving and shipping bays allow easier ingress of the facility transfer vehicle and the cask carrier than do the back-in cask receiving and shipping bays. This feature also reduces the span of the large-capacity crane used for lifting the casks off the carrier.

5.1.2 Separation of the Cask Preparation Areas from the Cask Receiving and Shipping Area

The cask preparation areas (which may potentially become contaminated as casks are opened) are separated by ventilation barriers from the cask receiving and shipping area. Hence, the potential for contamination is insignificant in the cask receiving and shipping area.

5.1.3 Modular Waste-Unloading and Welding Hot Cells

Modular waste-unloading and welding hot cells (1) facilitate design changes required by revised throughput requirements or other revised criteria, (2) allow waste unloading to continue even if one or more of the hot cells are down for maintenance, (3) eliminate crane interferences, and (4) help contain the potential spread of contamination resulting from SF handling operations.

5.1.4 Passive Cooling

The use of a passively cooled surface storage vault offers many advantages, including lower operating costs, lower energy consumption, less maintenance, and greater reliability (no equipment failure).

5.1.5 Cask Maintenance Area

In the WHB, there is a cask maintenance area where cask repairs, component replacements, and decontamination are performed. The cask maintenance area is provided to meet the requirements of DOE (1986). The design of this area can be further developed as more information becomes available on such items as cask designs, the existence of a central cask maintenance facility, and transportation systems.

5.2 Throughput Rates for the WHB

The Case B WHB is smaller than the Case A WHB because of the increased use of the larger capacity rail casks for shipping SF from the MRS. Because fewer casks are received in the Case B WHB, fewer cask receiving and shipping bays, cask access hatches, cask preparation stations, and unloading hot cells are required.

The timelines indicate that both the Case A and the Case B WHB can handle the required annual throughput rates of 3,000 MTU of SF and 400 MTU of HLW. The Case A WHB has a maximum waste throughput rate that is

about 18% higher than required. The Case B WHB has a maximum waste throughput rate that is about 11% higher than is required. The spare capacity is desirable because some logistical difficulties and nonroutine operations may be expected during actual operations.

5.3 Areas Requiring Further Evaluation

Although the general configuration of the WHB is based primarily on the waste-handling function, other supporting functions also affect this configuration. The location and layout of the supporting facilities such as the access control area, HVAC equipment rooms, offices, control room, health physics area, change rooms, and laboratories need to be considered further.

Space is allowed for HVAC equipment and duct routing, but a detailed analysis of the HVAC requirements has not been conducted. Ventilation concepts are described in Subsections 2.2.10 and 3.2.6. Additional HVAC requirements are described by SNL (1987). HVAC requirements, ventilation control doors, hatches, and ports need to be analyzed in more detail.

There are advantages of using a passively cooled surface storage vault to temporarily store the waste containers. However, to demonstrate the viability of the concept, more rigorous evaluations are recommended.

The use of inertia welding to close the container has to be evaluated further. Although this process produces welds of consistently good

quality in commercial applications, the use of inertia welding in hot cell applications has not been demonstrated at this time.

In this study, a common configuration has been assumed for the container for intact SF assemblies, SF in canisters, and hardware cages. Further evaluation is required to determine the optimum dimensions and configurations of the waste container.

The use of a diaphragm for inerting the container is assumed for this study. The effectiveness of the diaphragm, the requirement for inerting, and a method of inerting need to be further evaluated.

The thermal power of a waste container is assumed to be limited to 3,500 W for this study. This limitation needs to be further evaluated for efficient waste packaging and for underground borehole spacings.

A detailed layout and evaluation of the three-way track intersection for the container transfer cars, as shown in Figure 4-4, need to be performed to confirm the workability of the concept.

Because of the liquid radioactive waste generated in the cask and container decontamination facilities in the WHB, the impact on the liquid waste treatment facility needs to be evaluated.

The retractable loading chute for mating to the waste container before loading the waste needs to be designed in future studies.

The method of placing the cask seal protector on the cask before unloading the waste needs to be determined in future studies.

The cask and waste container design and dimensions shown are assumed for this study. As the design of the cask and waste containers is developed further, space requirements and building interfaces need to be evaluated.

In the design and layout of the alternative WHB configurations, radiation protection, contamination control, and safety features are considered. In the detailed design of the WHB, detailed calculations for these factors need to be carried out, including an evaluation of potential criticality.

6.0 REFERENCES

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APPENDIX A

REQUIREMENT ALLOCATION SHEETS

REQUIREMENT ALLOCATION SHEET

TASK:	1.1 Admit Shipment Carrier		
FACILITY:	Repository Gate Admitting and Inspection Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
1.1.1	Identify and admit the shipment carrier through Security Station 3 gate, and inspect the security seals.	Repository gate	N/A
1.1.2	Move the shipment carrier to the admitting and inspection area.	Admitting and inspection area	N/A

REQUIREMENT ALLOCATION SHEET

TASK:	<u>1.2 Survey and Inspect Shipment</u>		
FACILITY:	<u>Admitting and Inspection Area</u>		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
1.2.1	Inspect the cask carrier for safety, radiological, or security problems.	Radiological inspection tools	N/A
1.2.2	Uncouple the rail engine from the rail cask carrier or tractor from the truck cask carrier.	Uncoupling tools	N/A

REQUIREMENT ALLOCATION SHEET

TASK:	1.3 Transfer Cask Carrier to Interim Storage Area		
FACILITY:	Interim Storage Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
1.3.1	Couple the facility transfer vehicle and the cask carrier.	Facility transfer vehicle	N/A
1.3.2	Move the cask carrier to the interim storage area.	Interim storage area for cask carriers	N/A
1.3.3	Uncouple the facility transfer vehicle.	Facility transfer vehicle	N/A

REQUIREMENT ALLOCATION SHEET

TASK:

1.4 Transfer Cask Carrier to Waste-Handling Building

FACILITY:

Interim Storage Area
Cask Receiving and Shipping Bay

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
1.4.1	Couple the facility transfer vehicle and the cask carrier.	Facility transfer vehicle	N/A
1.4.2	Transfer the cask carrier from interim storage to the waste-handling building.	Interim storage area for cask carriers	N/A
1.4.3	Wash the cask carrier if necessary to remove road dirt and ice (nonroutine).	Washing equipment	Nonroutine
1.4.4	Move the cask carrier into the receiving and shipping bay.	Facility transfer vehicle	2
1.4.5	Move the facility transfer vehicle out of the receiving and shipping bay.	Facility transfer vehicle	4

REQUIREMENT ALLOCATION SHEET

TASK: 1.5 Open Personnel Barrier and Remove Impact Limiters			
FACILITY: Cask Receiving and Shipping Bay			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
1.5.1	Remove the security seals and release the personnel barrier fasteners.		5
1.5.2	Slide the personnel barrier open to the ends of the carrier.		5
1.5.3	Remove the impact limiters' security seals and release the impact limiter fasteners.		10
1.5.4	Using the gantry crane, lift and move the first impact limiter to temporary storage.	Gantry crane [equipped with an electromechanical (ELMCH) manipulator]. Storage area for impact limiters	11 (truck casks) 10 (rail and DHLW casks)
1.5.5	Using the gantry crane, lift and move the second impact limiter to temporary storage.	Gantry crane (equipped with an ELMCH manipulator). Storage area for impact limiters	9

REQUIREMENT ALLOCATION SHEET

TASK: 1.6 Perform Radiological Survey of Cask Exterior Surface			
FACILITY: Cask Receiving and Shipping Bay			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
1.6.1	Perform a direct radiation survey of the cask and record the results.	Radiation survey equipment	10
1.6.2	Perform a contamination survey of the cask surface; transfer the smears to the smear counter, count the smears, and record the results.	Contamination (smear) survey equipment	30
1.6.3	Spot decontaminate cask surfaces, as necessary (nonroutine).	Decontamination equipment	Nonroutine

REQUIREMENT ALLOCATION SHEET

TASK:	2.1 Remove Cask from Carrier and Transfer Cask to Transfer Tunnel		
FACILITY:	Cask Receiving and Shipping Bay Transfer Tunnel		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.1.1	Remove the cask tie-down security seals, release the tie-down fixtures, and store.	Storage area for cask tie-down fixtures Tools for cask tie-down removal	15
2.1.2	Select lifting yoke from the temporary storage area and attach the yoke to the bridge crane.	Cask lifting yoke (and storage area) Bridge crane	0 truck cask 4 rail, DHLW, SF and HDWR casks*
2.1.3	Transfer the lifting yoke to the cask and attach the yoke to the cask trunnions.	Cask lifting yoke Bridge crane	4
2.1.4	Raise the cask to the vertical position with the bridge crane.	Bridge crane	4
2.1.5	Using the bridge crane, lift the cask off the carrier and move the cask to the transfer tunnel.	Bridge crane	7 [DHLW cask (Case A)] 9 [truck, rail, SF, HDWR and DHLW (Case B) casks]

REQUIREMENT ALLOCATION SHEET

TASK: 2.1 Remove Cask from Carrier and Transfer Cask to Transfer Tunnel (Concluded)

FACILITY: Cask Receiving and Shipping Bay
Transfer Tunnel

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.1.6	Lower the cask to the cask transfer car in the transfer tunnel.	Bridge crane Cask transfer car Transfer tunnel hatch	6
2.1.7	Secure the cask to the cask transfer car.	Cask transfer car	3
2.1.8	Disconnect the yoke from the cask trunnions and return yoke to the temporary storage area.	Bridge crane Cask lifting yoke (and storage area)	5

* Parallel with 2.1.1

REQUIREMENT ALLOCATION SHEET

TASK:	<u>2.2 Transfer Cask to Cask Maintenance Area (Nonroutine)</u>		
FACILITY:	<u>Cask Maintenance Area</u>		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.2.1	Move the transfer cask and cask from the transfer tunnel to the cask maintenance area.	Cask transfer car	Nonroutine
2.2.2	Decontaminate the cask exterior.	Cask decontamination equipment	Nonroutine
2.2.3	Transfer the cask to the cask preparation area.	Cask transfer car	Nonroutine

REQUIREMENT ALLOCATION SHEET

TASK:	2.3 Transfer Cask to Cask Preparation Area		
FACILITY:	Transfer Tunnel Cask Preparation Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.3.1	Move the transfer car and cask from the transfer tunnel to the cask preparation area.	Cask transfer car	1

REQUIREMENT ALLOCATION SHEET

TASK: 2.4 Check Outer Cavity Pressure			
FACILITY: Cask Preparation Area			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.4.1	Locate the cask outer cavity vent valve and connect the pressure check assembly to the valve.	Pressure check assembly (and storage area)	7
2.4.2	Open the cask vent valve and pressure gauge valve, read the pressure, and record the results.		2
2.4.3	Close the cask vent valve and the pressure gauge valve.		1
2.4.4	Sample the outer cavity gas (nonroutine).	Outer cavity gas sampling equipment	Nonroutine

REQUIREMENT ALLOCATION SHEET

TASK: 2.5 Remove Outer Lid from Cask			
FACILITY: Cask Preparation Area			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.5.1	Remove the pressure check assembly from the cask outer cavity vent valve and store the assembly.	Pressure check assembly (and storage area)	4
2.5.2	Remove the outer lid security seal and release the outer lid fasteners.	Tools for outer lid seal removal and fastener release	20
2.5.3	Attach the outer lid lifting fixture to the crane, and lower the fixture to the outer lid of the cask.	Cask outer lid lifting fixture Crane	5
2.5.4	Attach the fixture to the outer lid, lift the lid, and place it at the temporary storage area.	Cask outer lid lifting fixture Crane Outer lid storage stand	6
2.5.5	Visually inspect the outer lid for damage and wear and tear.	Outer lid storage stand	0
2.5.6	Replace damaged or worn outer lid components (nonroutine).	Replacement components for outer lid (and storage area)	Nonroutine

REQUIREMENT ALLOCATION SHEET

TASK:	<u>2.6 Survey Surface of Cask Outer Cavity and Sample Gas in Inner Cavity</u>			
FACILITY:	<u>Cask Preparation Area</u>			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)	
2.6.1	Perform a contamination survey of the outer cavity of the cask; transfer the smears to the smear counter, count the smears, and record the results.	Contamination survey (smear) equipment	10	
2.6.2	Spot-decontaminate if necessary (nonroutine).	Decontamination equipment	Nonroutine	
2.6.3	Connect the gas sample and vent assembly to the inner cavity vent valve.	Gas sample and vent assembly (and storage area)	4	
2.6.4	Open the cask vent valve and the pressure gauge valve, record the pressure, and close the pressure gauge valve.	Gas sample and vent assembly	3	
2.6.5	Open the sample bottle valve, draw the gas into the bottle, and close the sample bottle valve.	Gas sample and vent assembly Sample bottles	2	
2.6.6	Transfer the sample to the gas counter and analyze.	Gas counter	3	
2.6.7	Vent the cavity gas to the filtered ventilation exhaust system (routine).	Filtered ventilation exhaust system Gas sample and vent assembly	4	

REQUIREMENT ALLOCATION SHEET

TASK: 2.6 Survey Surface of Cask Outer Cavity and Sample Gas in Inner Cavity (Continued)

FACILITY: Cask Preparation Area

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.6.8	Purge the cavity gas to the filtered ventilation exhaust	Filtered ventilation exhaust system Gas sample and vent assembly	Nonroutine
2.6.9	Disconnect the sample and vent assembly from the cask inner cavity vent valve, and store.	Gas sample and vent assembly (and storage area)	4

REQUIREMENT ALLOCATION SHEET

TASK:	2.7 Release Inner Lid Fasteners and Install Seal Adapter		
FACILITY:	Cask Preparation Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.7.1	Attach lifting rings to the cask inner lid.	Lifting rings	3
2.7.2	Release the inner lid fasteners.		20
2.7.3	Attach the cask-to-hot-cell seal adapter lifting fixture (with the adapter attached) to the crane, and move the adapter to the cask.	Seal adapter Seal adapter lifting fixture (and storage area) Crane	4
2.7.4	Install the seal adapter on the cask.	Seal adapter	2
2.7.5	Detach the lifting fixture from the cask seal adapter, and return the fixture to the storage area.	Seal adapter lifting fixture (and storage area)	3
2.7.6	Connect the cask seal adapter activation system to the control system on the transfer car.	Seal adapter activation system Transfer car control system Transfer car	2

REQUIREMENT ALLOCATION SHEET

TASK:

2.8 Transfer Cask to Unloading Station

FACILITY:

Unloading Hot Cell

OPERATION
NO.

DESCRIPTION

EQUIPMENT/FACILITY REQUIREMENTS

ESTIMATED
DURATION
(min)

2.8.1

Open the shield/ventilation barrier door to the cask unloading station.

Shield/ventilation barrier door

2

2.8.2

Move the cask transfer car to the unloading station, and position the cask under the unloading hot cell port.

Cask transfer car
Unloading hot cell port

2

2.8.3

Close the shield/ventilation barrier door.

Shield/ventilation barrier door

2

2.8.4

Activate the seal adapter to seal the cask to the unloading hot cell port.

Seal adapter activation equipment

1

REQUIREMENT ALLOCATION SHEET

TASK:

2.9 Remove Hot Cell Port Shield Plug and Cask Inner Lid

FACILITY:

Unloading Hot Cell

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.9.1	Using the bridge crane, remove the hot cell shield plug(s) to the temporary storage area.	Bridge crane Shield plugs (and temporary storage area)	10 (truck casks 27 rail, DHLW, SF, and HDWR casks)
2.9.2	Pick up the cask inner lid lifting fixture from the equipment storage area, and move to the cask. Cask transfer car	Inner lid lifting fixture (and storage area) Bridge crane	6
2.9.3	Attach the fixture to the inner lid and transfer the lid to the temporary storage area	Inner lid lifting fixture Inner lid temporary storage area Bridge crane	10
2.9.4	Install the cask seal surface protector.	Cask seal surface protector	14

REQUIREMENT ALLOCATION SHEET

TASK: 2.10 Unload, Inspect, and Place Waste in Storage Rack			
FACILITY: Unloading Hot Cell			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
2.10.1	Attach a waste-handling tool to the bridge crane, from the equipment storage area.	Waste-handling tool (and storage area) Bridge crane	4
2.10.2	Index the crane to the cask position.	Bridge crane Crane indexing equipment	2
2.10.3	Move the bridge crane to the unloading port and lift the waste into the hot cell.	Bridge crane Unloading port	7*
2.10.4	Visually inspect the waste and identification number(s).		5*
2.10.5	Transfer the waste to the appropriate storage rack in the unloading hot cell.	Bridge crane Storage rack	7*
2.10.6	Store the waste-handling tool.	Waste-handling tool (and storage area)	4 (truck, rail, SF, and HDWR casks) 5 (DHLW cask)

* Estimated duration per waste element.

REQUIREMENT ALLOCATION SHEET

TASK:		3.1 Inspect Cavity of Unloaded Cask			
FACILITY:		Unloading Hot Cell			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)		
3.1.1	Perform a radiological survey of the cask cavity.	Radiological survey equipment	10		
3.1.2	Remove the seal surface protector.	Seal surface protector	15		
3.1.3	Visually inspect the cavity of the cask with a closed-circuit television (CCTV) attached to the ELMCH manipulator to verify that the fuel or canisters have been removed. Inspect the fuel basket, seal surface, and closure alignment pins. Inspect the seal on the inner lid.	ELMCH manipulator CCTV camera	20		

REQUIREMENT ALLOCATION SHEET

TASK:	3.2 Replace Cask Inner Lid		
FACILITY:	Unloading Hot Cell		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.2.1	Lift the inner lid from the temporary storage area and replace it on the cask.	Inner lid temporary storage area Bridge crane	7
3.2.2	Disconnect and return the lifting fixture to the equipment storage area.	Inner lid lifting fixture (and storage area)	8
3.2.3	Replace the shield plug(s) in the hot cell port.	Bridge crane Unloading port	9 (truck) 22 (rail cask)

REQUIREMENT ALLOCATION SHEET

TASK: 3.3 Transfer Unloaded Cask to Preparation Area

FACILITY: Unloading Hot Cell

Cask Unloading Station

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.3.1	Deactivate the seal between the cask seal adapter and the hot cell port.	Seal adapter (de)activation equipment	1
3.3.2	Open the cask unloading station shield/ventilation barrier door.	Shield/ventilation barrier door	2
3.3.3	Transfer the unloaded cask on the cask transfer car to the cask preparation area.	Cask transfer car	2
3.3.4	Close the shield/ventilation barrier door.	Shield/ventilation barrier door	2

REQUIREMENT ALLOCATION SHEET

TASK:		3.4 Remove Seal Adapter and Tighten Inner Lid Bolts		
FACILITY:		Cask Preparation Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)	
3.4.1	Survey and decontaminate the seal adapter, as necessary.	Seal adapter decontamination equipment	15	
3.4.2	Select the cask seal adapter lifting fixture from the equipment storage area, and attach it to the adapter.	Seal adapter lifting fixture (and storage area)	3	
3.4.3	Remove the cask seal adapter and place it in the temporary storage area.	Seal adapter (and storage area)	4	
3.4.4	Survey and decontaminate the cask outer cavity and inner lid, as necessary.	Outer cavity and inner lid decontamination equipment	20	
3.4.5	Tighten the inner lid bolts.		20	

PEQUIREMENT ALLOCATION SHEET

TASK:		3.5 Leak Test Inner Cavity and Replace Outer Lid	
FACILITY:		Cask Preparation Area	
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.5.1	Connect the leak test assembly to the inner cavity vent valve.	Leak test assembly	4
3.5.2	Purge and pressurize the inner cavity.	Inner cavity purge and pressurization equipment	3
3.5.3	Perform a leak test, record the results, and remove the leak test assembly.	Leak test assembly	9
3.5.4	Remove inner lid lifting eyes.		3
3.5.5	Pick up the outer lid from the temporary storage area, and replace it on the cask.	Outer lid temporary storage area Crane	10

This task is parallel with Task 3.9.

REQUIREMENT ALLOCATION SHEET

TASK:	3.6 Transfer Cask to Cask Maintenance Area (Nonroutine)		
FACILITY:	Cask Maintenance Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.6.1	Transfer the cask to the cask maintenance area.	Cask transfer car	

REQUIREMENT ALLOCATION SHEET

TASK:	3.7 Take Corrective Action (Nonroutine)	
FACILITY:	Cask Maintenance Area	
OPERATION NO.	DESCRIPTION	ESTIMATED DURATION (min)
3.7.1	Remove the cask inner lid and replace the seals, if necessary.	Crane Cask inner lid replacement seals
3.7.2	Replace interchangeable parts, if necessary.	Interchangeable replacement parts
3.7.3	Decontaminate the inner cavity, if necessary. equipment	Inner cavity decontamination equipment
3.7.4	Reconfigure cask internal structure, if necessary.	
3.7.5	Decontaminate the cask exterior, if necessary.	Cask exterior decontamination equipment

REQUIREMENT ALLOCATION SHEET

TASK: <u>3.8 Leak Test Outer Cavity</u>			
FACILITY: <u>Cask Preparation Area</u>			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.8.1	Tighten the outer lid bolts.		20
3.8.2	Connect the leak test assembly to the outer cavity vent valve and pressurize the outer cavity.	Leak test assembly	6
3.8.3	Perform a leak test, record the results, and remove the leak test assembly.	Leak test assembly	12
3.8.4	Replace the seal(s), if necessary (nonroutine).	Replacement seals	Nonroutine

This task is parallel with Task 3.9.

REQUIREMENT ALLOCATION SHEET

TASK:		3.9 Survey Contamination on Cask and Spot Decontaminate		
FACILITY:		Cask Preparation Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)	
3.9.1	Survey the cask exterior surface for contamination; transfer the smears to the smear counter, and count the smears.	Contamination (smear) survey equipment	60	
3.9.2	Spot decontaminate, as necessary (routine).	Decontamination equipment	30	
3.9.3	Transfer the cask to the cask maintenance area for extensive decontamination (nonroutine).	Decontamination equipment (in cask maintenance area)		Nonroutine

REQUIREMENT ALLOCATION SHEET

TASK:	3.10 Transfer Unloaded Cask to Transfer Tunnel		
FACILITY:	Cask Preparation Area Transfer Tunnel		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.10.1	Move the transfer car and unloaded cask from the cask preparation area to the transfer tunnel.	Cask transfer car	1

REQUIREMENT ALLOCATION SHEET

TASK: 3.11 Remove Unloaded Cask from Transfer Car and Place Cask on Carrier

FACILITY: Receiving and Shipping Bay
Transfer Tunnel

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.11.1	Select a lifting yoke from the equipment storage area, attach it to the bridge crane, and move it to the cask.	Lifting yoke (and storage area) Bridge crane	2
3.11.2	Attach the lifting yoke to the cask trunnions.	Lifting yoke Bridge crane	3
3.11.3	Release the cask from the cask transfer car.	Cask transfer car Bridge crane	3
3.11.4	Lift the unloaded cask from the transfer car and move to the cask carrier.	Cask transfer car Cask carrier Bridge crane	15 (truck cask) 14 (rail cask)
3.11.5	Lower the unloaded cask onto the cradle of the carrier.	Carrier cradle Bridge crane	4
3.11.6	Disconnect the yoke from the cask trunnions and return it to the storage area.	Lifting yoke (and storage area) Bridge crane	5
3.11.7	Replace and tighten the cask tie downs.		15

REQUIREMENT ALLOCATION SHEET

TASK:		3.12 Replace Impact Limiters and Close Personnel Barrier		
FACILITY:		Receiving and Shipping Bay		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)	
3.12.1	Using the gantry crane, lift the first impact limiter from the temporary storage area and replace it on the cask.	Gantry crane Impact limiter temporary storage area	10 (truck cask) 9 (rail cask)	
3.12.2	Using the gantry crane, lift the second impact limiter from the temporary storage area and replace it on the cask.	Gantry crane Impact limiter temporary storage area	8 (truck cask) 7 (rail cask)	
3.12.3	Fasten the impact limiters to the cask.		10	
3.12.4	Slide the personnel barrier to the closed position and secure the fasteners.		10	

REQUIREMENT ALLOCATION SHEET

3.13 Transfer Unloaded Cask and Carrier to Admitting and Inspection Area			
TASK:			
FACILITY:	Admitting and Inspection Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.13.1	Bring the facility transfer vehicle into the receiving and shipping bay and attach the vehicle to the loaded cask carrier.	Facility transfer vehicle Loaded cask carrier	4
3.13.2	Move the unloaded cask and carrier to the admitting and inspection area.	Facility transfer vehicle Loaded cask carrier	N/A
3.13.3	Uncouple the facility transfer vehicle from the cask carrier.	Facility transfer vehicle Loaded cask carrier	N/A

REQUIREMENT ALLOCATION SHEET

TASK:	<u>3.14 Survey and Inspect Unloaded Cask and Carrier</u>		
FACILITY:	<u>Admitting and Inspection Area</u>		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.14.1	Couple the commercial vehicle to the carrier.	Loaded cask carrier Commercial vehicle	N/A
3.14.2	Inspect the shipment for safety and radiological conditions.		N/A

REQUIREMENT ALLOCATION SHEET

TASK:		3.15 Release Unloaded Cask and Carrier Offsite	
FACILITY:		Repository Gate	
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
3.15.1	Record the condition and identification of the carrier and unloaded cask and issue the bill of lading.	Loaded cask carrier	N/A
3.15.2	Move the commercial carrier and unloaded cask through the repository gate.		N/A

REQUIREMENT ALLOCATION SHEET

TASK:

4.1 Move Empty Container from Storage to Loading Station

FACILITY:

Empty Container Unloading Storage Area
Operating Gallery
Container Transfer Tunnel

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.1.1	Transfer an empty container from the empty container unloading and storage area to the empty container loading port.	Empty container (unloading and storage area) Empty container loading port Crane	10 (PWR and HYB) 18 (DHLW (Case A)) 13 (SF and HDWR) 11 (DHLW (Case B))
4.1.2	Open the empty container loading port shield valve.	Shield valve	1*
4.1.3	Lower the empty container onto the container transfer car.	Empty container Container transfer car Crane	7 (PWR, HYB, SF and HDWR) 8 (DHLW)
4.1.4	Close the empty container loading port shield valve.	Shield valve	1**
4.1.5	Transfer container from the container transfer car to the batching transfer car (Case A only).	Container Container transfer car Batching transfer car	11 (SF) 1 (DHLW)
4.1.5	Move the container transfer car and container to the container loading station (Case B only).	Container Container transfer car	11 (PWR and HYB) 1 (DHLW, SF and HDWR)

* Parallel with 4.1.1.3

** Parallel with 4.1.5.1

REQUIREMENT ALLOCATION SHEET

TASK:	4.2 Place Waste in Container		
FACILITY:	Unloading Hot Cell Container Loading Station		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.2.1	Open the shield valve over the container loading station.	Shield valve	2
4.2.2	Load the waste from the storage rack in the unloading hot cell into the container.	Batching transfer car (or storage rack Waste Crane	121 [SF (Case A)] 17 [DHLW (Case A)] 63 [SF (Case B)] 16 [DHLW (Case B)] 17 [HDWR (Case B)]
4.2.3	Place the diaphragm with surging connections into the container.	Diaphragm Container	4

REQUIREMENT ALLOCATION SHEET

TASK: 4.3 Move Container from Loading Station to Welding Hot Cell

FACILITY: Unloading Hot Cell
Container Loading Station

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.3.1	Move batching transfer car to container transfer station (Case A only).	Container Batching transfer car Container loading station	6 (SF) 2 (DHLW)
4.3.1	Move container transfer car to welding hot cell shield valve (Case B only).	Container Container transfer car Welding hot cell shield valve	2
4.3.2	Transfer container to container transfer car and move car to welding hot cell shield valve (Case A only).	Container Crane Container transfer car Welding hot cell shield valve	6 (SF) N/A (DHLW)

REQUIREMENT ALLOCATION SHEET

TASK: 4.4 Transfer Container to Welding Hot Cell			
FACILITY: Welding Hot Cell			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.4.1	Open the shield valve to the welding hot cell.	Shield valve	1*
4.4.2	Lift the container into the welding hot cell and move to the inerting station.	Container Inerting station Crane	14
4.4.3	Close the shield valve to the welding hot cell.	Shield valve	1**

*Parallel with 4.4.2.1
 **Parallel with 4.4.2.6

REQUIREMENT ALLOCATION SHEET

TASK:	4.5	Purge Container		
FACILITY:		Welding Hot Cell		
OPERATION NO.	4.5.1	Purge the container.	ESTIMATED DURATION (min)	12
			EQUIPMENT/FACILITY REQUIREMENTS	
			Purging equipment	
			Container purging connections	

REQUIREMENT ALLOCATION SHEET

TASK:	4.6 Weld Lid to Container		
FACILITY:	Welding Hot Cell		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.6.1	Move the container lid into the welding hot cell.	Container lid	0*
4.6.2	Place the lid on the container.	Container lid Container	5
4.6.3	Weld the lid to the container.	Container lid Container Welder	46

*Lids are assumed to be in hot cell.

REQUIREMENT ALLOCATION SHEET

TASK:	<u>4.7 Remove Flash</u>			ESTIMATED
FACILITY:	<u>Welding Hot Cell</u>			DURATION
OPERATION		DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	(min)
NO.				
4.7.1		Transfer the container from the weld station to the welded flash removal station.	Container Weld flash removal station Crane	15
4.7.2		Remove the weld flash and lid overlap from the container.	Container Flash removal tool Turntable	11

REQUIREMENT ALLOCATION SHEET

TASK:	4.8 Perform Load Test		
FACILITY:	Welding Hot Cell		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.8.1	Perform a load test and record the results.	Container Crane	5

REQUIREMENT ALLOCATION SHEET

TASK:	<u>4.9 Perform Leak Test</u>		ESTIMATED DURATION (min)
FACILITY:	<u>Welding Hot Cell</u>		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	
4.9.1	Transfer the container from the cutting station to the leak test chamber.	Container Crane Leak test station	16
4.9.2	Perform a leak test.	Leak test station	9

REQUIREMENT ALLOCATION SHEET

TASK: 4.10 Perform Visual and Ultrasonic Test			
FACILITY: Welding Hot Cell			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.10.1	Transfer the container from the leak test chamber to the nondestructive examination (NDE) station.	NDE station turntable Crane	16
4.10.2	Perform a visual examination and record the results.	NDE station turntable CCTV camera and monitor	2
4.10.3	Perform an ultrasonic test and record the results.	NDE station turntable Couplant grease gun Ultrasonic transducer and monitoring equipment	40

REQUIREMENT ALLOCATION SHEET

TASK: 4.11 Perform Container Cutting Operations			
FACILITY: Welding Hot Cell			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.11.1	Transfer the container from the NDE station to the cutting station.	Cutting station and turntable Crane	14
4.11.2	Remove the container flange (routine) and proceed to Task 4.14.	Cutting-station turntable Cutting tool Pintle support frame	11
4.11.3	Remove the container lid (nonroutine) and proceed to Task 4.13.	Cutting-station turntable Circular saw Pintle support frame	Nonroutine

REQUIREMENT ALLOCATION SHEET

TASK:	4.12 Return Container to Welding Station (Nonroutine)		
FACILITY:	Welding Hot Cell		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.12.1	Lift the container into the welding stations.	Crane (and container flange grapple)	Nonroutine
4.12.2	Move the container lid into the welding hot cell.	Container transfer car Welding hot cell crane	Nonroutine

REQUIREMENT ALLOCATION SHEET

TASK: 4.13 Transfer Container to Decontamination Station			
FACILITY: Container Decontamination Station			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
4.13.1	Transfer the container to the exit port shield valve.	Container Welding hot cell exit port shield valve Crane	7
4.13.2	Open the shield valve.	Welding hot cell exit port shield valve	1*
4.13.3	Lower the container onto the transfer car in the decontamination cell.	Container Decontamination cell transfer car Crane	10
4.13.4	Close the shield valve.	Welding hot cell exit port shield valve	1

*Parallel with 4.13.1.

REQUIREMENT ALLOCATION SHEET

TASK:	4.14 Survey and Decontaminate Container			
FACILITY:	Container Decontamination Station			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)	
4.14.1	Survey container for contamination.	Container Contamination survey equipment	30	
4.14.2	Decontaminate container by wiping as necessary (routine).	Container Master-slave manipulator	10	
4.14.3	Decontaminate container in spray chamber (nonroutine).	Container Spray chamber	Nonroutine	
4.14.4	Survey for contamination, as necessary.	Container Contamination survey equipment	10	

REQUIREMENT ALLOCATION SHEET

TASK:	<u>4.15 Transfer Container from Decontamination Cell to Transfer Tunnel</u>			
FACILITY:	<u>Container Transfer Tunnel</u>			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)	
4.15.1	Move the transfer car and container to the decontamination cell exit shield valve.	Container Decontamination cell transfer car Decontamination cell exit shield valve	1	
4.15.2	Open the shield valve.	Decontamination cell exit shield valve	1	
4.15.3	Lift the container from the decontamination cell, and move to the container transfer car in the transfer tunnel.	Container Container monorail hoist Transfer tunnel container transfer car	16	

REQUIREMENT ALLOCATION SHEET

TASK:

4.16 Move Transfer Car to Surface Storage Vault

FACILITY:

Container Transfer Tunnel

OPERATION
NO.

4.16.1

Move the container transfer car through the container transfer tunnel to the surface storage vault.

EQUIPMENT/FACILITY REQUIREMENTS

Container
Container transfer car for
the transfer tunnel

ESTIMATED
DURATION
(min)

4

REQUIREMENT ALLOCATION SHEET

TASK:	5.1 Move Container Transfer Machine (CTM) to Transfer Tunnel Port		
FACILITY:	Container Transfer Tunnel Surface Storage Vault		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
5.1.1	Move the CTM to the container transfer port.	CTM Container transfer tunnel port	2

REQUIREMENT ALLOCATION SHEET

TASK: 5.2 Position CTM over Transfer Port			
FACILITY:	Container Transfer Tunnel		
	Surface Storage Vault		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
5.2.1	Position and lower the CTM over the transfer port shield valve.	CTM Transfer port shield valve	3
5.2.2	Open the transfer port shield valve and the CTM shield valve.	Transfer port shield valve CTM shield valve	1

REQUIREMENT ALLOCATION SHEET

TASK:		5.3 Lift Container into CTM		
FACILITY:		Container Transfer Tunnel		
		Surface Storage Vault		
OPERATION NO.		DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
5.3.1		Load the container into the CTM shielded cask.	CTM (shielded cask) Container	7
5.3.2		Close the CTM shield valve and the transfer port shield valve.	CTM (shield valve) Transfer port shield valve	1

REQUIREMENT ALLOCATION SHEET

TASK:	<u>5.4 Move CTM to Container Storage Location</u>		
FACILITY:	<u>Surface Storage Vault</u>		
OPERATION NO.	<u>DESCRIPTION</u>	<u>EQUIPMENT/FACILITY REQUIREMENTS</u>	<u>ESTIMATED DURATION (min)</u>
5.4.1	Move the CTM with container to a preselected container storage location in the surface storage vault.	CTM (with container)	7
5.4.2	Position and lower the CTM over the storage location.	CTM (with container)	2
5.4.3	Index the CTM plug hoist over the storage vault shield plug.	CTM plug hoist	1

REQUIREMENT ALLOCATION SHEET

TASK:	<u>5.5 Lift Shield Plug into CTM</u>		
FACILITY:	<u>Surface Storage Vault</u>		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
5.5.1	Lower the shield plug hoist and lift the shield plug into the CTM.	CTM plug hoist Shield plug	4

REQUIREMENT ALLOCATION SHEET

TASK:		5.6 Position CTM and Store Container	
FACILITY:		Surface Storage Vault	
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
5.6.1	Index the CTM to the container storage position.	CTM (with container)	1
5.6.2	Lower the container into the storage sleeve located below the port, and release the grapple.	Container CTM (container grapple)	9

REQUIREMENT ALLOCATION SHEET

TASK:		5.7 Lower the Shield Plug into Place	
FACILITY:		Surface Storage Vault	
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
5.7.1	Index the CTM to the shield plug placement position.	CTM (without container)	1
5.7.2	Lower the shield plug into place.	CTM plug hoist Shield plug	10

REQUIREMENT ALLOCATION SHEET

TASK:	<u>6.1 Move CTM to Container Storage Location</u>		
FACILITY:	<u>Surface Storage Vault</u>		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.1.1	Move the CTM to the container storage location.	CTM (without container)	6
6.1.2	Position and lower the CTM over the storage location.	CTM (without container)	2
6.1.3	Index the CTM plug hoist over the storage vault shield plug.	CTM plug hoist	1

REQUIREMENT ALLOCATION SHEET

TASK:	6.2 Lift Shield Plug into CTM		
FACILITY:	Surface Storage Vault		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.2.1	Lower the shield plug hoist and lift the shield plug into the CTM.	CTM plug hoist Shield plug	4

REQUIREMENT ALLOCATION SHEET

TASK: 6.3 Position CTM and Retrieve Container			
FACILITY: Surface Storage Vault			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.3.1	Index the CTM to the container retrieval position.	CTM indexing feature	1
6.3.2	Open the shield valve on the CTM.	CTM shield valve	1
6.3.3	Load the container into the CTM shielded cask.	CTM container hoist grapple Container CTM shielded cask	7
6.3.4	Close the CTM shield valve.	CTM shield valve	1

REQUIREMENT ALLOCATION SHEET

TASK:	6.4 Lower Shield Plug Into Place		
FACILITY:	Surface Storage Vault		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.4.1	Index the CTM plug hoist over the storage location.	CTM indexing feature CTM plug hoist	1
6.4.2	Replace the storage sleeve shield plug.	CTM plug hoist	3

REQUIREMENT ALLOCATION SHEET

TASK:	6.5 Transfer Container to Transfer Port		
FACILITY:	Surface Storage Vault		
	Container Transfer Tunnel		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.5.1	Move the CTM and container to the container transfer port.	CTM (with container)	8

REQUIREMENT ALLOCATION SHEET

TASK: 6.6 Move Container to Transporter Loading Station

FACILITY: Container Transfer Tunnel
Transporter Loading Port

OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.6.1	Open the transfer port and CTM shield valves.	Transfer port shield valve CTM shield valve	1
6.6.2	Lower the container onto the transfer car.	CTM container hoist Container transfer car	7
6.6.3	Close the transfer port and CTM shield valves.	Transfer port shield valve CTM shield valve Container transfer car	5
6.6.4	Move the container transfer car and the container to the transporter loading station.	Container transfer car	2

REQUIREMENT ALLOCATION SHEET

TASK:		6.7 Position Transporter over Shield Valve		
FACILITY:	Container Transfer Tunnel			
	Transporter Loading Area			
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS		ESTIMATED DURATION (min)
6.7.1	Move the transporter over the loading port shield valve.	Transporter		2
6.7.2	Raise the transporter cask to the vertical position.	Transporter cask upender		2
6.7.3	Mate the transporter cask with the loading port shield valve.	Transporter cask Loading port shield valve		2

REQUIREMENT ALLOCATION SHEET

TASK:	6.8 Load Container into Transporter	ESTIMATED DURATION (min)
FACILITY:	Container Transfer Tunnel Transporter Loading Area	
OPERATION NO.	DESCRIPTION	
6.8.1	Open the loading port shield valve and the transporter cask shield valve.	
6.8.2	Load the container into the underground transporter.	9
6.8.3	Close the loading port and transporter cask shield valves.	1
		EQUIPMENT/FACILITY REQUIREMENTS
		Loading port shield valve Transporter cask shield valve
		Container Underground transporter
		Loading port shield valve Transporter cask shield valve

REQUIREMENT ALLOCATION SHEET

TASK:	6.9 Survey and Inspect Transporter Cask Closure		
FACILITY:	Container Transfer Tunnel		
	Transporter Loading Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.9.1	Lower the transporter cask to the horizontal position.	Transporter cask upender	2
6.9.2	Survey and inspect the transporter cask closure.		20

REQUIREMENT ALLOCATION SHEET

TASK:	6.10 Move Transporter and Container to Waste Ramp		
FACILITY:	Transporter Loading Area		
OPERATION NO.	DESCRIPTION	EQUIPMENT/FACILITY REQUIREMENTS	ESTIMATED DURATION (min)
6.10.1	Move the underground transporter out of the transporter loading area.	Underground transporter	2

APPENDIX B

MAJOR EQUIPMENT LIST, CASE A

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	BRIDGE CRANE	150 TONS	75 HP	1	TRUCK CASK RECEIVING AND SHIPPING BAYS
	ROTATING LOAD BLOCK	40 TONS		1	TRUCK CASK RECEIVING AND SHIPPING BAYS
	TRUCK CASK-LIFTING YOKE	40 TONS	-	1	TRUCK CASK RECEIVING AND SHIPPING BAYS
	GANTRY CRANE WITH ELMCH MANIPULATOR	5 TONS	5 HP	1	TRUCK CASK RECEIVING AND SHIPPING BAYS
	ROLL-UP DOOR WITH DRIVE (FOR TRUCK)	14'W x 16'H	2 HP	10	TRUCK CASK RECEIVING AND SHIPPING BAYS
	IMPACT LIMITER LIFTING YOKE	5 TONS		1	TRUCK CASK RECEIVING AND SHIPPING BAYS
	BRIDGE CRANE	150 TONS	75 HP	1	RAIL CASK RECEIVING AND SHIPPING BAYS
	ROTATING LOAD BLOCK	100 TONS		1	RAIL CASK RECEIVING AND SHIPPING BAYS
	RAIL CASK-LIFTING YOKE	100 TONS	-	1	RAIL CASK RECEIVING AND SHIPPING BAYS
	GANTRY CRANE WITH ELMCH MANIPULATOR	5 TONS	5 HP	1	RAIL CASK RECEIVING AND SHIPPING BAYS
	ROLL-UP DOOR WITH DRIVE (FOR RAIL CAR)	14'W x 18'H	2 HP	6	RAIL CASK RECEIVING AND SHIPPING BAYS
	IMPACT LIMITER LIFTING YOKE	5 TONS	-	1	RAIL CASK RECEIVING AND SHIPPING BAYS
	CASK TRANSFER CAR	100 TONS	5 HP	9	CASK PREPARATION AREA
	TRANSFER CAR CENTERING GUIDE (FOR TRUCK CASK)		-	5	CASK PREPARATION AREA
	CASK SEAL ADAPTER (FOR TRUCK CASK)		-	5	CASK PREPARATION AREA
	CASK SEAL ADAPTER (FOR RAIL CASK)			4	CASK PREPARATION AREA
	FLOOR-MOUNTED ROBOTIC ARM		2 HP	9	CASK PREPARATION AREA

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	CASK ACCESS HATCH WITH DRIVE		2 HP	9	CASK PREPARATION AREA
	SHIELD/VENTILATION DOOR WITH DRIVE		5 HP	9	CASK PREPARATION AREA
	CASK SEAL ADAPTER LIFTING YOKE (FOR RAIL CASK)		-	4	CASK PREPARATION AREA
	CASK SEAL ADAPTER LIFTING YOKE (FOR TRUCK CASK)		-	5	CASK PREPARATION AREA
	CASK OUTER LID LIFTING YOKE (FOR RAIL CASK)		-	4	CASK PREPARATION AREA
	CASK OUTER LID LIFTING YOKE (FOR TRUCK CASK)		-	5	CASK PREPARATION AREA
	OUTER LID STAND		-	9	CASK PREPARATION AREA
	MONORAIL HOIST	5 TONS	5 HP	9	CASK PREPARATION AREA
	CASK SAMPLING AND PURGING EQUIPMENT			9	CASK PREPARATION AREA
	PORTABLE PLATFORMS			9	CASK PREPARATION AREA
	COMPRESSED AIR SYSTEM FOR INFLATING CASK SEAL ADAPTER		2 HP	9	CASK PREPARATION AREA
	BRIDGE CRANE WITH ELMCH MANIPULATOR	20 TONS	15 HP	9	UNLOADING HOT CELL
	WASTE STORAGE RACK		-	9	UNLOADING HOT CELL
	SEAL PROTECTOR		-	9	
	PWR SPENT FUEL ASSEMBLY HANDLING TOOL			16	UNLOADING HOT CELL
	BWR SPENT FUEL ASSEMBLY HANDLING TOOL			8	UNLOADING HOT CELL
	ROTATING LOAD BLOCKS	20 TONS		9	UNLOADING HOT CELL

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	DHLW CANISTER HANDLING GRAPPLE			1	UNLOADING HOT CELL
	CASK INNER LID LIFTING YOKE (FOR TRUCK CASK)		-	8	UNLOADING HOT CELL
	CASK INNER LID LIFTING YOKE (FOR RAIL CASK)		-	8	UNLOADING HOT CELL
	INNER LID STAND			9	UNLOADING HOT CELL
	SHIELD WINDOW	3' x 3'		17	UNLOADING HOT CELL
	TRANSFER DRAWER		-	9	UNLOADING HOT CELL
	SHIELD DOOR WITH DRIVE (CRANE MAINTENANCE ROOM)		2 HP	1	UNLOADING HOT CELL
	BATCHING TRANSFER CAR	10 TONS	2 HP	2	UNLOADING HOT CELL
	SHIELD VALVE WITH DRIVE		1 HP	9	UNLOADING HOT CELL
	FLOOR SHIELD PLUG (INNER)		-	9	UNLOADING HOT CELL
	FLOOR SHIELD PLUG (OUTER)		-	9	UNLOADING HOT CELL
	FLOOR SHIELD PLUG LIFTING YOKE (INNER)		-	9	UNLOADING HOT CELL
	FLOOR SHIELD PLUG LIFTING YOKE (OUTER)		-	9	UNLOADING HOT CELL
	REMOTE VIEWING SYSTEM			5	UNLOADING HOT CELL
	MONORAIL HOIST (EMPTY CONTAINER TRANSFER)	2 TONS	3 HP	1	OPERATING GALLERY
	SHIELD VALVE WITH DRIVE		1 HP	3	OPERATING GALLERY
	INERTIA WELDING MACHINE			3	WELDING HOT CELL
	BRIDGE CRANE	10 TONS	12 HP	3	WELDING HOT CELL
	GRAPPLE (ENGAGE CON- TAINER FLANGE)	10 TONS		3	WELDING HOT CELL
	GRAPPLE (ENGAGE CON- TAINER PINTLE)	10 TONS		3	WELDING HOT CELL

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	CONTAINER TRANSFER CAR	10 TONS	2 HP	3	WELDING HOT CELL
	MONORAIL HOIST (HANDLE CONTAINER LID)	1 TON	1 HP	3	WELDING HOT CELL
	WELDER LOADING STATION		1 HP	3	WELDING HOT CELL
	CONTAINER LID FEEDER ARM		1 HP	3	WELDING HOT CELL
	MONORAIL HOIST (SERVICE WELDING MACHINE)	15 TONS	17-1/2 HP	3	WELDING HOT CELL
	CONTAINER TURNTABLE (FLOOR MOUNTED)		1 HP	12	WELDING HOT CELL
	ULTRASONIC TEST EQUIPMENT			3	WELDING HOT CELL
	LEAK TEST STATION AND EQUIPMENT			3	WELDING HOT CELL
	SHIELD WINDOW	3' x 3'	-	24	WELDING HOT CELL
	TRANSFER DRAWER		-	3	WELDING HOT CELL
	MASTER SLAVE MANIPULATOR			6	WELDING HOT CELL
	SHIELD VALVE WITH DRIVE		1 HP	6	WELDING HOT CELL
	CALIBRATION CYLINDER			3	WELDING HOT CELL
	SHIELD DOOR WITH DRIVE (CRANE MAINTENANCE ROOM)			3	WELDING HOT CELL
	ROTATING LOAD BLOCK	10 TONS		3	WELDING HOT CELL
	INERTING STATION AND EQUIPMENT			3	WELDING HOT CELL
	REMOTE VIEWING SYSTEM			3	WELDING HOT CELL
	DECON SPRAY CHAMBER			3	CONTAINER DECONTAMINATION CELL
	CONTAINER TRANSFER CAR	10 TONS	2 HP	3	CONTAINER DECONTAMINATION CELL
	MASTER SLAVE MANIPULATOR			3	CONTAINER DECONTAMINATION CELL

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	SHIELD WINDOW			3	CONTAINER DECONTAMINATION CELL
	CONTAINER DECONTAMINATION SUPPORT EQUIPMENT			3	CONTAINER DECONTAMINATION CELL
	MONORAIL HOIST (COMPLETED CONTAINER TRANSFER)	10 TONS	12-1/2 HP	1	OPERATING GALLERY
	SHIELD VALVE WITH DRIVE		1 HP	3	OPERATING GALLERY
	CONTAINER TRANSFER CAR	10 TONS	2 HP	4	SURFACE STORAGE VAULT TRANSFER TUNNEL
	CONTAINER TRANSFER MACHINE	100 TONS	100 HP	2	SURFACE STORAGE VAULT
	SHIELD VALVE WITH DRIVE		1 HP	8	SURFACE STORAGE VAULT
	GRAPPLE (ENGAGE CONTAINER PINTLE)	10 TONS		2	SURFACE STORAGE VAULT
	ROLL-UP DOOR WITH DRIVE (FOR UNDERGROUND TRANSPORTER)	20'W x 18'H	2 HP	4	SURFACE STORAGE VAULT
	SHIELD PLUGS			288	SURFACE STORAGE VAULT
	CONTAINER SLEEVE ASSEMBLY			288	SURFACE STORAGE VAULT
	VENT PIPE HEPA FILTER SYSTEM			1	SURFACE STORAGE VAULT
	BRIDGE CRANE	150 TONS	75 HP	1	CASK MAINTENANCE RECEIVING BAY
	ROTATING LOAD BLOCK (TRUCK CASK)	40 TONS		1	CASK MAINTENANCE RECEIVING BAY
	ROTATING LOAD BLOCK (RAIL CASK)	150 TONS		1	CASK MAINTENANCE RECEIVING BAY
	TRUCK CASK-LIFTING YOKE	40 TONS	-	1	CASK MAINTENANCE RECEIVING BAY
	RAIL CASK-LIFTING YOKE	100 TONS	-	1	CASK MAINTENANCE RECEIVING BAY

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	CASK TRANSFER CAR		5 HP	2	CASK MAINTENANCE RECEIVING BAY
	CASK FLUSH/LEAK TEST EQUIPMENT			1	CASK MAINTENANCE RECEIVING BAY
	CASK DECONTAMINATION SUPPORT EQUIPMENT			1	CASK MAINTENANCE RECEIVING BAY
	ROLL-UP DOOR WITH DRIVE	16'W x 22'H	2 HP	2	CASK MAINTENANCE RECEIVING BAY
	BRIDGE CRANE	5 TONS	5 HP	3	CASK MAINTENANCE AREA
	BASKET-LIFTING YOKE (TRUCK CASK)			2	CASK MAINTENANCE AREA
	BASKET-LIFTING YOKE (RAIL CASK)			2	CASK MAINTENANCE AREA
	SPACER-LIFTING YOKE (TRUCK CASK)			3	CASK MAINTENANCE AREA
	SPACER-LIFTING YOKE (RAIL CASK)			3	CASK MAINTENANCE AREA
	SPACER AND BASKET TRANSFER CAR			1	CASK MAINTENANCE AREA
	WET VACUUM AND SLUICER EQUIPMENT			2	CASK MAINTENANCE AREA
	SHIELD VALVE WITH DRIVE		1 HP	6	CASK MAINTENANCE AREA
	SHIELD WINDOWS	3' x 3'		26	CASK MAINTENANCE AREA
	ROLL-UP DOOR WITH DRIVE	16'W x 22'H	2 HP	4	CASK MAINTENANCE AREA
	ROLL-UP DOOR WITH DRIVE	12'W x 18'H	2 HP	2	CASK MAINTENANCE AREA
	SHIELD DOOR WITH DRIVE		2 HP	2	CASK MAINTENANCE AREA
	SUPPLY AIR HANDLING UNIT (FOR OPERATING GALLERIES)			2	HVAC MECH. ROOM (SYSTEM 1)
	OUTSIDE AIR INTAKE WITH TORNADO DAMPER (FOR OPERATING GALLERIES)			2	HVAC MECH. ROOM (SYSTEM 1)

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	SUPPLY AIR HANDLING UNIT (FOR UNLOADING AND WELDING HOT CELLS)			6	HVAC MECH. ROOM (SYSTEM 1)
	OUTSIDE AIR INTAKE WITH TORNADO DAMPER (FOR UNLOADING AND WELDING HOT CELLS)			6	HVAC MECH. ROOM (SYSTEM 1)
	HEPA FILTER UNIT--1ST STAGE (FOR UNLOADING AND WELDING HOT CELLS)			4	HEPA FILTER ROOM NO. 1 (SYSTEM 1)
	HEPA FILTER UNIT--2ND STAGE (FOR UNLOADING AND WELDING HOT CELLS)	6 W x 5 H		6	HEPA FILTER ROOM NO. 2 (SYSTEM 1)
	EXHAUST FAN (FOR UNLOADING AND WELDING HOT CELLS)			6	HEPA FILTER ROOM NO. 2 (SYSTEM 1)
	SUPPLY AIR HANDLING UNIT (FOR MAINTENANCE, RE- CEIVING AND SHIPPING)			8	HVAC MECH. ROOM (SYSTEM 2)
	OUTSIDE AIR INTAKE WITH TORNADO DAMPER (FOR MAINTENANCE, RECEIVING AND SHIPPING)			8	HVAC MECH. ROOM (SYSTEM 2)
	HEPA FILTER UNIT-2 STAGES (FOR MAINTENANCE, RE- CEIVING AND SHIPPING)			6	HEPA FILTER ROOM (SYSTEM 2)
	EXHAUST FAN (FOR MAINTENANCE, RE- CEIVING AND SHIPPING)			6	HEPA FILTER ROOM (SYSTEM 2)
	SUPPLY AIR HANDLING UNIT (FOR ADMIN. OFFICES AND LAB)			2	HVAC MECH. ROOM (SYSTEM 3)
	EXHAUST FAN			2	HVAC MECH. ROOM (SYSTEMS 3 AND 4)

MAJOR EQUIPMENT LIST
WASTE-HANDLING BUILDING--CASE A

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	SUPPLY AIR HANDLING UNIT (FOR CONTROL ROOM)			2	HVAC MECH. ROOM (SYSTEM 4)
	RADIATION MONITORS			LOT	THROUGHOUT WHB
	ELECTRICAL EQUIPMENT				THROUGHOUT WHB

APPENDIX C

MAJOR EQUIPMENT LIST, CASE B

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	BRIDGE CRANE	200 TONS	95 HP	2	CASK RECEIVING AND SHIPPING BAYS
	ROTATING LOAD BLOCK	150 TONS		2	CASK RECEIVING AND SHIPPING BAYS
	TRUCK CASK-LIFTING YOKE	40 TONS		1	CASK RECEIVING AND SHIPPING BAYS
	RAIL CASK-LIFTING YOKE	150 TONS		2	CASK RECEIVING AND SHIPPING BAYS
	GANTRY CRANE WITH ELMCH MANIPULATOR	5 TONS	5 HP	1	CASK RECEIVING AND SHIPPING BAYS
	ROLL-UP DOOR WITH DRIVE	14'W x 18'H	2 HP	6	CASK RECEIVING AND SHIPPING BAYS
	IMPACT LIMITER LIFTING YOKE (FOR TRUCK CASK)	5 TONS		1	CASK RECEIVING AND SHIPPING BAYS
	IMPACT LIMITER LIFTING YOKE (FOR RAIL CASK)	5 TONS		2	CASK RECEIVING AND SHIPPING BAYS
	CASK TRANSFER CAR	150 TONS	5 HP	5	CASK PREPARATION AREA
	TRANSFER CAR CENTERING GUIDE (FOR TRUCK CASK)			1	CASK PREPARATION AREA
	CASK SEAL ADAPTER (FOR TRUCK CASK)			1	CASK PREPARATION AREA
	CASK SEAL ADAPTER (FOR RAIL CASK)			4	CASK PREPARATION AREA
	FLOOR-MOUNTED ROBOTIC ARM		2 HP	5	CASK PREPARATION AREA
	CASK ACCESS HATCH WITH DRIVE		2 HP	5	CASK PREPARATION AREA
	SHIELD/VENTILATION DOOR WITH DRIVE		5 HP	5	CASK PREPARATION AREA

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	CASK SEAL ADAPTER LIFTING YOKE (FOR RAIL CASK)			4	CASK PREPARATION AREA
	CASK SEAL ADAPTER LIFTING YOKE (FOR TRUCK CASK)			1	CASK PREPARATION AREA
	CASK OUTER LID LIFTING YOKE (FOR TRUCK CASK)			1	CASK PREPARATION AREA
	CASK OUTER LID LIFTING YOKE (FOR RAIL CASK)			4	CASK PREPARATION AREA
	CASK SAMPLING AND PURGING EQUIPMENT			5	CASK PREPARATION AREA
	PORTABLE PLATFORMS			5	CASK PREPARATION AREA
	COMPRESSED AIR SYSTEM FOR INFLATING CASK SEAL ADAPTER		2 HP	5	CASK PREPARATION AREA
	BRIDGE CRANE WITH ELMCH MANIPULATOR	20 TONS	15 HP	5	UNLOADING HOT CELL
	WASTE STORAGE RACK			5	UNLOADING HOT CELL
	PWR SPENT FUEL ASSEMBLY HANDLING TOOL			2	UNLOADING HOT CELL
	BWR SPENT FUEL ASSEMBLY HANDLING TOOL			1	UNLOADING HOT CELL
	ROTATING LOAD BLOCK			5	UNLOADING HOT CELL
	GRAPPLE (DHLW CANISTER, CANISTERED WASTE AND HARDWARE)			4	UNLOADING HOT CELL
	CASK INNER LID LIFTING YOKE (FOR TRUCK CASK)			1	UNLOADING HOT CELL
	CASK INNER LID LIFTING YOKE (FOR RAIL CASK)			4	UNLOADING HOT CELL

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	Q'TY	LOCATION
	INNER LID STAND			5	UNLOADING HOT CELL
	SHIELD WINDOW	3' x 3'		10	UNLOADING HOT CELL
	TRANSFER DRAWER			5	UNLOADING HOT CELL
	SHIELD DOOR WITH DRIVE (CRANE MAINTENANCE ROOM)			1	UNLOADING HOT CELL
	CONTAINER TRANSFER CAR	10 TONS	2 HP	5	UNLOADING HOT CELL
	SHIELD VALVE WITH DRIVE		1 HP	5	UNLOADING HOT CELL
	FLOOR SHIELD PLUG (INNER)		-	5	UNLOADING HOT CELL
	FLOOR SHIELD PLUG (OUTER)		-	5	UNLOADING HOT CELL
	FLOOR SHIELD PLUG LIFTING YOKE (OUTER)			4	UNLOADING HOT CELL
	FLOOR SHIELD PLUG LIFTING YOKE (INNER)			1	UNLOADING HOT CELL
	REMOTE VIEWING SYSTEM			5	UNLOADING HOT CELL
	MONORAIL HOIST (EMPTY CONTAINER TRANSFER)	2 TONS	3 HP	1	OPERATING GALLERY
	SHIELD VALVE WITH DRIVE			5	OPERATING GALLERY
	INERTIA WELDING MACHINE			3	WELDING HOT CELL
	BRIDGE CRANE	10 TONS	12 HP	3	WELDING HOT CELL
	GRAPPLE (ENGAGE CON- TAINER FLANGE)	10 TONS		3	WELDING HOT CELL
	GRAPPLE (ENGAGE CON- TAINER PINTLE)	10 TONS		3	WELDING HOT CELL
	CONTAINER TRANSFER CAR	10 TONS	2 HP	3	WELDING HOT CELL
	WELDER LOADING STATION		1 HP	3	WELDING HOT CELL

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	MONORAIL HOIST (SERVICE WELDING MACHINE)	15 TONS	17-1/2 HP	3	WELDING HOT CELL
	CONTAINER TURNTABLE (FLOOR MOUNTED)		1 HP	12	WELDING HOT CELL
	ULTRASONIC TEST EQUIPMENT				
	LEAK TEST STATION AND EQUIPMENT			3	WELDING HOT CELL
	SHIELD WINDOW	3' x 3'		24	WELDING HOT CELL
	TRANSFER DRAWER			3	WELDING HOT CELL
	MASTER SLAVE MANIPULATOR			6	WELDING HOT CELL
	SHIELD VALVE WITH DRIVE		1 HP	6	WELDING HOT CELL
	CALIBRATION CYLINDER			3	WELDING HOT CELL
	SHIELD DOOR WITH DRIVE (CRANE MAINTENANCE ROOM)			3	WELDING HOT CELL
	ROTATING LOAD BLOCK	10 TONS		3	WELDING HOT CELL
	INERTING STATION AND EQUIPMENT			3	WELDING HOT CELL
	REMOTE VIEWING SYSTEM			3	WELDING HOT CELL
	DECON SPRAY CHAMBER			3	CONTAINER DECONTAMINATION CELL
	CONTAINER TRANSFER CAR	10 TONS	2 HP	3	CONTAINER DECONTAMINATION CELL
	MASTER SLAVE MANIPULATOR			3	CONTAINER DECONTAMINATION CELL
	SHIELD WINDOWS			3	CONTAINER DECONTAMINATION CELL
	CONTAINER DECONTAMINATION SUPPORT EQUIPMENT			3	CONTAINER DECONTAMINATION CELL

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	MONORAIL HOIST (COMPLETED CONTAINER TRANSFER)	10 TONS	12-1/2 HP	1	OPERATING GALLERY
	SHIELD VALVE WITH DRIVE		1 HP	3	OPERATING GALLERY
	CONTAINER TRANSFER CAR	10 TONS	2 HP	4	SURFACE STORAGE VAULT TRANSFER TUNNEL
	CONTAINER TRANSFER MACHINE	100 TONS	100 HP	2	SURFACE STORAGE VAULT
	SHIELD VALVE WITH DRIVE		1 HP	8	SURFACE STORAGE VAULT
	GRAPPLE (ENGAGE CONTAINER PINTLE)	10 TONS		2	SURFACE STORAGE VAULT
	ROLL-UP DOOR WITH DRIVE (FOR UNDERGROUND TRANSPORTER)	20'W x 18'H	2 HP	4	SURFACE STORAGE VAULT
	SHIELD PLUGS			288	CONTAINER DECONTAMINATION CELL
	CONTAINER SLEEVE ASSEMBLY			288	SURFACE STORAGE VAULT
	VENT PIPE HEPA FILTER SYSTEM			1	SURFACE STORAGE VAULT
	BRIDGE CRANE	200 TONS	95 HP	1	CASK MAINTENANCE RECEIVING BAY
	ROTATING LOAD BLOCK (TRUCK CASK)	40 TONS		1	CASK MAINTENANCE RECEIVING BAY
	ROTATING LOAD BLOCK (RAIL CASK)	150 TONS		1	CASK MAINTENANCE RECEIVING BAY
	TRUCK CASK-LIFTING YOKE	40 TONS		1	CASK MAINTENANCE RECEIVING BAY
	RAIL CASK-LIFTING YOKE	150 TONS		1	CASK MAINTENANCE RECEIVING BAY
	CASK TRANSFER CAR		5 HP	2	CASK MAINTENANCE RECEIVING BAY

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	CASK FLUSH/LEAK TEST EQUIPMENT			1	CASK MAINTENANCE RECEIVING BAY
	CASK DECONTAMINATION SUPPORT EQUIPMENT			1	CASK MAINTENANCE RECEIVING BAY
	ROLL-UP DOOR WITH DRIVE	16'W x 22'H	2 HP	2	CASK MAINTENANCE RECEIVING BAY
	BRIDGE CRANE	5 TONS	5 HP	3	CASK MAINTENANCE AREA
	BASKET-LIFTING YOKE (TRUCK CASK)			2	CASK MAINTENANCE AREA
	BASKET-LIFTING YOKE (RAIL CASK)			2	CASK MAINTENANCE AREA
	SPACER-LIFTING YOKE (TRUCK CASK)			3	CASK MAINTENANCE AREA
	SPACER-LIFTING YOKE (RAIL CASK)			3	CASK MAINTENANCE AREA
	SPACER AND BASKET TRANSFER CAR			1	CASK MAINTENANCE AREA
	WET VACUUM AND SLUICER EQUIPMENT			2	CASK MAINTENANCE AREA
	SHIELD VALVE WITH DRIVE		1 HP	6	CASK MAINTENANCE AREA
	SHIELD WINDOWS	3' x 3'		26	CASK MAINTENANCE AREA
	ROLL-UP DOOR WITH DRIVE	16'W x 22'H	2 HP	4	CASK MAINTENANCE AREA
	ROLL-UP DOOR WITH DRIVE	12'W x 18'H	2 HP	2	CASK MAINTENANCE AREA
	SHIELD DOOR WITH DRIVE		2 HP	2	CASK MAINTENANCE AREA
	SUPPLY AIR HANDLING UNIT (FOR OPERATING GALLERIES)			2	HVAC MECH. ROOM (SYSTEM 1)
	OUTSIDE AIR INTAKE WITH TORNADO DAMPER (FOR OPERATING GALLERIES)			2	HVAC MECH. ROOM (SYSTEM 1)

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	SUPPLY AIR HANDLING UNIT (FOR UNLOADING AND WELDING HOT CELLS)			6	HVAC MECH. ROOM (SYSTEM 1)
	OUTSIDE AIR INTAKE WITH TORNADO DAMPER (FOR UNLOADING AND WELDING HOT CELLS)			6	HVAC MECH. ROOM (SYSTEM 1)
	HEPA FILTER UNIT--1ST STAGE (FOR UNLOADING AND WELDING HOT CELLS)			4	HEPA FILTER ROOM NO. 1 (SYSTEM 1)
	HEPA FILTER UNIT--2ND STAGE (FOR UNLOADING AND WELDING HOT CELLS)			6	HEPA FILTER ROOM NO. 2 (SYSTEM 1)
	EXHAUST FAN (FOR UNLOADING AND WELDING HOT CELLS)			6	HEPA FILTER ROOM NO. 2 (SYSTEM 1)
	SUPPLY AIR HANDLING UNIT (FOR MAINTENANCE, RE- CEIVING AND SHIPPING)			8	HVAC MECH. ROOM (SYSTEM 2)
	OUTSIDE AIR INTAKE WITH TORNADO DAMPER (FOR MAINTENANCE, RECEIVING AND SHIPPING)			8	HVAC MECH. ROOM (SYSTEM 2)
	HEPA FILTER UNIT-2 STAGES (FOR MAINTENANCE, RE- CEIVING AND SHIPPING)			6	HEPA FILTER ROOM (SYSTEM 2)
	EXHAUST FAN (FOR MAINTENANCE, RE- CEIVING AND SHIPPING)			6	HEPA FILTER ROOM (SYSTEM 2)
	SUPPLY AIR HANDLING UNIT (FOR ADMIN. OFFICES AND LAB)			2	HVAC MECH. ROOM (SYSTEM 3)
	EXHAUST FAN			2	HVAC MECH. ROOM (SYSTEM 3 AND 4)

MAJOR EQUIPMENT LIST
WASTE HANDLING BUILDING--CASE B

EQUIP NO.	EQUIPMENT DESCRIPTION	ESTIMATED SIZE OR CAPACITY	ESTIMATED POWER RATING	QTY	LOCATION
	SUPPLY AIR HANDLING UNIT (FOR CONTROL ROOM)			2	HVAC MECH. ROOM (SYSTEM 4)
	RADIATION MONITORS			LOT	THROUGHOUT WHB
	ELECTRICAL EQUIPMENT				THROUGHOUT WHB

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