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AN ANALYSIS OF REPOSITORY WASTE-HANDLING OPERATIONS

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ABSTRACT

This study documents an operational analysis of a conceptual design for waste-handling facilities at a geologic repository for high-level nuclear waste. The facilities' waste-handling operations, equipment, and assumptions are identified and analyzed for the steady-state year 2011. It has been determined through time-line, equipment utilization, and position-time analyses that the waste-handling facilities for this conceptual design are adequate to receive, prepare, store, and emplace the projected quantity of waste on an annual basis. As a result of this analysis, several areas requiring additional work have also been identified.

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All work described in this report was performed under WBS No. 1.2.4.4 in response to DIM 2, Revision 1, dated 10/30/86, which was issued 17 months before NUREG-1318 (April 1988). Therefore, it would not be appropriate to claim compliance with these NUREG requirements.

ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

This report has been prepared to document the operational analysis of waste-handling facilities at a geologic repository for high-level nuclear waste. The site currently under investigation for the geologic repository is located at Yucca Mountain, Nye County, Nevada. The repository waste-handling operations have been identified and analyzed for the year 2011, a steady-state year during which the repository receives spent nuclear fuel containing the equivalent of 3,000 metric tons of uranium (MTU) and defense high-level waste containing the equivalent of 400 MTU.

The results of this analysis depend directly on the assumptions used; therefore, all of the assumptions have been identified in Chapter 2 and Appendices A, B, and C. The assumptions regarding waste forms and quantities, waste-shipping systems, waste disposal containers, and waste operations areas both on the surface and underground (addressed in Chapter 2) are fundamental, and changes in these assumptions will affect the results of this analysis. For example, if the mix of truck and rail shipments is changed from the assumed 70% truck and 30% rail to 100% truck, the receiving facilities will not have sufficient capacity to receive the quantities of waste stipulated for the year 2011. Likewise, if the transportation mix is changed to 100% rail, the receiving facilities will appear to have excess capacity.

As a result of this analysis, it has been determined that the waste-handling facilities are adequate to receive, prepare, store, and emplace the projected quantity of waste on an annual basis. In addition, several areas have been identified where additional work is required. The recommendations for future work have been divided into three categories: items that affect the total waste management system, operations within the repository boundary, and the methodology used to perform operational analyses for repository designs.

First, the amount of spent nuclear fuel introduced into the waste management system annually is not well defined. The definition currently being used is based on equivalent metric tonnage (the MTU initially

contained in unirradiated nuclear fuel). At this time, a system-wide design standard has not been adopted for identifying the number of PWR and BWR fuel assemblies that must be accepted annually. It is recommended, therefore, that system-wide criteria be developed, which can be adopted by the waste management system to provide guidance for either (1) converting MTU into PWR and BWR fuel assemblies or (2) defining the number of PWR and BWR fuel assemblies expected to be shipped from the reactors to the first repository on an annual basis (either for a single year or for the life of the repository).

Also, the waste-shipping system, which provides the connection between the waste generation and waste disposal activities, has not been described. A system-wide standard describing the configuration and operation of the waste-shipping system needs to be adopted. It is recommended, therefore, that system-wide design criteria be developed for both the waste-shipping system and the facilities that interface with the waste-shipping system.

Second, this category involves operations within the repository boundary related to the methods and procedures that will be used to encapsulate the waste in the disposal containers. The waste disposal containers are currently being developed, and the designs are not expected to be completed before the beginning of the repository advanced conceptual design activities. The closure methods and inspection procedures for the waste disposal containers will be selected following completion of the container design activities and selection of the material from which the waste containers will be fabricated. It is recommended that a set of block flow diagrams and requirement allocation sheets that identify operations, facilities, and equipment be established for encapsulating waste in containers fabricated from each candidate material. It is further recommended that conceptual designs be developed for the facilities required to house the encapsulation activities.

Third, methodologies must be developed for performing operational analyses. A manual approach using time-line, equipment utilization, and position-time diagrams was used in this study to determine operational capabilities. This manual approach is satisfactory for cases that are

well defined and require only a single solution. When multiple solutions or "what-if" analyses are required, computer-assisted methods are necessary. Such a method is currently being developed at Sandia National Laboratories, and this method will be used in future operational analyses. This computer-aided method of analysis, REPSIMS (REpository SIMulation System), uses commercial software with additional graphical interface enhancement and special features that allow rapid evaluation of the impact of facility design changes. It is recommended that work continue on REPSIM and that future operational analysis of the repository use computer-assisted methods.

This study reports the operations as planned by the designer; it should be used to identify how operations are currently planned. It can, however, be used as a basis for future evaluations, such as the advantages of manned versus remote repository operations.

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1.0 INTRODUCTION

This study has been performed as part of the Yucca Mountain Project's conceptual design efforts to determine the feasibility of constructing and operating a geologic repository at Yucca Mountain in southern Nevada. The design of a repository with a single waste-handling building (WHB) has been investigated to establish whether it can adequately provide for preparing and emplacing the annual waste receipts projected in the "Site Characterization Plan Conceptual Design Report" (SNL, 1987). This design is based on the parameters in the 1985 "Mission Plan for the Civilian Radioactive Waste Management Program" (DOE, 1985). A perspective showing the planned surface and subsurface facilities is shown in Figure 1-1.

The operations needed for handling the waste in a single WHB have been identified in this report and have been analyzed for the waste receipt rates projected for 2011. This year was chosen because it is a "steady-state" year during which the repository will receive spent nuclear fuel (SNF) containing the equivalent of 3,000 metric tons of uranium (MTU) and defense high-level waste containing the equivalent of 400 MTU.

All operations involving waste transport casks are addressed under the heading of waste receipt. Receiving operations begin with the admission of the waste shipment (cask) to the repository grounds and conclude with the release of the empty shipping cask and carrier from the repository grounds. All operations associated with unloading the waste from the transport cask are also addressed under receipt. Cask maintenance operations are not addressed in this study.

The operations that involve preparing the waste for emplacement are addressed under preparation. Preparation begins with placing the waste in a disposal container and concludes with transferring the filled container to the surface storage vault. The container closure and inspection and decontamination operations are addressed. Fuel consolidation operations are not addressed in this document.

Figure 1-1. Perspective of the Proposed Surface and Subsurface Facilities at Yucca Mountain (modified from SNL, 1987)

The operations that involve removing the waste disposal container from the preparation area and placing it in the surface storage vault are addressed under storage. The surface storage vault provides storage space for 270 containers, which represents a capacity of about 570 MTU of SNF.

Removal of the waste container from the surface facilities and its subsequent emplacement in the disposal area are addressed under transfer and emplacement. Transfer and emplacement begin with the removal of the waste disposal container from the surface storage vault and conclude with the return of the empty waste transporter to the surface storage vault. Operations for transferring and emplacing the waste container include loading the container into the transfer cask, transporting the container from the surface storage vault to the emplacement location underground, emplacing the container, closing the emplacement borehole, and returning the empty waste transporter to the surface.

The results of this analysis depend directly on the assumptions that are identified in Chapter 2 and Appendices A, B, and C. The assumptions regarding waste forms and quantities, shipping systems, disposal containers, and operations areas, both on the surface and underground, as addressed in Chapter 2, are fundamental; and changes to these assumptions will affect the results of this analysis. For example, if the mix of truck and rail shipments is changed from the assumed 70% truck and 30% rail to 100% truck, the receiving facilities will not have sufficient capacity to receive the quantities of waste stipulated for the year 2011. Likewise, if the transportation mix is changed to 100% rail, the receiving facilities will appear to have excess capacity.

The block flow diagrams (BFD) presented in Chapters 3 through 6 identify the sequence of waste-handling operations at the repository, and the requirement allocation sheets (RAS) in Appendix A describe the individual tasks that must be performed to complete each operation. In this analysis only one RAS has been developed for each operation; however, in future analyses multiple RASs may be developed for an operation. For example, Block 1.9 of the BFD for the receiving operations is "REMOVE

PERSONNEL BARRIERS AND IMPACT LIMITERS." In the future a RAS may identify the tasks that must be performed to accomplish this operation for each type of transport cask.

Time-line analyses for the preparation, storage, and transfer and emplacement of high-level waste are presented in Chapters 3 through 6. These analyses are based on the assumptions discussed above and indicate that the facility analyzed is capable of receiving and emplacing the high-level waste expected during the year 2011.

The recommendations for future work, identified as a result of this analysis, are presented in Chapter 7.

The RASs are contained in Appendix A; an equipment list is contained in Appendix B; and a set of facility general arrangement and time-line drawings is in Appendix C.

This report identifies operations currently planned for the repository; it can be used as a basis for future evaluations such as the advantages of manned versus remote repository operations.

The work in this report is supported by DIMs 2 and 103.

2.0 ASSUMPTIONS

2.1 Waste Forms and Quantities

The waste forms to be received and packaged for disposal will include both spent fuel from commercial power reactors and canisters of solidified high-level wastes from commercial and defense fuel-reprocessing operations. The commercial high-level waste is expected to come from the West Valley Demonstration Project in New York (DOE, 1984) and the Defense Waste Processing Facility at Savannah River, South Carolina (Baxter, 1983).

High-level radioactive wastes received from the West Valley Demonstration Project and the Defense Waste Processing Facility will have been immobilized in a borosilicate glass matrix contained in a stainless steel canister. Because of concern that the thermal cycling associated with the glass-pouring operation will result in highly stressed canisters (Baxter, 1983), these canisters will not be used as the primary barrier to meet the containment performance objective. Hereafter, both West Valley high-level waste (WVHLW) and defense high-level waste (DHLW) will be referred to by the term DHLW.

The waste receipt quantities are characterized in two ways: first, in MTUs and, second, by the number of canisters of DHLW or number of spent fuel assemblies. Table 2-1 lists the expected annual and cumulative waste receipts in MTU for a 25-yr period, and Table 2-2 lists the MTU and the number of DHLW canisters and spent fuel assemblies expected on an annual basis.

2.2 Waste-Shipping System

The waste-receiving and shipping area is designed to handle both truck and rail deliveries as required in Section B.2 of the "Generic Requirements for a Mined Geologic Disposal System" (GR) (DOE, 1986). Descriptions of the casks used in this analysis have been taken from Section B.2 of the GR and were used in the development of the reference repository in the "Site Characterization Plan Conceptual Design Report" (SNL, 1987) and the

TABLE 2-1

EXPECTED ANNUAL AND CUMULATIVE WASTE RECEIPTS*

Year	MTU DHLW		MTU Spent Fuel		Cumulative Receipt in MTU of DHLW and Spent Fuel
	This Year	Cumulative	This Year	Cumulative	
1998	0	0	400	400	400
1999	0	0	400	800	800
2000	0	0	400	1,200	1,200
2001	0	0	900	2,100	2,100
2002	0	0	1,800	3,900	3,900
2003	400	400	3,000	6,900	7,300
2004	400	800	3,000	9,900	10,700
2005	400	1,200	3,000	12,900	14,100
2006	400	1,600	3,000	15,900	17,500
2007	400	2,000	3,000	18,900	20,900
2008	400	2,400	3,000	21,900	24,300
2009	400	2,800	3,000	24,900	27,700
2010	400	3,200	3,000	27,900	31,100
2011	400	3,600	3,000	30,900	34,500
2012	400	4,000	3,000	33,900	37,900
2013	400	4,400	3,000	36,900	41,300
2014	400	4,800	3,000	39,900	44,700
2015	400	5,200	3,000	42,900	48,100
2016	400	5,600	3,000	45,900	51,500
2017	400	6,000	3,000	48,900	54,900
2018	400	6,400	3,000	51,900	58,300
2019	400	6,800	3,000	54,900	61,700
2020	400	7,200	3,000	57,900	65,100
2021	400	7,600	3,000	60,900	68,500
2022	400	8,000	1,100	62,000	70,000

*Source: SNL, 1987, Table 2-1.

alternative conceptual designs presented in the "OGR Repository-Specific Rod Consolidation Study" (O'Brien, 1988). The casks described in Section B.2 of the GR, in general, are handled the same as the casks currently being developed; however, the new casks are expected to hold more waste. The characteristics of the truck and rail casks used in this study are listed in Tables 2-3 and 2-4, and the characteristics assumed for trucks with trailers and for railroad cars in this study are listed in Table 2-5. The expected annual receipt rates for the shipping casks are listed in Table 2-6. The receipt rates shown in Table 2-6 are based on Tables 2-2 and 2-3, and on the assumption that 70% of the fuel is shipped by truck and 30% of the fuel is shipped by rail.

TABLE 2-2

EXPECTED ANNUAL RECEIPTS OF DEFENSE HIGH-LEVEL WASTE CANISTERS
AND SPENT FUEL ASSEMBLIES^a

Year	DHLW		PWR		BWR	
	MTU	Canister ^b	MTU	Assemblies ^c	MTU	Assemblies ^c
1998	0	0	240	519	160	860
1999	0	0	240	519	160	860
2000	0	0	240	519	160	860
2001	0	0	540	1,169	360	1,935
2002	0	0	1,080	2,338	720	3,871
2003	400	194	1,800	3,896	1,200	6,452
2004	400	436	1,800	3,896	1,200	6,452
2005	400	800	1,800	3,896	1,200	6,452
2006	400	800	1,800	3,896	1,200	6,452
2007	400	800	1,800	3,896	1,200	6,452
2008	400	800	1,800	3,896	1,200	6,452
2009	400	800	1,800	3,896	1,200	6,452
2010	400	800	1,800	3,896	1,200	6,452
2011	400	800	1,800	3,896	1,200	6,452
2012	400	800	1,800	3,896	1,200	6,452
2013	400	800	1,800	3,896	1,200	6,452
2014	400	800	1,800	3,896	1,200	6,452
2015	400	800	1,800	3,896	1,200	6,452
2016	400	800	1,800	3,896	1,200	6,452
2017	400	800	1,800	3,896	1,200	6,452
2018	400	800	1,800	3,896	1,200	6,452
2019	400	800	1,800	3,896	1,200	6,452
2020	400	800	1,800	3,896	1,200	6,452
2021	400	800	1,800	3,896	1,200	6,452
2022	400	800	660	1,429	440	2,366
Total	8,000	15,030	37,200	80,517	24,800	133,340

a. Source: SNL, 1987, Table 3-2.

b. Assumes 640 MTU as WVHLW in 310 canisters and 7,360 MTU as DHLW in 14,720 canisters.

c. Assumes an average ratio of 60% pressurized water reactor spent fuel (PWR) to 40% boiling water reactor spent fuel (BWR) in MTU for all years.

2.3 Waste Disposal Containers

The disposal container and an encapsulated waste form make up the end product of the surface waste-handling operations.

TABLE 2-3

CHARACTERISTICS OF TRUCK AND RAIL CASKS*

<u>Type</u>	<u>Diameter x Length (in.)</u>	<u>Weight (tons)</u>	<u>Capacity</u>
<u>Truck</u>			
DHLW	49 x 160	25	1 canister
PWR	72 x 216	25	2 assemblies
BWR	72 x 216	25	5 assemblies
<u>Rail</u>			
DHLW**	100 x 151	95	5 canisters
PWR	102 x 216	100	14 assemblies
BWR	102 x 216	100	36 assemblies

*Source: DOE, 1984.

**The facility design will accommodate this cask; however, all DHLW is assumed to be shipped in truck casks.

TABLE 2-4

FEATURES COMMON TO ALL CASKS*

Personnel Barrier	Removable
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
Temperature of Accessible Cask Surfaces	180°F
Neutron Shield	Solid
Dose Rate	
At accessible surface	50 mrem/hr
6.6 ft from vehicle	10 mrem/hr

*Source: DOE, 1984.

TABLE 2-5

CHARACTERISTICS OF THE TRANSPORT VEHICLES*

<u>Characteristic</u>	<u>Truck with Trailer</u>	<u>Railroad Car</u>
Height	13.5 ft	15.5 ft
Width	8 ft	10 ft
Length	60 ft	57 ft
Weight (loaded)	40 tons	132 tons
Turning Radius	50 ft	185 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

*Source: DOE, 1984.

2.3.1 Spent Fuel Container

The spent fuel container used in this study is designed with three internal arrangements (SNL, 1987) as shown in Figure 2-1. Arrangement 1 of the container can hold three PWR and four BWR fuel assemblies, Arrangement 2 can hold four PWR assemblies, and Arrangement 3 can hold 10 BWR assemblies.

2.3.2 Defense High-Level Waste Container

The reference design for the DHLW container is shown in Figure 2-2. This design includes a disposal container very similar to the reference spent fuel container. The 24-in.-diameter DHLW pour canister filled with the glass waste form is put in the 26-in.-diameter reference DHLW container. The physical characteristics of the spent fuel container and

TABLE 2-6

EXPECTED ANNUAL RECEIPT RATES FOR SHIPPING TASKS*

Year	DHLW		PWR		BWR	
	Truck	Rail	Truck	Rail	Truck	Rail
1998	0	0	182	11	120	7
1999	0	0	182	11	120	7
2000	0	0	182	11	120	7
2001	0	0	409	25	271	16
2002	0	0	818	50	542	32
2003	194	0	1,364	84	903	54
2004	436	0	1,364	84	903	54
2005	800	0	1,364	84	903	54
2006	800	0	1,364	84	903	54
2007	800	0	1,364	84	903	54
2008	800	0	1,364	84	903	54
2009	800	0	1,364	84	903	54
2010	800	0	1,364	84	903	54
2011	800	0	1,364	84	903	54
2012	800	0	1,364	84	903	54
2013	800	0	1,364	84	903	54
2014	800	0	1,364	84	903	54
2015	800	0	1,364	84	903	54
2016	800	0	1,364	84	903	54
2017	800	0	1,364	84	903	54
2018	800	0	1,364	84	903	54
2019	800	0	1,364	84	903	54
2020	800	0	1,364	84	903	54
2021	800	0	1,364	84	903	54
2022	800	0	500	31	331	20
Total	15,030	0	28,189	1,735	18,661	1,115

*Source: SNL, 1987, Table 3-2.

the DHLW container and canister are given in Table 2-7. The expected schedule for the annual preparation of containers for disposal is listed in Table 2-8.

2.4 Waste Operations Areas

Radioactive waste is received, prepared, and temporarily stored in the surface waste operations area (Figure 2-3) until it is emplaced in the subsurface facility. Waste receipt begins with admission of the waste

Figure 2-1. Spent Fuel Container (modified from SNL, 1987)

Figure 2-2. Defense High-Level Waste Container (modified from SNL, 1987)

Figure 2-3. Plan View of the Surface Waste Operations Area (modified from SNL, 1987)

TABLE 2-7

PHYSICAL CHARACTERISTICS OF DISPOSAL CONTAINERS*

<u>Characteristic</u>	<u>Spent Fuel Container</u>	<u>DHLW Container</u>
Maximum Overall Length (in.)	187.5	126
Diameter (in.)	28	26
Wall Thickness (in.)	0.375	0.375
Weight (lb)		
-Loaded	8,500-9,800	5,500
-Unloaded	2,700-3,250	1,200
*Source: SNL, 1987.		

shipment to the admitting and inspection area and terminates with unloading the spent fuel assemblies or high-level waste canisters at the WHB. The waste is then encapsulated in the WHB hot cells. After a disposal container has been filled with waste, closed, and decontaminated, it is stored in the surface storage vault until it is transferred to the emplacement area. Transfer and emplacement are initiated in the transfer bay of the storage vault and terminate in the subsurface waste operations area.

2.4.1 Surface Facilities and Equipment

The major activities performed in the WHB (Figures 2-4 and 2-5) involve unloading, preparing, and temporarily storing the waste. Ten entry bays and cask-receiving and shipping bays handle the incoming casks. The area housing the entry bays is a steel-framed structure that has two 5-ton bridge cranes to remove personnel barriers and impact limiters. The cask-receiving and shipping area is a high-bay, steel-framed structure with three 125-ton bridge cranes for unloading casks from the carriers. A truck entry bay adjacent to the receiving and shipping bays is also provided for collecting and transferring site-generated waste to the waste treatment building.

Ten cask transfer stations, in the preparation areas adjacent to the receiving and shipping bays, are equipped with elevated work platforms,

Figure 2-4. Plan View of the Waste-Handling Building

Figure 2-5. Section of the Waste-Handling Building

TABLE 2-8

ASSUMED ANNUAL PREPARATION RATES FOR DISPOSAL CONTAINERS

Year	Disposal Containers			
	DHLW	Arrangement 1 (3 PWR, 4 BWR)	Arrangement 2 (4 PWR)	Arrangement 3* (10 BWR)
1988	0	165	6	20
1999	0	165	6	20
2000	0	165	6	20
2001	0	371	14	46
2002	0	734	34	94
2003	194	1,232	50	153
2004	436	1,232	50	153
2005	800	1,232	50	153
2006	800	1,232	50	153
2007	800	1,232	50	153
2008	800	1,232	50	153
2009	800	1,232	50	153
2010	800	1,232	50	153
2011	800	1,232	50	153
2012	800	1,232	50	153
2013	800	1,232	50	153
2014	800	1,232	50	153
2015	800	1,232	50	153
2016	800	1,232	50	153
2017	800	1,232	50	153
2018	800	1,232	50	153
2019	800	1,232	50	153
2020	800	1,232	50	153
2021	800	1,232	50	153
2022	800	453	18	56
Total	15,030	25,461	1,034	3,163

*Includes one partially filled container per year.

robots mounted on the elevated work platforms, and devices necessary to perform the cask-receiving operations. After a cask has been removed from a carrier, it is moved to the cask preparation area. From the preparation area, the cask is moved to the port of a cask-unloading hot cell by a rail-mounted transfer car.

Two separate cask-unloading hot cells are provided. Hot Cell A, for DHLW, has two unloading ports and a 20-ton crane with a robotic manipulator mounted on a common bridge and trolley. Hot Cell B, for spent fuel, has

eight unloading ports and three 20-ton cranes with robotic manipulators mounted on a common bridge and trolley. Both hot cells have interim storage areas for the waste and are equipped to load, close, inspect, and decontaminate the waste disposal containers. Equipment galleries, with viewing windows and master/slave manipulators, are provided around the hot cells to assist in the operation and maintenance of hot cell equipment.

Each incoming cask is secured to and moved by a transfer car to a position under the unloading port for that transfer car. Each transfer car is stable and is constrained to move within a transfer tunnel, thus precluding collision with any other facility equipment. The inner lid of the cask is then removed, and the DHLW or spent fuel assemblies are lifted through the unloading port into the hot cell and placed in storage racks. The empty cask is returned to the cask preparation area where it is prepared for shipment. Equipment to flush the cask interior and decontaminate the cask exterior are located in this area.

When the waste canister or fuel assemblies have been placed in a disposal container, and the container has been closed and inspected, four below-grade transfer cars in the transfer tunnels move the full disposal containers to one of the two transfer bays for transfer to the surface storage vaults.

The transfer bays are also used to transfer waste containers from the surface storage vault to the facility transporters; the transfer bays shown in Figure 2-4 are designed for the reference vertical emplacement system. Horizontal transfer operations are included for completeness in the description of horizontal emplacement.

Two maintenance cells are provided below each cask-unloading hot cell for the remote maintenance of facility equipment. An equipment gallery extends the full length of the maintenance cells, and an equipment decontamination area is adjacent to the maintenance hot cells. A rail-mounted shuttle car provides access from the remote maintenance hot cell to the decontamination area.

Separate heating, ventilating, and air-conditioning (HVAC) systems are provided for the waste-handling areas, surface storage vault, and administration and office areas in the WHB. Exhaust equipment and high-efficiency particulate air filters are provided in the waste-handling areas to filter exhausted air. These HVAC systems maintain differential pressures that direct airflow (leakage) from areas of low potential for radioactive contamination, such as corridors and control rooms, to areas of higher potential for radioactive contamination, such as the unloading hot cells.

2.4.2 Subsurface Facilities and Equipment

Plan views of the subsurface facilities, the transporter, and the emplacement boreholes for both configurations are shown in Figures 2-6 and 2-7. The waste ramp provides access to the subsurface areas, and the tuff ramp provides for the removal of tuff excavated during development. The waste is transferred through the waste main, panel access drifts, and emplacement drifts to the emplacement boreholes.

The operations involved in emplacing waste in vertical boreholes consist of borehole preparation, waste transport, waste emplacement, and borehole closure. The transporter used to emplace the waste container and the emplacement of a waste container in a vertical borehole are illustrated in Figures 2-8, 2-9, and 2-10 (Stinebaugh and Frostenson, 1987; SNL, 1987). Horizontal emplacement consists of the same general steps as vertical emplacement. The transporter used to emplace the waste and the emplacement of waste containers in a horizontal borehole are illustrated in Figures 2-11, 2-12, and 2-13 (Stinebaugh et al., 1986; SNL, 1987).

Figure 2-6. Plan View of the Vertical Subsurface Facilities (SNL, 1987)

Figure 2-7. Plan View of the Horizontal Subsurface Facilities (SNL, 1987)

Figure 2-8. Waste Transporter in the Transport Mode, Vertical Configuration (Stinebaugh and Frostenson, 1987)

Figure 2-9. Waste Transporter in the Emplacement Mode, Vertical Configuration (Stinebaugh and Frostenson, 1987)

Figure 2-10. Vertical Borehole with the Emplaced Waste Container (SNL, 1987)

Figure 2-11. Waste Transporter in the Transport Mode, Horizontal Configuration
(Stinebaugh et al., 1986)

Figure 2-12. Waste Transporter in the Emplacement Mode, Horizontal Configuration
(Stinebaugh et al., 1986)

Figure 2-13. Horizontal Borehole with the Emplaced Waste Containers (SNL, 1987)

3.0 RECEIPT

3.1 Annual and Daily Receipt Rates

Waste will be received at the repository according to the schedule presented in Table 2-1 (SNL, 1987). The waste-handling operations are based on the projected waste receipt for a typical emplacement year 2011 and on the assumption that the repository will receive up to 3,000 metric tons of uranium (MTU) as spent fuel and up to 400 MTU as defense high-level waste (DHLW) annually. Seventy percent of the spent fuel (on an MTU basis) will be shipped by truck, 30% by rail, and all DHLW will be shipped by truck.

As in the reference case described in the "Site Characterization Plan Conceptual Design Report," the repository is designed to accept the waste shipments on a 24-hr/day, 365-day/yr schedule. In this study it is assumed that waste-handling operations are limited to 18 productive hours/day with 250 productive days/year. It also has been assumed that arriving shipments will be stored in an interim storage yard until they are taken to the waste-handling building (WHB). The cask unloading schedule assumes optimum use of the WHB facilities.

The facilities described in this report have been designed to receive 14 truck casks and 1 rail cask/day (3,500 truck and 250 rail casks/yr). The annual receipt rates used in this study are 3,067 truck casks and 138 rail casks. The annual and daily facility and criteria receipt rates are listed in Table 3-1.

The operations described in this report permit unloading 1,000 canisters of DHLW and 11,500 spent fuel assemblies annually. The criteria unloading rates are 800 canisters of DHLW and 10,348 spent fuel assemblies annually. These unloading rates are compared in Table 3-2. The facility design presented here allows for a 25% excess of DHLW canisters and an 11% excess of spent fuel assemblies.

TABLE 3-1

ANNUAL AND DAILY FACILITY AND CRITERIA RECEIPT RATES FOR CASKS

Shipment Mode	Type of Waste	Cask Receipt Rates			
		Annual (2011)		Daily (250 days/yr)	
		Facility	Criteria	Facility	Criteria
Truck		3,500	3,067	14	12.27
	DHLW	1,000	800	4	3.20
	PWR	1,500	1,364	6	5.46
	BWR	1,000	903	4	3.61
Rail		250	138	1	0.55
	DHLW	--	--	--	--
	PWR	250	84	1	0.34
	BWR	--	54	--	0.21
Total		3,750	3,205	15	12.82

TABLE 3-2

ANNUAL AND DAILY FACILITY AND CRITERIA RECEIPT
RATES FOR DEFENSE HIGH-LEVEL WASTE CANISTERS AND SPENT FUEL ASSEMBLIES

Shipment Mode	Type of Waste	Canister or Assembly Receipt Rates			
		Annual (2011)		Daily (250 days/yr)	
		Facility	Criteria	Facility	Criteria
Truck		9,000	8,043	36	32.18
	DHLW	1,000	800	4	3.20
	PWR	3,000	2,727	12	10.91
	BWR	5,000	4,516	20	18.07
Rail		3,500	3,105	14	12.42
	DHLW	--	--	--	--
	PWR	3,500	1,169	14	4.68
	BWR	--	1,936	--	7.74
Total		12,500	11,148	50	44.60

3.2 Waste Receipt Operations

The receiving operations include admitting the waste shipment to the repository operations area, unloading the cask from the shipping vehicle and the waste from the cask, and preparing the empty cask for return shipment.

3.2.1 Admit Shipment

The sequence of the operations for each waste-handling activity is identified in the blocks of the BFDs. Requirement allocation sheets provide detailed information about the tasks to be performed in each block of the BFDs and list the equipment, facilities, consumable materials, and assumptions required to complete each block. The time-line and equipment utilization diagrams show that the required operations can be completed in the time allotted and with the equipment provided.

The waste shipments will be admitted to the waste-receiving and inspection area through Gate 3. The operations associated with receipt of the shipment take place in the area between Gate 3 and the WHB (Figure 2-3). These operations are identified in the waste receipt BFD shown in Figure 3-1 and are described in the corresponding RASs (1.1 through 1.8 in Appendix A). Both routine and nonroutine operations are identified in the BFDs. Routine operations will be performed on all shipments, and only shipments with safety, radiological, or security problems will be subjected to nonroutine operations. It is assumed that no more than 1 shipment in 10 will require nonroutine handling.

3.2.2 Unload Shipment

The operations associated with unloading the shipment take place in the entry bays, cask-receiving and shipping bays, cask preparation area, cask transfer tunnel, and Unloading Hot Cells A and B. A plan view and section of the cask-receiving areas in the WHB are shown in Figures 3-2 and 3-3, respectively.

(2) October 19, 1988 7 45 AM
82 5189418 (GB1)

Figure 3-1. Block Flow Diagram for Waste Receipt

RECEIVING

Figure 3-3. Section of the Cask-Receiving Areas in the Waste-Handling Building

3.2.3 Return Empty Cask

The operations involved in unloading the shipping cask from the carrier, preparing the cask for unloading the waste, and unloading the waste are identified in the BFD shown in Figure 3-4 and are analyzed in the corresponding RASs (1.9 through 1.23 in Appendix A).

The operations associated with returning the empty shipping casks take place in the WHB and in the area between the WHB and Gate 3. These areas, the same areas that were involved in unloading and admitting the shipment, are shown in Figures 2-3, 3-2, and 3-3.

The operations involved in inspecting, preparing, and returning the empty cask and transport vehicle to Gate 3 for shipment are identified in the empty cask return BFD shown in Figure 3-5 and are described in the corresponding RASs (1.24 through 1.40 in Appendix A).

3.3 Analysis of Operations

Time-line, equipment utilization, and position-time diagrams were used to analyze and graphically represent the operations described in Section 3.2, Waste Receipt Operations. These operations are listed along the ordinate of the time line, and 1-hr intervals for an 18-hr period are listed across the top of the diagram. The time lines with the associated equipment utilization diagram ensure that the equipment provided is adequate. Position-time diagrams, developed for the bridge cranes, represent the positions of the bridge cranes at particular times during specific operations. These diagrams ensure that all the movements of a bridge crane are coordinated with the movements of the other bridge cranes operating in the same area.

An analysis of the receipt of DHLW and spent fuel is shown in the time lines in Figures 3-6 through 3-10. The equipment utilization diagram is shown in Figure 3-11. And the position-time analysis is shown in Figure 3-12, for the two 5-ton bridge cranes in the entry bay; in Figure 3-13, for the three 125-ton bridge cranes in the receiving and shipping area; and

(3) October 21, 1988 2:21 PM
03 XLO5818 (G01)

Figure 3-4. Block Flow Diagram for Unloading the Waste

(4) January 4, 1989 7:54 AM
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Figure 3-5. Block Flow Diagram for Returning the Empty Cask

TIME LINE DIAGRAM FOR ADMITTING DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL SHIPMENTS

- (a) Time Lines 1, 3, 4, 6, 7, and 11 are for admitting pressurized water reactor (PWR) truck casks
- (b) Time Lines 2, 5, 8, and 9 are for admitting boiling water reactor truck casks
- (c) Time Line 10 is for admitting a PWR rail cask
- (d) Time Lines 12, 13, 14, and 15 are for admitting defense high-level waste truck casks

Figure 3-6. Time-Line Diagram for Admitting Waste Shipments to the Repository

TIME LINE DIAGRAM FOR DEFENSE HIGH-LEVEL WASTE UNLOADING

(a) Time Lines 1, 2, 3, and 4 are for unloading defense high level waste truck casks
 This time-line diagram is based on Sandia National Laboratories Drawing Number SK-212-M-315, NNWSI Project Waste Handling Building,
 Unload Shipping Cask (HLW) Timeline Diagram: 100% Truck, Revision B, August 28, 1987

Figure 3-7. Time-Lire Diagram for Unloading Defense High-Level Waste

TIME LINE DIAGRAM FOR SPENT FUEL UNLOADING

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87-50048 (GFI)

(a) Time Lines 1, 3, 4, 6, 7, and 11 are for unloading pressurized water reactor (PWR) truck casks

(b) Time Lines 2, 5, 8, and 9 are for unloading boiling water reactor (BWR) truck casks

(c) Time Line 10 is for unloading a PWR rail cask

(d) The time required to unload waste from the three cask types are: PWR truck, 35 min; BWR truck, 75 min; and PWR rail, 190 min

The time required to unload a BWR rail cask (not shown on time line) is 480 min for a total time of 750 min

This time line diagram is based on Sandia National Laboratories Drawing Number SK-212 M-318, NNWSI Project Waste Handling Building.

Unload Shipping Cask (Fuel Assemblies) Timeline Diagram, 30% Rail, 70% Truck, Revision C, November 6, 1987

Figure 3-8. Time-Line Diagram for Unloading Spent Fuel

No	Title	Time (min)
1 24	Inspect Cavity of Empty Cask	10
1 25	Replace Inner Lid of Cask	20
1 26	Transfer Empty Cask to Preparation Area	20
1 27	Remove Adapter, Tighten Inner Lid Bolts, and Survey Empty Cask	50
1 29	Replace Outer Cover of Cask	20
1 31	Transfer Empty Cask to Receiving and Shipping Bay	20
1 32	Place Empty Cask on Carrier	55
1 33	Transfer Empty Cask and Carrier to Entry Bay	5
1 34	Replace Personnel Barrier and Impact Limiters	10
1 35	Transfer Empty Cask and Carrier to Interim Storage	15
1 36	Transfer Empty Cask and Carrier to Admitting and Inspection Area	15
1 37	Survey and Inspect Empty Cask and Carrier	15
1 40	Ship Empty Cask and Carrier Offsite	15

Total Time (min): 270

(S) January 4, 1989 / 59 AM
08 X 02181501

(a) Time Lines 1, 2, 3, and 4 are for returning defense high level waste to the NNSA. The NNSA is currently drawing Number SK 212-M 315. NNSA's Project Waste Handling Building.

Time line diagram is based on Sandia National Laboratories Drawing Number SK-212-IM-311
United Shipping Cask (HLW) Timeline Diagram: 100% Truck, Revision B; August 28, 1987

Figure 3-9. Time-Line Diagram for Returning the Defense High-Level Waste Cask

TIME LINE DIAGRAM FOR SPENT FUEL CASK RETURN

(11 November 27, 1989 10:10 AM)
09:54:00 (GSI)

(a) Time Lines 1, 3, 4, 6, 7, and 11 are for returning pressurized water reactor (PWR) truck casks

(b) Time Lines 2, 5, 8, and 9 are for returning boiling water reactor truck casks

(c) Time Line 10 is for returning a PWR rail cask

This time-line diagram is based on Sandia National Laboratories Drawing Number SK-212 M-318, NNWSI Project Waste Handling Building, Unload Shipping Cask (Fuel Assemblies) Timeline Diagram, 30% Rail, 70% Truck, Revision C, November 6, 1987

Figure 3-10. Time-Line Diagram for Returning the Spent Fuel Cask

EQUIPMENT UTILIZATION DIAGRAM FOR UNLOADING AND RETURNING DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL CASKS

- (a) Equipment Utilization Lines 1, 3, 4, 6, 7, and 11 are for unloading and returning pressurized water reactor (PWR) truck casks
- (b) Equipment Utilization Lines 2, 5, 8, and 9 are for unloading and returning boiling water reactor truck casks
- (c) Equipment Utilization Lines 12, 13, 14, and 15 are for unloading and returning defense high level waste truck casks
- (d) Equipment Utilization Line 10 is for unloading and returning a PWR rail cask

This equipment utilization diagram is based on Sandia National Laboratories Drawing Numbers SK 212-M 315 and SK 212-M 318, NNS's Project Waste Handling Building Unloading Shipping Cask (HLW) Timeline Diagram 100% Truck, Revision B, August 28, 1987 and NNS's Project Waste Handling Building Unloading Shipping Cask (Fuel Assemblies) Timeline Diagram 30% Rail, 70% Truck, Revision C, November 6, 1987

Figure 3-11. Equipment Utilization Diagram for Unloading the Defense High-Level Waste and Spent Fuel Casks

POSITION TIME ANALYSIS DIAGRAM FOR CRANE MOVEMENTS IN THE ENTRY BAYS

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- Pick up personnel barrier handling fixture, remove personnel barrier and impact limiters
 - Survey task surfaces
 - Replace impact limiters and barrier on carrier, return fixture to storage area
 - (a) Crane Movements 1, 3, 4, 6, 7, and 11 are for pressurized water reactor (PWR) truck casks
 - (b) Crane Movements 2, 5, 8, and 9 are for boiling water reactor truck casks
 - (c) Crane Movement 10 is for a PWR rail cask
 - (d) Crane Movements 12 through 15 are for defense high level waste casks
- This equipment utilization diagram is based on Sandia National Laboratories Drawing Numbers SK 212 M 315 and SK 212 M 318.
 NWSI Project Waste Handling Building Unloading Shipping Cask (H/W) Timeline Diagram 100% Truck Revision B, August 28, 1987 and
 NWSI Project Waste Handling Building Unloading Shipping Cask (Fuel Assemblies) Timeline Diagram 30% Rail, 70% Truck, Revision C,
 November 6, 1987

Figure 3-12. Position-Time Analysis of Crane Movements in the Entry Bays

POSITION TIME ANALYSIS DIAGRAM FOR CRANE MOVEMENTS IN THE RECEIVING AND SHIPPING BAYS

● Select and attach task lifting yoke - remove task from carrier

■ Transfer task to preparation area port

○ Transfer empty task to receiving and shipping area - place empty task on carrier

△ Disconnect and return yoke to storage

(a) Crane Movements 1, 2, 4, 6, 7, and 11 are for pressurized water reactor (PWR) truck tasks

(b) Crane Movements 2, 4, 6, 7, and 9 are for boiling water reactor (BWR) truck tasks

(c) Crane Movement 10 is for a PWR rail task

(d) Crane Movements 12 through 15 are for defense high level waste truck tasks

This equipment utilization diagram is based on Naval Facilities Engineering District Number 312 M 315 and SK 212 M 319. It is a revision of the diagram titled "NAVFAC Project Waste Handling Building (Unloading Shipping Task) (H) Timeline Diagram - 100% Truck Revision B August 28, 1987 and NAVFAC Project Waste Handling Building (Unloading Shipping Task) (H) Timeline Diagram - 100% Rail 70% Truck Revision C November 6, 1987".

Figure 3-13. Position-Time Analysis of Crane Movements in the Receiving and Shipping Bays

in Figures 3-14 and 3-15, for the four 20-ton bridge cranes in Hot Cells A and B.

Separate time lines have been developed for DHLW and spent fuel receipt operations, which include unloading the cask from the transport vehicle (Figures 3-7 and 3-8), preparing the cask for unloading the waste (Figures 3-7 and 3-8), unloading the waste from the cask (Figures 3-7 and 3-8), and preparing the empty cask for shipment and returning it to the interim storage area (Figures 3-9 and 3-10).

3.4 Conclusions

The time-line and position-time analyses indicate that the design of receiving area in the WHB will meet the waste receipt criteria. This conclusion is based on the assumptions made in Section 3.1.

The results of the time-line analyses indicate that both Hot Cells A and B can receive more waste than is currently scheduled. This ability to handle additional waste means that other high-level wastes can be accommodated in Hot Cell A if the unloading, preparation, and storage facilities are compatible. At the time this study was performed, the other high-level wastes to be emplaced had not been identified and the container to dispose of these wastes had not been designed.

The number of receiving bays, hot cell unloading ports, and associated equipment in the WHB depends on how the waste is shipped (truck-rail ratio) and the capacity of the shipping casks. If a larger percentage of the waste is shipped by rail, for example, the size of the receiving facilities can be reduced.

POSITION TIME ANALYSIS DIAGRAM FOR CRANE MOVEMENTS IN HOT CELL A

Position and Movements of the 20 Ton Bridge Crane

- Remove hot cell shield plug and inner cask lid, remove defense high level waste (DHLW) canister to canister storage rack
 - Inspect cask cavity with viewing system, replace cask lid and hot cell shield plug
 - Transfer DHLW canister to weld station and place in disposal container
 - Transfer empty disposal container and disposal container cover to weld station
 - ▲ Transfer disposal container to weld inspection station
 - △ Transfer disposal container to decontamination station
- (a) Crane Movements 12 through 15 are for: ... W truck casks with one DHLW waste canister
 (b) Crane Movements in baskets 1 through 4 are for disposal containers with one DHLW waste canister

This position time analysis diagram is based on Sandia National Laboratories Drawing Numbers SK 212 M 315, SK 212 M 323, SK 212 M 318 and SK 212 M 316
 NNWSI Project Waste Handling Building Unloading Shipping Cask (HLW) Timeline Diagram, 100% Truck Revision B, August 28, 1987.
 NNWSI Project Waste Handling Building Prepare HLW Containers for Disposal Timeline Diagram Revision A, August 28, 1987
 NNWSI Project Waste Handling Building Unloading Shipping Cask (Fuel Assemblies) Timeline Diagram, 30% Rail, 70% Truck, Revision C, November 6, 1987, and
 NNWSI Project Waste Handling Building Prepare Fuel Containers for Disposal Timeline Diagram, Revision B, August 28, 1987

SK 212 M 315
 11/1/87

Figure 3-14. Position-Time Analysis of Crane Movements in Hot Cell A

POSITION TIME ANALYSIS DIAGRAM FOR CRANE MOVEMENTS IN HOT CELL B

- Remove hot cell shield plug and inner cask lid - remove spent fuel assemblies to fuel storage cask
 - Inspect cask cavity with viewing system - replace cask lid and hot cell plug
 - Transfer spent fuel assemblies to weld station and place in disposal container
 - Transfer empty disposal container and disposal container cover to weld station
 - Transfer disposal container to leak test station - transfer disposal container to weld inspection station
 - Transfer disposal container to decontamination station
- (a) Crane Movements 1, 4, 6, 7, and 11 are for pressurized water reactor (PWR) truck casks with two 2 PWR spent fuel assemblies
- (b) Crane Movements 2, 5, 8, and 9 are for boiling water reactor (BWR) truck casks with two 5 BWR spent fuel assemblies
- (c) Crane Movement 10 is for a PWR cask with fourteen 14 PWR spent fuel assemblies
- (d) Crane Movements in brackets 5 through 10 are for disposal containers with seven 7 spent fuel assemblies (1 PWR and 6 BWR)
- This position time analysis diagram is based on Sandia National Laboratories Drawing Numbers SA 212 M 115, SA 212 M 123, SA 212 M 118, and SA 212 M 116
- NAWS Project Waste Handling Building Interlocking Shipping Cask (HWC) Timeline Diagram, 100% Truck Revision B, August 28, 1987
- NAWS Project Waste Handling Building Prepare to W/C Containers for Disposal Timeline Diagram, Revision A, August 28, 1987
- NAWS Project Waste Handling Building Interlocking Shipping Cask (Fuel Assemblies) Timeline Diagram, 10% Rev. 10% Truck Revision C, November 6, 1987, and
- NAWS Project Waste Handling Building Prepare Fuel Containers for Disposal Timeline Diagram, Revision B, August 28, 1987

Figure 3-15. Position-Time Analysis of Crane Movements in Hot Cell B

4.0 WASTE PREPARATION

4.1 Annual and Daily Preparation Rates

Waste will be prepared for disposal at the repository by placing one defense high-level waste (DHLW) canister or multiple spent fuel assemblies in each disposal container and closing and inspecting the container. The disposal container used for spent fuel in this study is shown in Figure 2-1, and the container for DHLW is shown in Figure 2-2. To emplace the DHLW and spent fuel shipped to the repository during the steady-state year, 2011, 2,225 disposal containers must be prepared. The facilities have been designed to prepare 2,500 containers/year for disposal, as shown in Table 4-1.

TABLE 4-1

ANNUAL AND DAILY FACILITY AND CRITERIA RATES FOR THE PREPARATION OF
DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL DISPOSAL CONTAINERS

Type of Waste	Arrangement	Disposal Container Preparation			
		Annual (2011)		Daily (250 days/yr)	
		Facility	Criteria	Facility	Criteria
DHLW		1,000	800	4.0	3.20
Spent Fuel		1,500	1,435	6.0	5.74
	1 (3 PWR, 4 BWR)	1,250	1,232	5.0	4.93
	2 (4 PWR)	50	50	0.2	0.20
	3 (10 BWR)	<u>200</u>	<u>153</u>	<u>0.8</u>	<u>0.61</u>
Total		2,500	2,235	10.0	8.94

Although the repository can accommodate waste shipments on a 24-hr/day, 365-day/yr schedule, the waste-handling facilities are assumed to have 18 productive hours/day and 250 productive days/year. It has been assumed that the surge storage provided by the canister storage rack located in Hot Cell A (36 positions for DHLW canisters) and the two fuel storage racks located in Hot Cell B (400 positions for spent fuel assemblies) will be adequate for the preparation of the waste for disposal.

The waste preparation facilities are designed to prepare 1,000 DHLW containers and 1,500 spent fuel containers for disposal annually. This preparation rate provides for a 25% excess capacity of DHLW disposal containers and a 5% excess of spent fuel disposal containers.

4.2 Waste Preparation Operations

Routine operations will be performed on all containers when encapsulating the waste, and only containers that do not pass inspection will be subject to nonroutine operations to correct the problem as shown in the BFD in Figure 4-1. These operations are described in the corresponding RASs (2.1 through 2.15 in Appendix A). The operations associated with preparing the waste for disposal take place in Unloading Hot Cells A and B and in Inspection Hot Cells A and B (Figures 4-2 and 4-3). The operations include placing the waste in a disposal container and inspecting the container to ensure that it is acceptable for emplacement in the repository.

4.3 Analysis of Operations

Time-line, equipment utilization, and position-time diagrams analyze and graphically represent the operations described in Section 4.2, Waste Preparation Operations. The time-line and associated equipment utilization diagrams show that the required operations can be completed in the allotted 18-hr period and that the equipment provided is adequate.

The position-time diagrams represent the position of the bridge cranes at particular times during specific operations. These diagrams ensure that all the movements of a bridge crane are coordinated with the movements of the other bridge cranes operating in the same general area.

The time-line analysis for preparation of DHLW disposal containers is shown in Figure 4-4, and the time-line analysis for preparation of spent fuel disposal containers is shown in Figure 4-5. The equipment utilization diagram is shown in Figure 4-6. The position-time analyses for the 20-ton bridge cranes in Hot Cells A and B are shown in Figures 3-14 and 3-15.

Figure 4-1. Block Flow Diagram for Waste Preparation

Figure 4-2. Plan View of the Container Preparation Areas in the Waste-Handling Building

Figure 4-3. Section of the Container Preparation Areas in the Waste-Handling Building

TIME LINE DIAGRAM FOR DEFENSE HIGH-LEVEL WASTE DISPOSAL CONTAINER PREPARATION

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(a) Time Lines 1 through 4 are for preparing defense high-level waste disposal containers
This time-line diagram is based on Sandia National Laboratories Drawing Number SK-212-M-323, NNWSI Project Waste Handling Building,
Prepare HLW Containers for Disposal Timeline Diagram, Revision A, August 28, 1987.

Figure 4-4. Time-Line Diagram for Preparing Defense High-Level Waste Disposal Containers

TIME LINE DIAGRAM FOR SPENT FUEL DISPOSAL CONTAINER PREPARATION

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17 XL05018 (GCR)

- (a) Time Lines 1 through 6 are for preparing spent fuel disposal containers
This time-line diagram is based on Sandia National Laboratories Drawing Number SK-212-M-316, NNWSI Project Waste Handling Building.
Prepare Fuel Containers for Disposal Timeline Diagram, Revision B, August 28, 1987

Figure 4-5. Time-Line Diagram for Preparing Spent Fuel Disposal Containers

EQUIPMENT UTILIZATION DIAGRAM FOR PREPARING DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL DISPOSAL CONTAINERS

(2) October 21, 1988 2:32 PM
18 XLS0018 (G01)

(a) Equipment Utilization Lines 1 through 4 are for preparing defense high-level waste disposal containers

(b) Equipment Utilization Lines 5 through 10 are for preparing spent fuel disposal containers

This equipment utilization diagram is based on Sandia National Laboratories Drawing Numbers SK-212-M-323 and SK-212-M-316; NNWSI Project Waste Handling Building, Prepare HLW Containers for Disposal Timeline Diagram, Revision A, August 28, 1987 and NNWSI Project Waste Handling Building, Prepare Fuel Containers for Disposal Timeline Diagram, Revision B, August 28, 1987.

Figure 4-6. Equipment Utilization Diagram for Preparing Defense High-Level Waste and Spent Fuel Disposal Containers

4.4 Conclusions

The time-line and position-time analyses indicate that the design of the preparation area in the WHB will meet the waste receipt criteria. This conclusion is based on placing 800 DHLW canisters and 3,896 PWR and 6,452 BWR spent fuel assemblies in the disposal containers per year.

The time-line analysis indicates that both Hot Cells A and B have excess capacity. However, because the excess capacity in Hot Cell B is approximately 5%, only Hot Cell A, capable of handling a 25% excess, can reasonably be considered for placing other high-level waste in disposal containers. However, these additional wastes can be prepared for disposal in Hot Cell A only if the facilities are suitable for preparing them. At the time this study was performed, the physical characteristics of the additional high-level waste and the disposal container for this waste had not been identified.

The waste preparation facilities and throughput are strongly tied to the physical characteristics of the waste disposal container, the container closure and inspection procedures, and the type of waste to be placed in the disposal container. If any one of these three items changes significantly, the results of this analysis will also change.

5.0 STORAGE

5.1 Annual and Daily Storage Rates

Disposal containers are moved from the waste-handling building (WHB) hot cells to the surface storage vault through transfer tunnels below the transfer bays. The storage vaults can store 270 disposal containers at one time. When operating under routine conditions during the steady-state year, 2011, 10 disposal containers will be stored each day (2,500/yr). The annual and daily storage rates are the same as discussed under preparation and are listed in Table 4-1.

5.2 Storage Operations

The operations associated with storing waste containers are identified in the BFD shown in Figure 5-1 and are described in the corresponding RASs (3.1 through 3.4 in Appendix A). The operations begin with a waste container in one of the four below-grade transfer stations: two of the stations receive defense high-level waste (DHLW) from Hot Cell A and two stations receive spent fuel from Hot Cell B. The container is moved in a shielded cask by a container transfer machine (CTM) from the container transfer car in the transfer station to a storage location in the surface storage vault (Figures 5-2 and 5-3). The CTM is bridge mounted and equipped with a hoisting mechanism to pull the container into the cask and lower it into the storage rack. The CTM also has a plug hoist to remove and replace shield plugs, when necessary.

5.3 Analysis of Operations

Time-line diagrams are used to analyze and graphically represent the operations described in Section 5.2, Storage Operations. The time-line and associated equipment utilization diagrams ensure that the operations can be performed with no conflicts and that the equipment provided is adequate.

Figure 5-1. Block Flow Diagram for Routine Storage

Figure 5-2. Plan View of the Container Storage Area in the Waste-Handling Building

Figure 5-3. Section of the Container Storage Area in the Waste-Handling Building

The time-line analysis for storage of waste containers is shown in Figure 5-4, and the time-line analysis for equipment utilization is shown in Figure 5-5.

5.4 Conclusions

The results of the time-line analysis indicates that the design of the surface storage vault, two storage areas each with a CTM, will meet the waste-handling criteria, which require that 10 containers be handled on a daily basis.

TIME LINE DIAGRAM FOR DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL DISPOSAL CONTAINER STORAGE

(B) October 21 1988 2 34 PM
20 5105018 (G01)

(a) Time Lines 1, 2, 4, 5, 7, and 9 are for storing spent fuel disposal containers.

(b) Time Lines 3, 6, 8, and 10 are for storing defense high-level waste disposal containers

This time-line diagram is based on Sandia National Laboratories Drawing Number SK-212-M-317, NNWSI Project Waste Handling Building, Surface Storage Transfer to Disposal Area Timeline Diagram, Revision B, August 28, 1987

Figure 5-4. Time-Line Diagram for Storing Disposal Containers

EQUIPMENT UTILIZATION DIAGRAM FOR STORING DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL DISPOSAL CONTAINERS

(3) October 21 1988 2 35 PM
21 XLO5018 (G01)

- (a) Equipment Utilization Lines 1, 2, 4, 5, 7, and 9 are for storing spent fuel disposal containers
 (b) Equipment Utilization Lines 3, 6, 8, and 10 are for storing defense high-level waste disposal containers
 This equipment utilization diagram is based on Sandia National Laboratories Drawing Number SK-212-M-317; NNWSI Project Waste Handling Building, Surface Storage Transfer to Disposal Area Timeline Diagram, Revision B, August 28, 1987

Figure 5-5. Equipment Utilization Diagram for Storing Disposal Containers

6.0 TRANSFER AND EMPLACEMENT

6.1 Annual and Daily Transfer and Emplacement Rates

The subsurface facilities for both the vertical and horizontal configurations are designed to receive and permit emplacement of 10 disposal containers/day (2,500/yr).

6.2 Transfer and Emplacement Operations

The transfer of disposal containers to the transporter casks takes place in the transfer bays of the surface storage vault (Figures 5-1 and 5-2). The operations include returning a disposal container to the transfer car in the transfer station, positioning the facility transporter in the surface vault transfer bay, loading the container into the transporter, and moving the transporter to the waste ramp portal. Both routine and nonroutine operations are identified in the transfer and emplacement block flow diagram (BFD) shown in Figure 6-1. Nonroutine operations will be performed only for transporter casks that do not meet radiation survey and inspection requirements.

Emplacement operations begin at the entrance to the subsurface waste operations area (Figure 6-2). The operations for both the vertical and horizontal configurations include travel to the emplacement borehole (Figures 6-3 and 6-4), emplacement of the disposal container in the borehole (Figures 6-5 and 6-6), and return of the transporter to the surface operations area. Routine and nonroutine operations are identified in Figure 6-1. Nonroutine operations will only address shielding closure problems at the borehole.

The transfer bay design depicts the reference vertical container-handling system. Horizontal handling operations have also been included in this study for completeness.

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22 SLOS018 (G01)

Figure 6-1. Block Flow Diagram for Transfer and Emplacement

Figure 6-2. Detail of the Entrance to the Waste Operations Area (Subsurface Facility)
(modified from SNL, 1987)

DHLW DEFENSE HIGH-LEVEL WASTE
H HEIGHT
W WIDTH
DIA DIAMETER

Figure 6-3. Detail of an Emplacement Panel in the Waste Operations Area (Subsurface Facility), Vertical Configuration (SNL, 1987)

Figure 6-4. Detail of an Emplacement Panel in the Waste Operations Area (Subsurface Facility), Horizontal Configuration (SNL, 1987)

Figure 6-5. Detail of the Vertical Emplacement Plan (SNL, 1987)

HORIZONTAL EMPLACEMENT PLAN

NOT TO SCALE

Figure 6-6. Detail of the Horizontal Emplacement Plan (SNL, 1987)

Requirement Allocation Sheets 4.1 through 4.12 (Appendix A), which correspond to the blocks in Figure 6-1, list the tasks and equipment and facility requirements for both emplacement configurations.

6.3 Analysis of Operations

A time-line diagram was used to analyze the operational procedures described in Section 6.2, Transfer and Emplacement Operations. This diagram shows that the required sequence of operations can be completed in an 18-hr period.

A position-time diagram represents the movement of equipment and the facility transporter in the surface storage facility. Movement of the transporter underground and ramp access and egress are also indicated. The time-line and position-time diagrams are shown in Figures 6-7 and 6-8, respectively.

6.4 Conclusions

The time-line and position-time analyses confirm that transfer and emplacement operations will meet the waste receipt criteria. This conclusion is based on emplacing 10 containers/day (2,500/yr).

TIME LINE DIAGRAM FOR DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL DISPOSAL CONTAINER TRANSFER AND EMPLACEMENT

(a) Time Lines 1, 2, 4, 5, 7, and 9 are for transferring and emplacing spent fuel disposal containers

(b) Time Lines 3, 6, 8, and 10 are for transferring and emplacing defense high level waste disposal containers

(c) Blocks on time lines for Operations 4 8 and 4 12 indicate the time that the transporter is on the waste ramp, approximately 15 min

This time line diagram is based on Sandia National Laboratories Drawing Numbers SK 212 M 317 and R06867 OP, NNWSI Project Waste Handling Building Surface Storage Transfer to Disposal Area Timeline Diagram, Revision B, August 28, 1987 and Nuclear Waste Repository in Tuff Subsurface Facility Conceptual Design - Waste Transporter Operations Schedule, Vertical Emplacement, Revision A, May 28, 1988

Figure 6-7. Time-Line Diagram for Transferring and Emplacing a Disposal Container

EQUIPMENT UTILIZATION DIAGRAM FOR TRANSFERRING AND EMLACING DEFENSE HIGH-LEVEL WASTE AND SPENT FUEL DISPOSAL CONTAINERS

(4) October 21, 1988 2:42 PM
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- (a) Equipment Utilization Lines 1, 2, 4, 5, 7, and 9 are for transferring and emplacing spent fuel disposal containers
 - (b) Equipment Utilization Lines 3, 6, 8, and 10 are for transferring and emplacing defense high-level waste disposal containers.
 - (c) Blocks on equipment utilization lines for Transporters 1, 2, and 3 indicate the time that the transporter is on the waste ramp, approximately 15 min.
- This equipment utilization diagram is based on Sandia National Laboratories Drawing Numbers SK-212-M-317 and R06867-OP: NNWSI Project Waste Handling Building, Surface Storage Transfer to Disposal Area Timeline Diagram, Revision B, August 28, 1987 and Nuclear Waste Repository in Tuff Subsurface Facility Conceptual Design--Waste Transporter Operations Schedule, Vertical Emplacement, Revision A, May 28, 1988

Figure 6-8. Position-Time Analysis for Transferring and Emplacing a Disposal Container

7.0 RECOMMENDATIONS FOR FUTURE WORK

The recommendations for future work have been divided into three categories. The first category is composed of items that affect the total waste management system [the repository, the monitored retrievable storage (MRS) facility, and the transportation system]. The second category involves operations within the repository boundary. And the third category concerns the methodology used to perform operational analyses for repository designs.

The first category includes the amount of SNF introduced into the waste management system annually and a description of the waste transportation system.

The amount of SNF that the waste management system is required to accept and emplace annually is not well defined. The definition currently being used for design purposes (Section 1.1--Waste Forms and Quantities) is based on equivalent metric tonnage: the metric tons of uranium (MTU) initially contained in unirradiated nuclear fuel. In any given year, the fraction of the total SNF, expressed in MTU and represented by pressurized-water reactor (PWR) and boiling-water reactor (BWR) fuel assemblies, is expected to vary. Also, fractional MTUs initially contained in both PWR and BWR fuel assemblies vary over a wide range (DOE, 1987). The reactors, transportation system, MRS, and repository all must deal with the physical entities--PWR and BWR fuel assemblies. At this time, however, a system-wide standard has not been adopted for identifying the number of PWR and BWR fuel assemblies that must be accepted annually.

It is recommended, therefore, that system-wide criteria be developed, which can be adopted by the waste management system to provide guidance for either (1) converting MTUs into PWR and BWR fuel assemblies or (2) defining the number of PWR and BWR fuel assemblies expected to be shipped from the reactors to the first repository on an annual basis (either for a single year or for the life of the repository).

The waste-shipping system (Section 1.2--Waste Shipping System) provides the connection between the waste generation and the waste disposal activities. At this time, a system-wide standard that describes the configuration and operation of the waste-shipping system has not been adopted.

It is recommended that system-wide design criteria be developed for both the waste-shipping system and the facilities that interface with the waste-shipping system. From the facility interface standpoint requirement, such criteria should include BFDs and RASs similar to those presented in Chapter 3--Receipt.

The second category, involving operations within the repository boundary, relates to the methods and procedures that will be used to encapsulate the waste in the containers (Section 1.3--Waste Disposal Containers). The waste containers are currently being developed, and their designs are not expected to be completed before the beginning of the repository advanced conceptual design activities. The closure methods and inspection procedures for the waste disposal containers will be selected following completion of the container design activities and selection of the material from which the waste containers will be fabricated.

It is recommended that a BFD and a set of RASs, similar to those developed for Chapter 4--Waste Preparation, be developed to identify the operations, facilities, and equipment required to encapsulate waste in containers fabricated from each candidate material. It is further recommended that conceptual designs be developed for the facilities required to house encapsulation activities.

This report encompasses only currently planned operations; it can, however, be used as a basis for future evaluations, such as the advantages of manned versus remote repository operations.

The third category concerns the development of methodologies to perform operational analysis. Time-line, equipment utilization, and

position-time diagrams were used in a manual approach to determine operational capabilities. This approach is satisfactory for cases that are well defined and require only a single solution. When multiple solutions for "what-if" analyses are required, computer-assisted methods are necessary. Such a method is currently being developed at Sandia National Laboratories and will be used in future operational analyses. This computer-aided analysis, REPSIMS (REpository SIMulation System), uses commercial software with additional graphical interface enhancement and special features that allow the impact of facility design changes to be evaluated rapidly. It is recommended that work continue on REPSIMS and that an operational analysis of the repository be developed using REPSIMS.

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APPENDIX A
REQUIREMENT ALLOCATION SHEETS

1.1 ADMIT SHIPMENT (Routine)

Tasks

- 1.1.1 Identify and admit the shipment through Security Station 3 and inspect the security seals.
- 1.1.2 Move the shipment to the admitting and inspection area.
- 1.1.3 Inspect and record the condition of the shipment.
- 1.1.4 Uncouple the rail engine from the railroad car or tractor from the truck trailer.
- 1.1.5 Move the rail engine or tractor off the repository site.

Equipment and Facility Requirements

Security Station 3 at Gate 3
Portal radiation monitor
Admitting and inspection area

Material Required

NA

Assumptions

- (1) The inspection at Security Station 3, Gate 3, consists of verifying that the shipment is scheduled for receipt at the repository by examining the bill of lading; inspecting security seals on the personnel barrier and recording their condition; and moving the vehicle, carrier, and shipment through a portal monitor to measure and record gross radiation levels.
- (2) Tasks 1.1.1 and 1.1.3 are performed by repository personnel.
- (3) Tasks 1.1.2, 1.1.4, and 1.1.5 are performed by commercial carrier personnel.

1.2 SURVEY AND INSPECT SHIPMENT (Routine)

Tasks

- 1.2.1 Inspect carrier and shipment for safety, radiological, or security problems.
- 1.2.2 Record safety, radiological, and security inspection tasks and results.
- 1.2.3 Based on the results of the inspections, transfer the shipment to the (1) interim storage area (1.7, routine); (2) wash station (1.3, nonroutine); or (3) impoundment area (1.5, nonroutine).

Equipment and Facility Requirements

Safety and security inspection equipment
Explosives-detecting equipment
Radiological survey instruments

Material Required

Contamination survey materials

Assumptions

- (1) Safety inspection consists of inspecting the shipment and carrier for safe operating condition. Radiological inspection consists of monitoring the exterior surfaces of the shipment and carrier to determine the level of transferrable contamination. Security inspection consists of inspecting the shipment's exterior surfaces to ensure that unauthorized personnel or materials are not admitted to the facility.
- (2) All tasks are performed by repository personnel.

1.3 TRANSFER SHIPMENT TO WASH STATION (Nonroutine)

Tasks

- 1.3.1 Couple the facility transfer vehicle and the carrier.
- 1.3.2 Move the carrier and shipment through Security Station 4 to the wash station.
- 1.3.3 Uncouple the transfer vehicle.
- 1.3.4 Record the transfer.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Security Station 4 at Gate 4

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.4 WASH CARRIER AND PERSONNEL BARRIER (Nonroutine)

Tasks

- 1.4.1 Wash the carrier and personnel barrier.
- 1.4.2 Collect and monitor the wash water in the storage tank before it is treated or disposed of and the carrier is released.
- 1.4.3 Record task and monitoring information.
- 1.4.4 Proceed to Operation 1.7.

Equipment and Facility Requirements

Vehicle wash station in surface waste operations area (Facility 215-2)
Laboratory in the WHB to monitor water samples
Waste treatment building for radiological waste
Sewage treatment facility for nonradiological waste

Material Required

Detergent and other supplies for wash station
Treated water
Laboratory equipment and supplies

Assumptions

- (1) The exposed surfaces of the carrier, including the undercarriage and the exterior surfaces of the personnel barrier, will be washed to remove accumulated road grime.
- (2) All tasks are performed remotely.

1.5 TRANSFER SHIPMENT TO IMPOUNDMENT AREA (Nonroutine)

Tasks

- 1.5.1 Couple the facility transfer vehicle and the carrier.
- 1.5.2 Move the shipment through Security Station 4 to the impoundment area.
- 1.5.3 Uncouple the transfer vehicle.
- 1.5.4 Record the transfer.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Security Station 4 at Gate 4
Impoundment area in the surface waste operations area

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.6 ADDRESS SAFETY, RADIOLOGICAL, OR SECURITY PROBLEM(S) (Nonroutine)

Tasks

- 1.6.1 Address the safety problem(s), as required, before the cask and shipment are removed from the carrier.
- 1.6.2 Address the radiological problem(s), as required, before the cask and shipment are removed from the carrier.
- 1.6.3 Address the security problem(s), as required, before the cask and shipment are removed from the carrier.
- 1.6.4 Record task(s) and resolution of the safety, radiological, and/or security problem(s).
- 1.6.5 Proceed to Operation 1.7.

Equipment and Facility Requirements

Impoundment area

Material Required

Replacement parts to correct safety problem
Decontamination supplies to contain radiological problem
Explosives disposal container for security problem

Assumptions

- (1) The impoundment area is a designated location in the surface waste operations area where safety, radiological, and security problems are addressed. The problem(s) identified during survey and inspection (Operation 1.2) will be addressed, and actions will be taken to resolve the problem(s).
- (2) All tasks are performed by repository personnel.

1.7 TRANSFER SHIPMENT TO INTERIM STORAGE AREA (Routine)

Tasks

- 1.7.1 Couple the facility transfer vehicle and the carrier (if required).
- 1.7.2 Move the carrier and shipment to the interim storage area.
- 1.7.3 Uncouple the transfer vehicle.
- 1.7.4 Record the transfer and availability of the shipment for preparation and unloading.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Interim storage area (railroad car and truck trailer)

Material Required

NA

Assumptions

- (1) The carrier and shipment from Operation 1.2 are moved through Security Station 4 at Gate 4. The shipment will remain in interim storage until scheduled for receiving and preparation.
- (2) All tasks are performed by repository personnel.

1.8 TRANSFER SHIPMENT TO WASTE-HANDLING BUILDING ENTRY BAY (Routine)

Tasks

- 1.8.1 Couple the facility transfer vehicle and the carrier.
- 1.8.2 Transfer the carrier and shipment from interim storage to the WHB.
- 1.8.3 Open the roll-up door to the entry bay.
- 1.8.4 Move the shipment into the entry bay.
- 1.8.5 Uncouple the transfer vehicle.
- 1.8.6 Move the transfer vehicle out of the entry bay.
- 1.8.7 Close the entry bay door.
- 1.8.8 Record the transfer and carrier identification.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Entry bay in waste-handling building
Roll-up door (SK-212-N-035, A through L)
Waste-handling building (Facility 212)

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.
- (2) The facility transfer vehicle will not remain coupled to the carrier while it is in the entry bay or the shipping and receiving bay of the WHB.

1.9 REMOVE PERSONNEL BARRIER AND IMPACT LIMITERS (Routine)

Tasks

- 1.9.1 Release the personnel barrier tie downs.
- 1.9.2 Pick up the personnel barrier handling fixture from the equipment storage area.
- 1.9.3 Attach the handling fixture to the lifting lugs on the personnel barrier.
- 1.9.4 Using the 5-ton bridge crane, lift and move the personnel barrier to the temporary storage area.
- 1.9.5 Return the personnel barrier handling fixture to the storage area.
- 1.9.6 Release the impact limiters.
- 1.9.7 Using the bridge crane, lift and move the first impact limiter to the temporary storage area.
- 1.9.8 Using the bridge crane, lift and move the second impact limiter to the temporary storage area.
- 1.9.9 Record the tasks and cask identification.

Equipment and Facility Requirements

5-ton bridge crane with robotic manipulator (SK-212-H-250, A and B)
Personnel barrier handling fixture (SK-212-H-253, A through F)
Equipment storage area for personnel barrier handling fixture
Temporary storage area for personnel barrier and two impact limiters
Entry bay

Material Required

NA

Assumptions

- (1) Lifting lugs are provided on the personnel barrier.
- (2) Lifting lugs are provided on the impact limiters.
- (3) All tasks are performed by repository personnel.

1.10 SURVEY CASK SURFACE AND SAMPLE GAS IN OUTER CAVITY (Routine)

Tasks

- 1.10.1 Using the robotic manipulator on the 5-ton bridge crane, pick up the smear tool and holder from the equipment storage area.
- 1.10.2 Survey the surface of the cask.
- 1.10.3 Transfer the smears to the smear counter and record the count.
- 1.10.4 Return the smear tool and holder to the storage area.
- 1.10.5 Connect the gas-sampling line to the sampling connection of the outer cavity on the shipping cask's outer cover.
- 1.10.6 Open the sampling valve.
- 1.10.7 Draw the sample and transfer it to the laboratory for analysis.
- 1.10.8 Close the valve.
- 1.10.9 Disconnect the sampling line from the connection on the shipping cask.
- 1.10.10 Analyze the gas sample.
- 1.10.11 Record results and tasks.

Equipment and Facility Requirements

5-ton bridge crane with robotic manipulator (SK-212-H-250, A and B)
Smear tool and holder with stand
Smear counter in entry bay area
Container for used smears
Equipment storage area for smear holder and tool
Cask gas-sampling and venting system in entry bay (SK-212-Q-003, A)

Material Required

Smear holder with smear papers
Laboratory equipment and supplies

1.10 SURVEY CASK SURFACE AND SAMPLE GAS IN OUTER CAVITY (Routine)
(Concluded)

Assumptions

- (1) The robotic manipulator on the 5-ton bridge crane will perform Tasks 1.10.1 through 1.10.4.
- (2) Tasks 1.10.5 through 1.10.9 are performed by repository personnel.
- (3) Tasks 1.10.5 through 1.10.10 are performed in parallel with the survey.
- (4) Steps 1.10.5 through 1.10 10 are not required for DHLW.
- (5) For personnel safety, the cask lid will be surveyed and the robotic equipment removed before gas sampling begins.
- (6) Outer cavity gases are sampled to identify and assess problem(s) and to perform corrective action(s).

1.11 TRANSFER CASK AND CARRIER TO RECEIVING AND SHIPPING BAY (Routine)

Tasks

- 1.11.1 Open the roll-up doors and move the facility transfer vehicle into the entry bay.
- 1.11.2 Couple the transfer vehicle and the carrier.
- 1.11.3 Move the carrier and cask into the receiving and shipping bay.
- 1.11.4 Uncouple the transfer vehicle.
- 1.11.5 Move the transfer vehicle out of the WHB and close the roll-up doors.
- 1.11.6 Record the transfer.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Receiving and shipping bay

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.12 REMOVE CASK FROM CARRIER (Routine)

Tasks

- 1.12.1 Release the cask tie-down fixtures and remove them to the temporary storage area.
- 1.12.2 Select a lifting yoke and attach it to the cask trunnions.
- 1.12.3 Raise the cask to the vertical position with the 125/25-ton bridge crane.
- 1.12.4 Using the bridge crane, lift the cask off the carrier.
- 1.12.5 Based on the results of the survey (1.10, routine), transfer the cask to (1) the cask preparation area (1.14, routine) or (2) the cask decontamination station (1.13, nonroutine).

Equipment and Facility Requirements

Temporary storage area for cask tie downs
125/25-ton bridge crane (SK-212-H-027, A through C)
Cask-lifting yoke, rail (SK-212-H-017, A and B)
Cask-lifting yoke, truck (SK-212-H-010, A through C)
Yoke storage rack (SK-212-S-252, A through E)

Material Required

NA

Assumptions

- (1) The bridge crane is manually controlled.
- (2) The lift is limited to the minimum space required for the cask to clear the carrier.
- (3) The exposure of the crane operator will be limited by the location of and/or shielding on the control cab.
- (4) All tasks are performed by repository personnel.

1.13 TRANSFER CASK TO DECONTAMINATION STATION AND DECONTAMINATE (Nonroutine)

Tasks

- 1.13.1 Using the 125/25-ton bridge crane, transfer the cask to the decontamination station.
- 1.13.2 Record the transfer.
- 1.13.3 Disconnect the yoke from the cask trunnions and move it to the temporary storage area.
- 1.13.4 Decontaminate the cask.
- 1.13.5 Lift the yoke from the storage area and connect it to the cask trunnions.
- 1.13.6 Lift the cask with the crane.
- 1.13.7 Record the tasks.
- 1.13.8 Proceed to Operation 1.14.

Equipment and Facility Requirements

125/25-ton bridge crane (SK-212-H-027, A through C)
Cask-lifting yoke, rail (SK-212-H-017, A and B)
Cask-lifting yoke, truck (SK-212-H-010, A through C)
Temporary storage area for lifting yokes
Cask decontamination station (SK-212-Q-006, A and B)
Decontamination station platform (SK-212-S-021, A and B)

Material Required

Decontamination supplies

Assumptions

- (1) The cask is decontaminated using a liquid high-pressure spray.
- (2) Decontamination (Task 1.13.4) is performed remotely.
- (3) All other tasks are performed by repository personnel.

1.14 TRANSFER CASK TO PREPARATION AREA (Routine)

Tasks

- 1.14.1 Using the 125/25-ton bridge crane, transfer the cask to the preparation area.
- 1.14.2 Position and secure the cask on the cask transfer car.
- 1.14.3 Disconnect the yoke from the cask trunnions and move it to the temporary storage area.
- 1.14.4 Record the transfer and operations.
- 1.14.5 Based on the outer cavity sampling (Operation 1.10, routine),
 - (1) remove the outer cover (Operation 1.16, routine) or
 - (2) purge the outer cavity (Operation 1.15, nonroutine).

Equipment and Facility Requirements

125/25-ton bridge crane (SK-212-H-027, A through C)
Cask-lifting yoke, rail (SK-212-H-017, A and B)
Cask-lifting yoke, truck (SK-212-H-010, A through C)
Temporary storage area for lifting yokes
Cask transfer car with drive (SK-212-S-015, A through L)
Cask preparation area

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.15 PURGE OUTER CAVITY GASES (Nonroutine)

Tasks

- 1.15.1 Connect the gas-venting line to the cask.
- 1.15.2 Open the venting valve.
- 1.15.3 Purge the outer cavity.
- 1.15.4 Close the valve.
- 1.15.5 Disconnect the venting line from the cask.
- 1.15.6 Record the tasks.
- 1.15.7 Proceed to Operation 1.16.

Equipment and Facility Requirements

Cask gas-sampling and venting system (SK-212-Q-003, B)

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.16 UNSCREW BOLTS AND REMOVE OUTER COVER OF CASK (Routine)

Tasks

- 1.16.1 Attach the lifting fixture to the outer cover of the cask.
- 1.16.2 Unscrew the captive bolts of the outer cover.
- 1.16.3 Lift the outer cover and store it on the adjacent platform.

Equipment and Facility Requirements

Outer cover lifting fixture
Equipment storage area for lifting fixture
Floor-mounted robot (SK-212-R-250, A through F)
Temporary storage platform for outer cover of cask (SK-212-S-020)
2.5-ton wall-mounted traveling jib crane (SK-212-H-251, A and B)

Material Required

NA

Assumptions

- (1) All tasks are performed remotely by floor-mounted robots.
- (2) Lifting fixture, an adapter for lid removal in the hot cell, will be provided by the cask manufacturer.

1.17 SURVEY SURFACE OF CASK OUTER CAVITY AND SAMPLE GAS IN INNER CAVITY (Routine)

Tasks

- 1.17.1 Using a robot, pick up the smear holder and tool from the equipment storage area.
- 1.17.2 Survey the outer cavity of the cask.
- 1.17.3 Transfer the smears to the smear counter and record the count.
- 1.17.4 Return the smear holder and tool to the storage area.
- 1.17.5 Connect the gas-sampling line to the sampling connection of the shipping cask's inner cavity.
- 1.17.6 Open the sampling valve.
- 1.17.7 Draw the sample and transfer it to the laboratory for analysis.
- 1.17.8 Close the valve.
- 1.17.9 Disconnect the sampling line from the shipping cask.
- 1.17.10 Analyze the gas sample.
- 1.17.11 Record the results and tasks.
- 1.17.12 Based on the results of the survey and sampling, (1) unscrew the inner lid bolts (Operation 1.19, routine) or (2) decontaminate the outer cavity and/or purge inner cavity (Operation 1.18, nonroutine).

Equipment and Facility Requirements

Floor-mounted robot (SK-212-R-250, A through F)
Smear holder and tool with stand
Smear counter in cask preparation area
Container for used smears
Equipment storage area for smear holder and tool
Cask gas-sampling and venting system (SK-212-Q-003, B)

Material Required

Smear holder with smear papers
Laboratory equipment and supplies

1.17 SURVEY SURFACE OF CASK OUTER CAVITY AND SAMPLE GAS IN INNER CAVITY
(Routine) (concluded)

Assumptions

- (1) Tasks 1.17.1 through 1.17.4 are performed remotely by floor-mounted robots.
- (2) Tasks 1.17.5 through 1.17.10 are performed by repository personnel.
- (3) Tasks 1.17.5 through 1.17.10 are not required for DHLW.

1.18 DECONTAMINATE OUTER CAVITY SURFACES AND PURGE INNER CAVITY GASES (Nonroutine)

Tasks

- 1.18.1 Decontaminate the top of the inner cover, the surface of the outer cavity, and the exterior surfaces of the cask, if required.
- 1.18.2 Dispose of the used decontamination materials.
- 1.18.3 Connect the gas-venting line to the cask.
- 1.18.4 Open the venting valve.
- 1.18.5 Purge the inner cavity.
- 1.18.6 Close the valve.
- 1.18.7 Disconnect the venting line from the cask.
- 1.18.8 Record the tasks.
- 1.18.9 Proceed to Operation 1.19.

Equipment and Facility Requirements

Container for unused decontamination materials
Container for used decontamination materials
Equipment storage area for cleaning materials
Cask gas-sampling and venting system (SK-212-Q-003, B)
Cask preparation area

Material Required

Decontamination materials

Assumptions

- (1) All tasks are performed by repository personnel.
- (2) Inner cavity gas will be purged based on volume and time.

1.19 UNSCREW BOLTS OF INNER LID (Routine)

Tasks

1.19.1 Unscrew the captive bolts of the inner lid.

Equipment and Facility Requirements

Floor-mounted robot (SK-212-R-250, A through F)

Material Required

NA

Assumptions

(1) All tasks are performed remotely by the floor-mounted robot.

1.20 INSTALL CASK-TO-HOT-CELL SEAL ADAPTER (Routine)

Tasks

- 1.20.1 Select a lifting fixture and attach it to a 2.5-ton jib crane.
- 1.20.2 Lift the cask-to-hot-cell seal adapter and move it to the cask.
- 1.20.3 Install the cask seal adapter.
- 1.20.4 Disconnect the lifting fixture from the cask seal adapter and return the fixture to the storage area.
- 1.20.5 Connect the cask seal adapter activation system to the control system on the transfer car.

Equipment and Facility Requirements

2.5-ton wall-mounted traveling jib crane (SK-212-H-251, A and B)
Adapter lifting fixture, rail cask (SK-212-H-254, A and B)
Adapter lifting fixture, truck cask (SK-212-H-255, A and B)
Cask-to-hot-cell seal adapters, rail cask/truck cask (SK-212-N-008, A through L)
Equipment storage area for lifting fixtures, cask seal adapters, and activation system
Cask transfer car with drive (SK-212-S-015, A through L)
Cask seal adapter activation system

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.
- (2) The cask-to-hot-cell seal adapters will be available for all types of casks received at the repository.

1.21 TRANSFER CASK TO HOT CELL (Routine)

Tasks

- 1.21.1 Open the shield-ventilation door on the cask transfer tunnel.
- 1.21.2 Move the cask transfer car under the hot cell port.
- 1.21.3 Close the shield-ventilation door.
- 1.21.4 Activate the seal adapter to seal the cask to the hot cell port.
- 1.21.5 Record the transfer and tasks.

Equipment and Facility Requirements

Cask transfer car with drive (SK-212-S-015, A through L)
Shield-ventilation door with drive (SK-212-N-007, A through L)
Cask transfer tunnel
Cask-to-hot-cell seal adapter (SK-212-N-008, A through L)
Hot cell port

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

1.22 REMOVE INNER LID OF CASK (Routine)

Tasks

- 1.22.1 Using the 20-ton bridge crane, pick up the removal fixture for the hot cell shield plug.
- 1.22.2 Attach the fixture to the shield plug and remove the plug to open the hot cell port.
- 1.22.3 Place the plug in a temporary storage area.
- 1.22.4 Using the bridge crane, pick up the lifting fixture for the inner lid of the cask.
- 1.22.5 Attach the fixture to the inner lid and remove the lid and spacers placing them in a temporary storage area.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A through D)
Hot cell shield plug (SK-212-N-010, A through L)
Removal fixture for the hot cell shield plug (SK-212-H-032, A through L)
Inner lid
Equipment storage area for the fixture that removes the hot cell shield plug and for the inner lid lifting fixture
Temporary equipment storage area for the shield plug and the inner lid and spacers
Unloading Hot Cells A and B

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.
- (2) The spacers, if present, are attached to the inner lid.

1.23 UNLOAD, INSPECT, AND PLACE WASTE IN STORAGE RACK (Routine)

Tasks

- 1.23.1 Select a fuel-handling tool for spent fuel assemblies or a canister grapple for a DHLW canister and attach it to the 20-ton bridge crane.
- 1.23.2 Move the bridge crane to the unloading port and lift the fuel or canister into the hot cell.
- 1.23.3 Visually inspect the fuel or canister.
- 1.23.4 Record the identification number(s).
- 1.23.5 Transfer the fuel or canister to the storage rack in the unloading hot cell.
- 1.23.6 Store the tool or grapple.
- 1.23.7 Proceed to Operation 2.0 to continue waste handling.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A through D)
Rotating load block (SK-212-H-030, A through D)
Fuel-handling tools with stand (Hot Cell B, SK-212-H-046, A through R)
Canister/container grapple (Hot Cell A, SK-212-H-031, A through D)
Equipment storage area for fuel-handling tools and grapple
Remote viewing system--television camera and light source (SK-212-V-005, A through K)
Fuel storage rack (SK-212-S-250, A and B)
Canister storage rack (SK-212-S-096)
Fuel inspection station (SK-212-S-018, A and B)
Canister inspection station (SK-212-S-203)

Material Required

NA

Assumptions

- (1) Waste will be packaged for disposal in an "as received" condition.
- (2) All tasks are performed remotely.

1.24 INSPECT CAVITY OF EMPTY CASK (Routine)

Tasks

- 1.24.1 Using the robotic manipulator on the bridge crane, pick up the cask viewing system.
- 1.24.2 Visually inspect the cavity of the cask to verify that the fuel or canister has been removed.
- 1.24.3 Return the viewing system to the storage area.
- 1.24.4 Record the operations.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A through D)
Remote viewing system--television camera and light source (SK-212-V-005, A through K)
Equipment storage area for viewing system

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

1.25 REPLACE INNER LID OF CASK (Routine)

Tasks

- 1.25.1 Using the 20-ton bridge crane, lift the lid from the temporary storage area and replace the inner lid and spacers on the cask.
- 1.25.2 Disconnect the lifting fixture from the lid.
- 1.25.3 Using the bridge crane, return the lifting fixture to the storage area.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A through D)
Rotating load block (SK-212-H-030, A through D)
Inner lid lifting fixture

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

1.26 TRANSFER EMPTY CASK TO PREPARATION AREA (Routine)

Tasks

- 1.26.1 Using the 20-ton bridge crane, replace the hot cell shield plug in the hot cell port.
- 1.26.2 Return the removal fixture to the storage area.
- 1.26.3 Deactivate the seal between the cask seal adapter and the hot cell port.
- 1.26.4 Open the shield-ventilation door.
- 1.26.5 Transfer the cask transfer car and empty cask to the preparation area.
- 1.26.6 Close the shield-ventilation door.
- 1.26.7 Record the operation.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A through D)
Hot cell shield plug (SK-212-N-010, A through L)
Plug removal fixture (SK-212-H-032, A through L)
Cask transfer car with drive (SK-212-S-015, A through L)
Shield-ventilation door with drive (SK-212-N-007, A through L)
Hot cell port
Hot Cells A and B and cask preparation area

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

1.27 REMOVE ADAPTER, TIGHTEN INNER LID BOLTS, AND SURVEY EMPTY CASK
(Routine)

Tasks

- 1.27.1 Select a lifting fixture and attach it to the cask seal adapter.
- 1.27.2 Using the jib crane, remove the cask seal adapter and transfer it to the decontamination area.
- 1.27.3 Tighten the captive bolts of the inner lid.
- 1.27.4 Pick up the smear holder and tool.
- 1.27.5 Survey the top of the inner lid, the outer cavity, and the exterior surfaces of the cask.
- 1.27.6 Transfer the smears to the smear counter and record the count.
- 1.27.7 Based on the results of the survey, (1) replace the cask outer cover (Operation 1.29, routine) or (2) decontaminate the outer cavity (Operation 1.28, nonroutine).

Equipment and Facility Requirements

2.5-ton wall-mounted traveling jib crane (SK-212-H-251)
Adapter lifting fixture, rail (SK-212-H-254, A and B)
Adapter lifting fixture, truck (SK-212-H-255, A and B)
Smear holder and tool with stand
Smear counter in cask preparation area
Container for used smears
Equipment storage area for smear holder and tool
Cask preparation area
Floor-mounted robot (SK-212-R-250, A through F)

Material Required

Smear holder with smear papers

Assumptions

- (1) Tasks 1.27.1 and 1.27.2 are performed by repository personnel.
- (2) Tasks 1.27.3 through 1.27.6 are performed remotely.
- (3) Surveying the exterior surface for contamination is done in parallel with other operations listed above and for Operation 1.28.

1.28 DECONTAMINATE OUTER CAVITY OF EMPTY CASK (Nonroutine)

Tasks

- 1.28.1 Clean the top of the inner lid, the outer cavity, and the exterior surfaces of the cask, as required.
- 1.28.2 Dispose of the used cleaning materials.
- 1.28.3 Record the tasks.
- 1.28.4 Proceed to Operation 1.29.

Equipment and Facility Requirements

Container for unused cleaning materials
Container for used cleaning materials

Material Required

Decontamination materials

Assumptions

- (1) All tasks are performed by repository personnel.

1.29 REPLACE OUTER COVER OF CASK (Routine)

Tasks

- 1.29.1 Pick up the outer cover from the storage platform.
- 1.29.2 Replace the outer cover on the cask.
- 1.29.3 Tighten the captive bolts of the outer cover.
- 1.29.4 Remove the outer cover lifting fixture and return the fixture to the storage area.
- 1.29.5 Select the lifting yoke from the temporary storage area and attach it to the upper cask trunnions.
- 1.29.6 Release the cask from the cask transfer car.
- 1.29.7 Using the 125/25-ton bridge crane, lift the cask off the cask transfer car.
- 1.29.8 Record the tasks.
- 1.29.9 Based on the results of the survey (Operation 1.27, routine), transfer the cask to the (1) receiving and shipping area (Operation 1.31, routine) or (2) decontamination station (Operation 1.30, nonroutine).

Equipment and Facility Requirements

125/25-ton bridge crane (SK-212-H-027, A through C)
Floor-mounted robot (SK-212-R-250, A through F)
Outer cover lifting fixture
Equipment storage area for lifting fixture
Cask preparation area
Cask lifting yoke, rail (SK-212-H-017, A and B)
Cask lifting yoke, truck (SK-212-H-010, A through C)

Material Required

NA

Assumptions

- (1) Tasks 1.29.1 through 1.29.4 are performed remotely.
- (2) Tasks 1.29.5 through 1.29.7 are performed by repository personnel.

1.30 TRANSFER EMPTY CASK TO DECONTAMINATION STATION AND DECONTAMINATE
(Nonroutine)

Tasks

- 1.30.1 Using the 125/25-ton bridge crane, transfer the cask to the decontamination station.
- 1.30.2 Disconnect the yoke from the cask trunnions and move it to the temporary storage area.
- 1.30.3 Decontaminate the cask.
- 1.30.4 Lift the yoke from the storage area and connect it to the cask trunnions.
- 1.30.5 Record the transfer and tasks.
- 1.30.6 Proceed to Operation 1.31.

Equipment and Facility Requirements

125/25-ton bridge crane (SK-212-H-027, A through C)
Cask lifting yoke, rail (SK-212-H-017, A and B)
Cask lifting yoke, truck (SK-212-H-010, A through C)
Temporary storage area for lifting yokes
Cask decontamination station (SK-212-Q-006, A and B)
Decontamination spray equipment (SK-212-Q-002, A and B)

Material Required

Decontamination liquid and supplies

Assumptions

- (1) Task 1.30.3 is performed remotely.
- (2) All other tasks are performed by repository personnel.

1.31 TRANSFER EMPTY CASK TO RECEIVING AND SHIPPING BAY (Routine)

Tasks

- 1.31.1 Certify that the cask meets Department of Transportation (DOT) regulations for offsite shipment. Record certification and cask identification.
- 1.31.2 Using the bridge crane, transfer the cask to the receiving and shipping bay.
- 1.31.3 Record the transfer and tasks.

Equipment and Facility Requirements

125/25-ton bridge crane (SK-212-H-027, A through C)
Cask lifting yoke, rail (SK-212-H-017, A and B)
Cask lifting yoke, truck (SK-212-H-010, A through C)
Cask transfer car with drive (SK-212-S-015, A through L)
Receiving and shipping bay

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.32 PLACE EMPTY CASK ON CARRIER (Routine)

Tasks

- 1.32.1 Using the 125/25-ton bridge crane, lower the empty cask onto the cradle of the carrier.
- 1.32.2 Disconnect the yoke from the cask trunnions and return it to the storage area.
- 1.32.3 Replace and tighten the cask tie downs.
- 1.32.4 Record the tasks.

Equipment and Facility Requirements

125/25-ton bridge crane (SK-212-H-027, A and C)
Cask lifting yoke, rail (SK-212-H-017, A and B)
Cask lifting yoke, truck (SK-212-H-010, A)
Equipment storage area for lifting yokes (SK-212-S-252, A through E)
Receiving and shipping bay

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.33 TRANSFER EMPTY CASK AND CARRIER TO ENTRY BAY (Routine)

Tasks

- 1.33.1 Open the roll-up doors and move the facility transfer vehicle into the receiving and shipping area.
- 1.33.2 Couple the facility transfer vehicle and the carrier.
- 1.33.3 Transfer the empty cask from the receiving and shipping area to the entry bay.
- 1.33.4 Uncouple the transfer vehicle, move it out of the WHB, and close the roll-up doors.
- 1.33.5 Record the transfer and tasks.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)

Material Required

NA

Assumptions

- (1) The facility transfer vehicle will not remain coupled to the carrier while it is in the shipping and receiving bay or the entry bay of the WHB.

1.34 REPLACE PERSONNEL BARRIER AND IMPACT LIMITERS (Routine)

Tasks

- 1.34.1 Using the 5-ton bridge crane, lift the first impact limiter from the temporary storage area and replace it on the cask.
- 1.34.2 Using the bridge crane, lift the second impact limiter from the temporary storage area and replace it on the cask.
- 1.34.3 Using the bridge crane, pick up the personnel barrier handling fixture from the equipment storage area.
- 1.34.4 Attach the handling fixture to the lifting lugs on the personnel barrier.
- 1.34.5 Using the bridge crane, lift and move the personnel barrier from the temporary storage area and replace it on the carrier.
- 1.34.6 Return the personnel barrier handling fixture to the storage area.
- 1.34.7 Secure the personnel barrier tie downs.
- 1.34.8 Record the tasks and carrier identification.

Equipment and Facility Requirements

5-ton bridge crane with robotic manipulator (SK-212-H-250, A and B)
Personnel barrier handling fixture (SK-212-H-253, A through F)
Temporary storage area for personnel barrier and two impact limiters
Equipment storage area for personnel barrier handling fixture
Entry bay

Material Required

NA

Assumptions

- (1) Lifting lugs are provided on the impact limiters.
- (2) Lifting lugs are provided on the personnel barrier.
- (3) All tasks are performed by repository personnel.

1.35 TRANSFER EMPTY CASK AND CARRIER TO INTERIM STORAGE (Routine)

Tasks

- 1.35.1 Open the roll-up doors and move the facility transfer vehicle into the entry bay.
- 1.35.2 Couple the transfer vehicle and the carrier.
- 1.35.3 Transfer the empty cask and carrier to interim storage.
- 1.35.4 Uncouple the facility transfer vehicle and the carrier.
- 1.35.5 Report that the cask and carrier are ready for transfer to the admitting and inspection area.
- 1.35.6 Record the transfer and confirm carrier identification.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Interim storage area

Material Required

NA

Assumptions

- (1) The cask and carrier will remain in interim storage until scheduled for shipment offsite.
- (2) All tasks are performed by repository personnel.

1.36 TRANSFER EMPTY CASK AND CARRIER TO ADMITTING AND INSPECTION AREA
(Routine)

Tasks

- 1.36.1 Couple the facility transfer vehicle and the carrier.
- 1.36.2 Move the empty cask and carrier through Security Station 4 to the admitting and inspection area.
- 1.36.3 Uncouple the transfer vehicle.
- 1.36.4 Report that the cask and carrier are ready for survey and final inspection.
- 1.36.5 Record the transfer and confirm carrier identification.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Admitting (release) and inspection area
Security Station 4 at Gate 4

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.37 SURVEY AND INSPECT EMPTY CASK AND CARRIER (Routine)

Tasks

- 1.37.1 Inspect empty cask and carrier for safety, radiological, and/or security problems in accordance with current guidance and regulations governing shipments of empty casks.
- 1.37.2 Record safety, radiological, and security inspection tasks and results.
- 1.37.3 Based on the results of the inspections, (1) release the empty cask and carrier offsite (1.40, routine) or (2) transfer the empty cask and carrier to the impoundment area (1.38, nonroutine).

Equipment and Facility Requirements

Safety and security inspection equipment
Radiological survey instruments
Admitting (release) and inspection area
Security Station 3 at Gate 3

Material Required

Contamination survey materials

Assumptions

- (1) Safety inspection consists of inspecting the empty cask and carrier to ensure compliance with DOT regulations. Radiological inspection consists of monitoring the exterior surfaces of the cask and carrier to determine the level of transferrable contamination. Security inspection consists of confirming that the seals on the personnel barrier are activated.
- (2) All tasks are performed by repository personnel.

1.38 TRANSFER EMPTY CASK AND CARRIER TO IMPOUNDMENT AREA (Nonroutine)

Tasks

- 1.38.1 Couple the facility transfer vehicle and the carrier.
- 1.38.2 Move the empty cask and carrier through Security Station 4 to the impoundment area.
- 1.38.3 Uncouple the transfer vehicle.
- 1.38.4 Record the transfer.

Equipment and Facility Requirements

Facility transfer vehicle (SK-212-S-014, A through D)
Security Station 4 at Gate 4
Impoundment area in the surface waste operations area

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

1.39 ADDRESS SURVEY OR INSPECTION PROBLEM(S) (Nonroutine)

Tasks

- 1.39.1 Address the safety problem(s), as required, before the empty cask and carrier are released.
- 1.39.2 Address the radiological problem(s), as required, before the empty cask and carrier are released.
- 1.39.3 Address the security problem(s), as required, before the empty cask and carrier are released.
- 1.39.4 Record task(s) and resolution of the safety, radiological, and/or security problem(s).
- 1.39.5 Proceed to Operation 1.36.

Equipment and Facility Requirements

Impoundment area

Material Required

Replacement parts to correct safety problem
Decontamination supplies to correct radiological problem
Replacement parts to correct security problem

Assumptions

- (1) The impoundment area is a designated location in the surface waste operations area where safety, radiological, and security problems are addressed. The problem(s) identified during the survey and inspection (Operation 1.37) will be addressed, and actions will be taken to resolve the problem(s).
- (2) All tasks are performed by repository personnel.

1.40 RELEASE EMPTY CASK AND CARRIER OFFSITE (Routine)

Tasks

- 1.40.1 Couple the commercial vehicle and the carrier.
- 1.40.2 Move the commercial carrier and empty cask through the portal of Security Station 3.
- 1.40.3 Record the condition and identification of the carrier and empty cask and issue the bill of lading.
- 1.40.4 Release the empty cask and carrier offsite through Gate 3.

Equipment and Facility Requirements

Security Station 3 at Gate 3
Portal radiation monitor
Admitting (release) and inspection area
Carrier (railroad car or truck trailer)
Commercial vehicle (rail engine or truck)
Empty cask

Material Required

NA

Assumptions

- (1) The release of the empty cask and carrier offsite through Gate 3 consists of verifying that the empty cask is scheduled for release, inspecting security seals on the personnel barrier, moving the vehicle and carrier through a portal monitor measure gross radiation levels, recording vehicle and carrier condition and identification, and issuing a bill of lading.
- (2) All tasks are performed by repository personnel.

2.1 PLACE WASTE IN CONTAINER AT WELD STATION (Routine)

Tasks

- 2.1.1 Move the empty disposal containers into the hot cell on the empty container transfer car and place a container in each weld station.
- 2.1.2 Move the container covers into the hot cell.
- 2.1.3 Load the fuel or canister directly from the storage rack into the container in the weld station.
- 2.1.4 Place the cover on the container.
- 2.1.5 Record the tasks and the container identification.

Equipment and Facility Requirements

Empty container-handling fixture (SK-212-H-018, A through C)
Empty container transfer monorail (SK-212-H-042)
Monorail system with 1-ton hoist (SK-212-H-043)
20-ton bridge crane with robotic manipulator (SK-212-H-012, A through D)
Unloading Hot Cells A and B
DHLW canister storage rack (Hot Cell A, SK-212-S-096)
Fuel storage rack (Hot Cell B, SK-212-S-250, A and B)
Empty container transfer car (SK-212-S-016, A through C)
Fuel-handling tools (SK-212-H-046, A through R)
Container grapple (SK-212-H-031, A through D)
Container transfer lock shield valve (SK-212-N-045, A through C)
Weld station (SK-212-S-088, A through C)

Material Required

Disposal containers and container covers

Assumptions

- (1) All tasks are performed remotely.
- (2) The 20-ton bridge crane in the hot cell has machine vision capability and programmable positioning. The crane control system is to be integrated with the computer inventory and control system to transfer waste from a predetermined storage location to a predetermined container location.
- (3) All hot cell equipment is capable of disassembly by remote methods for removal, repair, and replacement.

2.2 WELD COVER TO CONTAINER (Routine)

Tasks

- 2.2.1 Prepare the container for welding.
- 2.2.2 Weld the cover to the container.
- 2.2.3 Visually inspect the weld using a remote viewing system.
- 2.2.4 Record container identification.

Equipment and Facility Requirements

Weld station (SK-212-S-088, A through C)
Remote viewing system (SK-212-V-005, A through K)
Unloading Hot Cells A and B

Material Required

Welding materials

Assumptions

- (1) All tasks are performed remotely.
- (2) The weld station includes a welder that is both automatic and remotely operable. It must be possible to decontaminate welder components and replace them remotely.

2.3 TRANSFER CONTAINER TO LEAK TEST STATION (Spent Fuel Only--Routine)

Tasks

- 2.3.1 Open the chamber in the leak test station.
- 2.3.2 Lower the grapple and attach it to the container pintle.
- 2.3.3 Pick up, transfer, and lower the container into the chamber in the leak test station.
- 2.3.4 Record the transfer.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012 C)
Container grapple (SK-212-H-031, A through C)
Leak test station (SK-212-S-039, A and B)
Unloading Hot Cell B

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

2.4 PERFORM LEAK TEST (Spent Fuel Only--Routine)

Tasks

- 2.4.1 Close the chamber in the leak test station.
- 2.4.2 Evacuate the leak test chamber.
- 2.4.3 Monitor the leak test chamber to determine whether the container leaks.
- 2.4.4 Return the leak test chamber to ambient pressure.
- 2.4.5 Open the chamber.
- 2.4.6 Record the results, tasks, and container identification.

Equipment and Facility Requirements

Leak test station (SK-212-S-039, A and B)
Unloading Hot Cell B
Remote viewing system (SK-212-V-005, A through K)

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.
- (2) It must be possible to decontaminate leak test station components and replace them remotely.
- (3) Leak test chamber instrumentation will be able to detect chamber leaks as well as container leaks.

2.5 TRANSFER CONTAINER TO WELD INSPECTION STATION (Routine)

Tasks

- 2.5.1 Lower the grapple and attach it to the container pintle.
- 2.5.2 Lift the container with the grapple and transfer it to the weld inspection station.
- 2.5.3 Record the transfer.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A and C)
Remote viewing system (SK-212-V-005, A through K)
Container grapple (SK-212-H-031, A and C)
Weld inspection station (SK-212-S-202, A through D)
Unloading Hot Cells A and B

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

2.6 INSPECT WELD (Routine)

Tasks

- 2.6.1 Perform nondestructive inspection of the weld.
- 2.6.2 Record the results, tasks, and container identification.
- 2.6.3 Based on the results of the inspection, (1) transfer the container to the decontamination station (Operation 2.9, routine) or (2) return the container to weld station (Operation 2.7, nonroutine).

Equipment and Facility Requirements

Rotating load block (SK-212-H-030, A and C)
Remote viewing system (SK-212-V-005, A through K)
Container grapple (SK-212-H-031, A and C)
Weld inspection station (SK-212-S-202, A through D)
Unloading Hot Cells A and B

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

2.7 RETURN CONTAINER TO WELD STATION (Nonroutine)

Tasks

2.7.1 Lift and return the container to the weld station.

2.7.2 Record the return.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A and C)

Rotating load block (SK-212-H-030, A and C)

Container grapple (SK-212-H-031, A and C)

Weld station (SK-212-H-088, A through D)

Unloading Hot Cells A and B

Material Required

NA

Assumptions

(1) All tasks are performed remotely.

2.8 PREPARE FOR REWELD (Nonroutine)

Tasks

2.8.1 Prepare the container for reweld.

2.8.2 Record the task.

2.8.3 Proceed to Operation 2.2.

Equipment and Facility Requirements

Master/slave manipulator (SK-212-R-002; B, D, and E)
20-ton bridge crane with robotic manipulator (SK-212-H-012, A and C)
Rotating load block (SK-212-H-030, A and C)
Container grapple (SK-212-H-031, A and C)
Weld inspection stations
Weld station (SK-212-S-088, A through C)
Unloading Hot Cells A and B

Material Required

NA

Assumptions

(1) All tasks are performed remotely.

2.9 TRANSFER CONTAINER TO DECONTAMINATION STATION (Routine)

Tasks

- 2.9.1 Lift the container and transfer it to the container decontamination station.
- 2.9.2 Open the shield valve to the decontamination station.
- 2.9.3 Open the decontamination chamber.
- 2.9.4 Lower the container into the decontamination chamber.
- 2.9.5 Close the decontamination chamber.
- 2.9.6 Close the shield valve.
- 2.9.7 Record the transfer.

Equipment and Facility Requirements

20-ton bridge crane with robotic manipulator (SK-212-H-012, A and C)
Container grapple (SK-212-H-031, A and C)
Shield valve with drive (SK-212-N-202, A through C)
Container decontamination station (SK-212-Q-005, A through C)
Unloading Hot Cells A and B and inspection air locks

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

2.10 DECONTAMINATE CONTAINER (Routine)

Tasks

2.10.1 Decontaminate the container.

2.10.2 Record the operation.

Equipment and Facility Requirements

Container decontamination station (SK-212-Q-005, A through C)

Water collection system for decontamination station (SK-212-T-002, A through C)

Unloading Hot Cells A and B and inspection air locks

Material Required

Decontamination liquid and supplies

Assumptions

(1) All tasks are performed remotely.

2.11 TRANSFER CONTAINER TO INSPECTION HOT CELL (Routine)

Tasks

- 2.11.1 Move the rail-mounted container decontamination station to the inspection hot cell port.
- 2.11.2 Open the shield valve over the inspection hot cell port.
- 2.11.3 Open the decontamination chamber.
- 2.11.4 Lift the container into the inspection hot cell.
- 2.11.5 Move the container to the inspection station.
- 2.11.6 Close the shield valve.
- 2.11.7 Record the transfer.

Equipment and Facility Requirements

Container decontamination station (SK-212-Q-005, A through C)
Container decontamination air lock and shield valve with drive (SK-212-N-202, D through F)
5-ton bridge crane with robotic manipulator (SK-212-H-200, A and B)
Container grapple (SK-212-H-202, A and B)
Unloading Hot Cells A and B and inspection air lock

Material Required

NA

Assumptions

- (1) The rail-mounted decontamination station and motorized shield valves will have an independent back-up drive.
- (2) The operation of the two shield valves in the inspection hot cell is interlocked with the operation of the two shield valves in the transfer bay in the storage vault, which ensures that both valves in one area will be closed before either of the valves in the other area is opened.
- (3) The decontamination station carries both supply and collection systems for decontamination liquids.
- (4) All tasks are performed remotely.

2.12 SURVEY CONTAINER (Routine)

Tasks

- 2.12.1 Using the wall-mounted master/slave manipulator, pick up the smear holder and tool from the equipment storage area.
- 2.12.2 Rotate the container suspended from the bridge crane.
- 2.12.3 Survey the surface of the container while it rotates.
- 2.12.4 Transfer the smears to the smear counter and record count.
- 2.12.5 Return the smear holder and tool to storage area.
- 2.12.6 Record the results and tasks.
- 2.12.7 Based on the survey, (1) place the container on the transfer car (Operation 2.14, routine) or (2) transfer the container to the decontamination station (Operation 2.13, nonroutine).

Equipment and Facility Requirements

Master/slave manipulator (SK-212-R-002, A through G)
5-ton bridge crane with robotic manipulator (SK-212-H-200, A and B)
Rotating load block (SK-212-H-201, A and B)
Transfer drawer (SK-212-N-201, A through C)
Smear holder and tool with stand
Smear counter
Container for used smears
Equipment storage area for smear holder and tool
Inspection Hot Cells A and B and container inspection station (SK-212-S-201, A through C)

Material Required

Smear holder with smear paper

Assumptions

- (1) All tasks are performed remotely.
- (2) Smears will be collected individually in a uniform sequential manner.

2.13 TRANSFER CONTAINER TO DECONTAMINATION STATION (Nonroutine)

Tasks

- 2.13.1 Open the shield valve to the decontamination station.
- 2.13.2 Open the decontamination chamber.
- 2.13.3 Using the 5-ton bridge crane, move the container to the decontamination chamber.
- 2.13.4 Lower the container into the decontamination chamber.
- 2.13.5 Close the decontamination chamber.
- 2.13.6 Close the shield valve.
- 2.13.7 Record the transfer.
- 2.13.8 Proceed to Operation 2.10.

Equipment and Facility Requirements

5-ton bridge crane with robotic manipulator (SK-212-H-200, A and B)
Container grapple (SK-212-H-202, A and B)
Container decontamination air lock and shield valve with drive (SK-212-N-202, D through F)
Container decontamination station (SK-212-Q-005, A through C)
Unloading Hot Cells A and B and inspection air lock

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

2.14 PLACE CONTAINER ON TRANSFER CAR (Routine)

Tasks

- 2.14.1 Move the container to the container transfer car.
- 2.14.2 Lower the container onto the transfer car.
- 2.14.3 Record the transfer.

Equipment and Facility Requirements

5-ton bridge crane with robotic manipulator (SK-212-H-200, A and B)
Container grapple (SK-212-H-202, A and B)
Container transfer car (SK-212-S-031, A through D)
Inspection Hot Cells A and B

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

2.15 MOVE TRANSFER CAR TO SURFACE STORAGE VAULT (Routine)

Tasks

- 2.15.1 Move the container transfer car through the container transfer tunnel to the surface storage vault.
- 2.15.2 Record the transfer.
- 2.15.3 Proceed to Operation 3.0.

Equipment and Facility Requirements

Container transfer car (SK-212-S-031, A through D)
Container transfer tunnel

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

3.1 POSITION CONTAINER TRANSFER MACHINE (CTM) OVER TRANSFER STATION (Routine)

Tasks

- 3.1.1 Position the CTM over the transfer tunnel shield valve in the transfer bay.
- 3.1.2 Open the transfer tunnel shield valve.
- 3.1.3 Record container identification.

Equipment and Facility Requirements

Container transfer machine (SK-212-H-013, A and B)
Shield valve with drive (SK-212-N-250, A through D)
Transfer bay in storage vault
Container transfer car (SK-212-S-031, A through D)
Remote viewing system in transfer tunnel

Material Required

NA

Assumptions

- (1) The operation of the two shield valves in the inspection hot cell is interlocked with the operation of the two shield valves in the transfer bay in the storage vault, which ensures that both valves in one area will be closed before either of the valves in the other area is opened.
- (2) The CTM, operated from the control room, is remotely positioned and operated. Contact or "hands-on" maintenance can be performed on the CTM, when necessary. The CTMs are integrated with the computer inventory and control system to record the locations of specific disposal containers and maintain an inventory of the materials in the storage vault.

3.2 LIFT CONTAINER INTO CTM (Routine)

Tasks

- 3.2.1 Lower the grapple and attach it to the container pintle.
- 3.2.2 Lift the container into the CTM cask.
- 3.2.3 Close the CTM shield valve.
- 3.2.4 Close the transfer tunnel shield valve.
- 3.2.5 Record the tasks.

Equipment and Facility Requirements

Container grapple (SK-212-H-202, A and B)
Container transfer machine (SK-212-H-013, A and B)
Shield valve with drive (SK-212-N-250, A through D)
Transfer bay in storage vault
Container transfer car (SK-212-S-031, A through D)

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

3.3 MOVE CTM TO CONTAINER STORAGE LOCATION (Routine)

Tasks

- 3.3.1 Move the CTM to a preselected container storage location in the surface storage vault.
- 3.3.2 Position the CTM plug hoist over the storage vault plug.
- 3.3.3 Lift the shield plug into the CTM.

Equipment and Facility Requirements

Surface storage vault
Container transfer machine (SK-212-H-013, A and B)
CTM plug hoist

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

3.4 STORE CONTAINER (Routine)

Tasks

- 3.4.1 Position the container in the CTM over the port of the surface storage vault.
- 3.4.2 Lower the container into the storage rack located below the port and release the grapple.
- 3.4.3 Position the CTM plug hoist over the port of the surface storage vault and replace the shield plug.
- 3.4.4 Record operations and storage location.
- 3.4.5 Proceed to Operation 4.0.

Equipment and Facility Requirements

Surface storage vault
Container transfer machine (SK-212-H-013, A and B)
Container grapple (SK-212-H-202, A and B)
CTM plug hoist
Container storage rack (135 positions each) (SK-212-S-086, A and B)

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

4.1 RETURN CONTAINER TO TRANSFER CAR (Routine)

Tasks

- 4.1.1 Position the CTM plug hoist over a preselected location in the surface storage vault and lift the port shield plug.
- 4.1.2 Position the CTM over the port.
- 4.1.3 Lower the grapple into the container location and connect it to the disposal container.
- 4.1.4 Lift the container into the CTM and confirm the identification of the container.
- 4.1.5 Close the CTM shield valve.
- 4.1.6 Position the CTM plug hoist over the port of the surface storage vault and replace the shield plug.
- 4.1.7 Move the CTM to the shield valve port in the transfer bay over the transfer tunnel.
- 4.1.8 Open the transfer tunnel shield valve.
- 4.1.9 Place the container on the container transfer car in the container transfer tunnel.
- 4.1.10 Disconnect the grapple from the container.
- 4.1.11 Close the transfer tunnel shield valve.
- 4.1.12 Record operation and container identification.

Equipment and Facility Requirements

Container transfer machine (SK-212-H-013, A and B)
Container transfer car (SK-212-S-031, A through D)
Surface storage vault
Container storage rack (SK-212-S-086, A and B)
Shield valve with drive (SK-212-N-250, A through D)
Transfer tunnel
Transfer bay (horizontal emplacement transfer bay not shown on facility drawing)
Remote viewing system in transfer tunnel

Material Required

NA

4.1 RETURN CONTAINER TO TRANSFER CAR (Routine) (concluded)

Assumptions

- (1) The operation of the two shield valves in the inspection hot cell is interlocked with the operation of the two shield valves in the transfer tunnel in the transfer bay and the storage vault, which ensures that both valves in one area will be closed before either of the valves in the other area is opened.
- (2) All tasks are performed remotely.

4.2 POSITION WASTE TRANSPORTER IN TRANSFER BAY (Routine)

Tasks

Vertical

- 4.2.1 Open the ventilation roll-up door to the transfer bay.
- 4.2.2 Move the transporter into the transfer bay.
- 4.2.3 Close the ventilation roll-up door.
- 4.2.4 Raise the cask to the vertical loading position on the transporter.
- 4.2.5 Position the cask over the transfer tunnel shield valve.

Horizontal

- 4.2.1 Open the ventilation roll-up door to the transfer bay.
- 4.2.2 Move the transporter into the transfer bay.
- 4.2.3 Close the ventilation roll-up door.
- 4.2.4 Rotate the cask to the perpendicular loading position on the transporter.
- 4.2.5 Align the cask with the transfer tunnel shield valve.

Equipment and Facility Requirements

Transporter with cask (vertical and horizontal)
Ventilation roll-up door (SK-212-N-021, A and B)
Transfer bay

Material Required

Dolly for disposal container in horizontal configuration

Assumptions

- (1) All tasks are performed by repository personnel.

4.3 LOAD DISPOSAL CONTAINER INTO TRANSPORTER (Routine)

Tasks

Vertical

- 4.3.1 Lower the transporter cask onto the transfer tunnel port.
- 4.3.2 Open the cask door.
- 4.3.3 Open the transfer tunnel shield valve.
- 4.3.4 Confirm container identification using the remote viewing system in the transfer tunnel.
- 4.3.5 Lower the cask grapple into the transfer tunnel and connect it to the disposal container.
- 4.3.6 Lift the container into the cask.
- 4.3.7 Close the cask door.
- 4.3.8 Verify the closure of the cask door.
- 4.3.9 Close the shield valve.
- 4.3.10 Lower the cask to the horizontal transport position.

Horizontal

- 4.3.1 Rotate the cask to the transfer tunnel port.
- 4.3.2 Extend the shielding collar and open the cask door.
- 4.3.3 Open the transfer tunnel shield valve.
- 4.3.4 Confirm container identification.
- 4.3.5 Extend the cask mechanism into the transfer tunnel.
- 4.3.6 Pull the disposal container into the transporter.
- 4.3.7 Close the shield valve.
- 4.3.8 Close the cask door and retract the collar.
- 4.3.9 Verify the closure of the cask door.
- 4.3.10 Rotate the cask to the transport position.

4.3 LOAD DISPOSAL CONTAINER INTO TRANSPORTER (Routine) (concluded)

Equipment and Facility Requirements

Vertical

Facility transporter with cask (vertical)
Transfer bay
Shield valve with drive (SK-212-N-250, A through D)
Remote viewing system in transfer tunnel.

Horizontal

Facility transporter with cask (horizontal)
Transfer bay (not shown in facility drawing)
Shield valve with drive (not shown in facility drawing)
Remote viewing system in transfer tunnel

Material Required

NA

Assumptions

- (1) The operation of the two shield valves in the inspection hot cell is interlocked with the operation of two shield valves on the transfer bay in the storage vault, which ensures that both valves in one area will be closed before either of the valves in the other area is opened.
- (2) The facility transporter cask (vertical emplacement) incorporates a hoist and grapple for lifting the disposal container into the cask from the transfer tunnel.
- (3) The facility transporter cask (horizontal emplacement) incorporates an emplacement mechanism to pull the disposal container (mounted on a movable dolly in a horizontal loading position) from the transfer tunnel into the cask.
- (4) All tasks are performed remotely.

4.4 SURVEY AND INSPECT CASK CLOSURE (Routine)

Tasks

- 4.4.1 Move the robot to the cask closure door from the robot storage area.
- 4.4.2 Visually inspect for complete door closure.
- 4.4.3 Survey the closure for radiological leakage.
- 4.4.4 Record the results, observations, and operation.
- 4.4.5 Return the robot to the storage area.
- 4.4.6 Based on visual inspection and radiological survey, (1) move transporter to ramp portal (Operation 4.7, routine) or (2) return container to transfer car (Operation 4.5, nonroutine).

Equipment and Facility Requirements

Mobile floor robot with visual inspection and radiological survey equipment
Equipment storage area for mobile robot
Transfer bay

Material Required

NA

Assumptions

- (1) All tasks are performed remotely.

4.5 RETURN CONTAINER TO TRANSFER CAR (Nonroutine)

Tasks

Vertical

- 4.5.1 Raise the transporter cask to the vertical loading position on the transporter.
- 4.5.2 Position the cask over the transfer tunnel shield valve.
- 4.5.3 Lower the cask onto the transfer tunnel port.
- 4.5.4 Open the cask door.
- 4.5.5 Open the tunnel shield valve.
- 4.5.6 Lower the disposal container onto the container transfer car in the tunnel.
- 4.5.7 Disconnect the grapple.
- 4.5.8 Close the shield valve.
- 4.5.9 Close the shield door.
- 4.5.10 Lower the cask to the horizontal position.

Horizontal

- 4.5.1 Rotate the transporter cask to the perpendicular loading position on the transporter.
- 4.5.2 Align the cask with the transfer tunnel shield valve.
- 4.5.3 Extend the shielding collar and open the cask door.
- 4.5.4 Open the tunnel shield valve.
- 4.5.5 Extend the cask mechanism and push the disposal container onto the container transfer car in the tunnel.
- 4.5.6 Retract the cask mechanism.
- 4.5.7 Close the shield valve.
- 4.5.8 Close the cask door and retract the collar.
- 4.5.9 Rotate the cask to the transport position.

4.5 RETURN CONTAINER TO TRANSFER CAR (Nonroutine) (concluded)

Equipment and Facility Requirements

Vertical

Facility transporter with cask (vertical)
Transfer bay
Shield valve with drive (SK-212-N-250, A through D)

Horizontal

Facility transporter with cask (horizontal)
Transfer bay (not shown in facility drawing)
Shield valve with drive (not shown in facility drawings)

Material Required

NA

Assumptions

(1) All tasks performed remotely.

4.6 REMOVE TRANSPORTER FROM TRANSFER BAY (Nonroutine)

Tasks

- 4.6.1 Open the ventilation roll-up door.
- 4.6.2 Move the transporter out of the transfer bay.
- 4.6.3 Close the ventilation roll-up door.
- 4.6.4 Proceed to Operation 4.2.

Equipment and Facility Requirements

Facility transporter with cask (vertical and horizontal)
Transfer bay (horizontal emplacement transfer bay not shown on
facility drawing)
Ventilation roll-up door (SK-212-N-021, A and B)

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

4.7 MOVE TRANSPORTER AND CONTAINER TO WASTE RAMP PORTAL (Routine)

Tasks

- 4.7.1 Open the ventilation roll-up door.
- 4.7.2 Move the transporter out of the transfer bay to the waste ramp access control station at the entrance to the ramp portal.
- 4.7.3 Close the ventilation roll-up door.

Equipment and Facility Requirements

Facility transporter with cask
Transfer bay
Ventilation roll-up door (SK-212-N-021, A and B)
Waste ramp access control station

Material Required

NA

Assumptions

- (1) All tasks are performed by repository personnel.

4.8 MOVE TRANSPORTER AND CONTAINER TO EMPLACEMENT BOREHOLE (Routine)

Tasks

- 4.8.1 When authorized, proceed from the waste ramp access control station down the waste ramp to the waste main access control station in the waste operations area (subsurface).
- 4.8.2 Record authorization.
- 4.8.3 When authorization and destination have been provided, proceed from the waste main access control station down the waste main to the designated panel access drift, emplacement drift, and borehole.
- 4.8.4 Record authorization and destination.

Equipment and Facility Requirements

Facility transporter with cask
Waste ramp access control station
Waste main access control station

Material Required

NA

Assumptions

- (1) Authorization to proceed down the waste ramp is controlled by a person in the waste ramp access control station, which ensures that only one transporter is on the ramp at one time.
- (2) The emplacement of disposal containers in boreholes will be made in a predetermined sequence at specific locations. Destination and access for the transporter will be provided at the waste main access control station.
- (3) All tasks are performed by repository personnel.

4.9 POSITION TRANSPORTER AT BOREHOLE (Routine)

Tasks

Vertical

- 4.9.1 Move the transporter over the vertical borehole.
- 4.9.2 Raise the cask to the vertical emplacement position.
- 4.9.3 Align and lower the cask onto the shielding closure.

Horizontal

- 4.9.1 Move the transporter to the horizontal borehole.
- 4.9.2 Rotate the cask to the horizontal emplacement position.
- 4.9.3 Align the cask with the shielding closure.

Equipment and Facility Requirements

Vertical

Facility transporter (vertical)
Shielding closure (vertical)

Horizontal

Facility transporter (horizontal)
Shielding closure (horizontal)

Material Required

NA

Assumptions

- (1) The operations are performed remotely by a worker in a shielded transporter.

4.10 EMPLACE DISPOSAL CONTAINER (Routine)

Tasks

Vertical

- 4.10.1 Open the cask and closure doors.
- 4.10.2 Lower the disposal container into the borehole.
- 4.10.3 Disconnect and retract the grapple.
- 4.10.4 Close the cask and closure doors.
- 4.10.5 Confirm closure.
- 4.10.6 Record the operation.
- 4.10.7 Based on closure confirmation, (1) return the transporter to the surface (Operation 4.12, routine) or (2) address the closure problem (Operation 4.11, nonroutine).

Horizontal

- 4.10.1 Extend the shielding collar and open the cask and closure doors.
- 4.10.2 Push the disposal container into the borehole, releasing the dolly and container from the cask mechanism.
- 4.10.3 Retract the cask mechanism.
- 4.10.4 Close the cask and closure doors and retract the shielding collar.
- 4.10.5 Confirm closure.
- 4.10.6 Record the operation.
- 4.10.7 Based on closure confirmation, (1) return the transporter to the surface (Operation 4.12, routine) or (2) address the closure problem (Operation 4.11, nonroutine).

Equipment and Facility Requirements

Vertical

Facility transporter (vertical)
Shielding closure (vertical)

4.10 EMPLACE DISPOSAL CONTAINER (Routine) (concluded)

Horizontal

Facility transporter (horizontal)

Shielding closure (horizontal)

Material Required

NA

Assumptions

- (1) The operations are performed remotely by a worker in a shielded transporter.

4.11 ADDRESS SHIELDING CLOSURE PROBLEM (Nonroutine)

Tasks

- 4.11.1 Address the shielding closure problem, as needed, before the transporter cask is moved to the transport position.
- 4.11.2 Record operation and resolution of closure problem.
- 4.11.3 Proceed to Operation 4.12.

Equipment and Facility Requirements

Facility transporter (vertical and horizontal)

Material Required

NA

Assumptions

- (1) The operations to resolve the closure problem are performed by repository personnel.

4.12 RETURN TRANSPORTER TO SURFACE (Routine)

Tasks

Vertical

- 4.12.1 Raise the cask away from the shielding closure and lower to the horizontal position on the transporter.
- 4.12.2 Move the transporter to the waste main access control station at the base of the waste ramp.
- 4.12.3 When authorized, move the transporter up the ramp to the parking area adjacent to the transfer bay in the waste operations area (surface).
- 4.12.4 Record authorization and operation.

Horizontal

- 4.12.1 Rotate the cask away from the shielding closure to the transport position.
- 4.12.2 Move the transporter to waste main access control station at base of waste ramp.
- 4.12.3 When authorized, move the transporter up the ramp to the parking area adjacent to the transfer bay in the waste operations area (surface).
- 4.12.4 Record authorization and operation.

Equipment and Facility Requirements

Vertical

Facility transporter (vertical)
Emplacement and access drifts (vertical)
Waste main access control station
Waste ramp

Horizontal

Facility transporter (horizontal)
Emplacement and access drifts (horizontal)
Waste main access control station
Waste ramp

4.12 RETURN TRANSPORTER TO SURFACE (Routine) (concluded)

Material Required

NA

Assumptions

- (1) The operations are performed remotely by a worker in a shielded transporter.

APPENDIX B

EQUIPMENT LIST BY OPERATION

EQUIPMENT LIST

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Receipt</u>				
1.1	--	1	Portal radiation monitor	Gate 3, Entrance to Admitting and inspection area.
1.2	--	--	Safety and security inspection equipment	Admitting and inspection area
	--	--	Explosives-detecting equipment	"
	--	--	Radiological survey instruments	"
1.3	212-S-014 A-D	4	Facility transfer vehicle	Surface waste operations area, Gate 4
1.4	Facility 215-2	1	Vehicle wash station	Surface waste operations area
	--	1	Laboratory to monitor water samples	"
	--	1	Waste treatment building for radiological waste	"
	--	1	Sewage treatment facility for nonradiological waste	"
1.5	212-S-014 A-D	4	Facility transfer vehicle	Surface waste operations area
1.6	--	--	Replacement parts for safety problems	Surface waste operations area
	--	--	Decontamination supplies to contain radiological problems	"
	--	--	Explosives disposal container	"

EQUIPMENT LIST
(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Receipt (cont.)</u>				
1.7	212-S-014 A-D	4	Facility transfer vehicle	Surface waste operations area
1.8	212-S-014 A-D	4	Facility transfer vehicle	Entry bay, WHB
	212-N-035 A-L	10	Roll-up door	"
1.9	212-H-250 A-B	2	5-ton bridge crane with robotic manipulator	Entry bay
	212-H-253 A-F	6	Personnel barrier handling fixture	"
1.10	212-Q-003 A	1	5-ton bridge crane with robotic manipulator	Entry bay
	--	--	Smear equipment	"
	--	--	Cask gas-sampling and venting system	"
1.11	212-S-014 A-D	4	Facility transfer vehicle	Receiving and shipping bay
1.12	212-H-027 A-C	3	125/25-ton bridge crane (two hoists on a single bridge)	Receiving and shipping bay
	212-H-017 A-B	2	Cask-lifting yoke, rail	"
	212-H-010 A-C	3	Cask-lifting yoke, truck	"
	212-S-252 A-E	5	Yoke storage rack	"
1.13	212-H-027 A-C	3	125/25-ton bridge crane	Receiving and shipping bay
	212-H-017 A-B	2	Cask-lifting yoke, rail	"
	212-H-010 A-C	3	Cask-lifting yoke, truck	"
	212-Q-006 A-B	2	Cask decontamination station	Cask preparation area
	212-S-021 A-B	2	Decontamination station platform	"

EQUIPMENT LIST

(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Receipt (cont.)</u>				
1.14	212-H-027 A-C	3	125/25-ton bridge crane	Receiving and shipping bay
	212-H-017 A-B	2	Cask-lifting yoke, rail	"
	212-H-010 A-C	3	Cask-lifting yoke, truck	"
	212-S-015 A-L	10	Cask transfer car with drive	Cask preparation area
1.15	212-Q-003 B	1	Cask gas-sampling and venting system	Cask preparation area
1.16	--	10	Outer cover lifting fixture	Cask preparation area
	212-R-250 A-F	6	Floor-mounted robot with attachments	"
	212-S-020	6	Temporary storage platform for outer cover of cask	"
	212-H-251 A-B	2	2.5-ton wall-mounted traveling jib crane	"
1.17	2-2-R-250 A-F	6	Floor-mounted robot	Cask preparation area
	--	--	Smear equipment	"
	212-Q-003 B	1	Cask gas-sampling and venting system	"
1.18	--	--	Containers for unused and used decontamination materials	Cask preparation area
	--	--	Cleaning materials	"
	212-Q-003 B	1	Cask gas-sampling and venting system	"
1.19	212-R-250 A-F	4	Floor-mounted robot	Cask preparation area

EQUIPMENT LIST

(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Receipt (cont.)</u>				
1.20	212-H-251 A-B	2	2.5-ton wall-mounted traveling jib crane	Cask preparation area
	212-H-254 A-B	2	Adapter lifting fixture, rail	"
	212-H-255 A-B	2	Adapter lifting fixture, truck	"
	212-N-008 A-L	10	Cask-to-hot-cell seal adapter with activation system (rail and truck)	"
	212-S-015 A-L	10	Cask transfer car with drive	"
	--	--	Cask seal adapter activation system	"
1.21	212-S-015 A-L	10	Cask transfer car with drive	Cask transfer tunnel
	212-N-007 A-L	10	Shield-ventilation door with drive	"
	212-N-008 A-L	10	Cask-to-hot-cell seal adapter	Hot cell port
1.22	212-H-012 A-D	4	20-ton bridge crane with robotic manipulator	Hot Cells A and B
	212-N-010 A-L	10	Hot cell shield plug	"
	212-H-032 A-L	10	Removal fixture for hot cell shield plug	"
	--	10	Inner lid lifting fixture	"

EQUIPMENT LIST
(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Receipt (cont.)</u>				
1.23	212-H-012 A-D	4	20-ton bridge crane with robotic manipulator	Hot Cells A and B
	212-H-030 A-D	4	Rotating load block	"
	212-H-046 A-R	16	Fuel-handling tools with stand (Hot Cell B)	"
	212-H-031 A-D	4	Canister/container grapple (Hot Cell A)	"
	212-V-005 A-K	9	Remote viewing system	"
	212-S-250 A-B	2	Fuel storage rack	"
	212-S-096	1	Canister storage rack	"
	212-S-018 A-B	2	Fuel inspection station	"
	212-S-203	1	Canister inspection station	"
1.24	212-H-012 A-D	4	20-ton bridge crane with robotic manipulator	Hot Cells A and B
	--	--	Cask-viewing system	"
1.25	212-H-030 A-D	4	Rotating load block	Hot Cells A and B
	--	10	Inner lid lifting fixture	"
	212-H-012 A-D	4	20-ton bridge crane with robotic manipulator	"
1.26	212-H-012 A-D	4	20-ton bridge crane with robotic manipulator	Hot cell
	212-N-010 A-L	10	Hot cell shield plug	"
	212-H-032 A-L	10	Plug removal fixture	Cask preparation area
	212-S-015 A-L	10	Cask transfer car with drive	"
	212-N-007 A-L	10	Shield-ventilation door with drive	"

EQUIPMENT LIST
(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Receipt (cont.)</u>				
1.27	212-H-251	2	2.5-ton wall-mounted traveling jib crane	Cask preparation area
	212-H-254 A-B	2	Adapter lifting fixture, rail	"
	212-H-255 A-B	2	Adapter lifting fixture, truck	"
	--	--	Smear equipment	"
	212-R-250 A-F	6	Floor-mounted robot	"
1.28	--	--	Containers for unused and used cleaning materials	
1.29	212-H-027 A-C	3	125/25-ton bridge crane	Cask preparation area
	212-R-250 A-F	4	Floor-mounted robot	"
	--	--	Outer cover lifting fixture	"
1.30	212-H-027 A-C	3	125/25-ton bridge crane	Cask decontamination station
	212-H-017 A-B	2	Cask lifting yoke, rail	"
	212-H-010 A-C	3	Cask lifting yoke, truck	"
	212-Q-006 A-B	2	Cask decontamination station	"
	212-Q-002 A-B	2	Decontamination spray equipment	"
1.31	212-H-027 A-C	3	125/25-ton bridge crane	Receiving and shipping bay
	212-H-017 A-B	2	Cask-lifting yoke, rail	"
	212-H-010 A-C	3	Cask-lifting yoke, truck	"
	212-S-015 A-L	10	Cask transfer car with drive	"
1.32	212-H-027 A-C	3	125/25-ton bridge crane	Receiving and shipping bay
	212-H-017 A-B	2	Cask lifting yoke, rail	"
	212-H-010 A-C	3	Cask lifting yoke, truck	"

EQUIPMENT LIST
(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Receipt (cont.)</u>				
1.33	212-S-014 A-D	4	Facility transfer vehicle	Entry bay
1.34	212-H-250 A-B	2	5-ton bridge crane	Entry bay "
	212-H-253 A-F	6	Personnel barrier handling fixture	
	--	--	Carrier	"
1.35	212-S-014 A-D	4	Facility transfer vehicle	Interim storage area
	--	--	Carrier	"
1.36	212-S-014 A-D	4	Facility transfer vehicle	Surface waste operations area, Gate 4
1.37	--	--	Commercial vehicle	Admitting and inspection area, Gate 3
	--	--	Safety and security inspection equipment	
	--	--	Radiological survey instruments	
1.38	212-S-014 A-D	4	Facility transfer vehicle	Surface waste operations area, Gate 4
1.39	--	--	Replacement parts for safety problems	Surface waste operations area
	--	--	Decontamination supplies	
	--	--	Replacement parts for security problems	
1.40	--	--	Portal radiation monitor	Admitting and inspection area, Gate 3
	--	--	Carrier	
	--	--	Commercial vehicle	

EQUIPMENT LIST

(Continued)

<u>Operation Number</u>	<u>Equipment Number</u>	<u>Total Quantity</u>	<u>Description</u>	<u>Location</u>
<u>Preparation</u>				
2.1	212-H-018 A-C	3	Empty container-handling fixture	Hot Cells A and B
	212-H-042	1	Empty container transfer monorail	"
	212-H-043	1	Monorail system with 1-ton hoist	"
	212-H-012 A-D	4	20-ton bridge crane with robotic manipulator	"
	212-S-016 A-C	3	Empty container transfer car	"
	212-S-096	1	DHLW canister storage rack	"
	212-S-250 A-B	2	Fuel storage rack	"
	212-H-046 A-R	16	Fuel-handling tools	"
	212-H-031 A-D	4	Container grapple	"
	212-N-045 A-C	3	Container transfer lock shield valve	"
	212-S-088 A-C	3	Weld station	"
2.2	212-S-088 A-C	3	Weld station	Hot Cells A and B
	212-V-005 A-K	9	Remote-viewing system	"
2.3	212-H-012 B-C	2	20-ton bridge crane with robotic manipulator	Hot Cell B
	212-H-031 A-B	2	Container grapple	"
	212-S-039 A-B	2	Leak test station	"
2.4	212-S-039 A-B	2	Leak test station	Hot Cell B
	212-V-005 A-H	7	Remote viewing system	"
2.5, 2.6	212-H-012 A&C	2	20-ton bridge crane with robotic manipulator	Hot Cells A and B
	212-V-005 A-K	9	Remote-viewing system	"
	212-H-031 A&C	2	Container grapple	"
	212-S-202 A-D	4	Weld inspection station	"

EQUIPMENT LIST
(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Preparation (cont.)</u>				
2.7	212-H-012 A&C	2	20-ton bridge crane with robotic manipulator	Hot Cells A and B
	212-H-030 A&C	2	Rotating load block	"
	212-H-031 A&C	2	Container grapple	"
	212-S-088 A-C	3	Weld station	"
2.8	212-R-002 B,D&E	3	Master/slave manipulator	Hot Cells A and B
	212-H-012 A&C	2	20-ton bridge crane with robotic manipulator	"
	212-H-031 A&C	2	Container grapple	"
	212-S-088 A-C	3	Weld station	"
2.9	212-H-012 A&C	2	20-ton bridge crane with robotic manipulator	Hot Cells A and B
	212-H-031 A&C	2	Container grapple	"
	212-N-202 A-C	3	Shield valve with drive	"
	212-Q-005 A-C	3	Container decontamination station	Inspection air locks
2.10	212-Q-005 A-C	3	Container decontamination station	Inspection air locks
	212-T-002 A-C	3	Water collection system for decontamination station	"
2.11	212-Q-005 A-C	3	Container decontamination station	Inspection air locks
	212-N-202 D-F	3	Shield valve with drive	"
	212-H-200 A-B	2	5-ton bridge crane with robotic manipulator	"
	212-H-202 A-B	2	Container grapple	"

EQUIPMENT LIST
(Continued)

Operation Number	Equipment Number	Total Quantity	Description	Location
<u>Preparation (cont.)</u>				
2.12	212-R-002 A-G	7	Master/slave manipulator	Inspection hot cells
	212-H-200 A-B	2	5-ton bridge crane with robotic manipulator	"
	212-H-201 A-B	2	Rotating load block	"
	212-N-201 A-C	3	Transfer drawer	"
	--	--	Smear equipment	"
2.13	212-H-200 A-B	2	5-ton bridge crane with robotic manipulator	Inspection hot cells
	212-H-202 A-B	2	Container grapple	"
	212-N-202 D-F	3	Shield valve with drive	"
	212-Q-005 A-C	3	Container decontamination station	"
2.14	212-H-200 A-B	2	5-ton bridge crane with robotic manipulator	Inspection hot cells
	212-H-202 A-B	2	Container grapple	"
	212-S-031 A-D	4	Container transfer car	"
2.15	212-S-031 A-D	4	Container transfer car	Container transfer tunnel
<u>Surface Storage</u>				
3.1	212-S-031 A-D	4	Container transfer car	Transfer bays
	212-H-012 A-B	2	Container transfer machine	"
	212-N-250 A-D	4	Shield valve with drive	"
	--	--	Remote viewing system	"
3.2	212-S-031 A-D	4	Container transfer car	Transfer bays
	212-H-202 A-B	2	Container grapple	"
	212-H-013 A-B	2	Container transfer machine	"
	212-N-250 A-D	4	Shield valve with drive	"

EQUIPMENT LIST

(Continued)

<u>Operation Number</u>	<u>Equipment Number</u>	<u>Total Quantity</u>	<u>Description</u>	<u>Location</u>
<u>Surface Storage (cont.)</u>				
3.3	212-H-013 A-B	2	Container transfer machine CTM plug hoist (part of container transfer machine)	Surface storage vaults
3.4	212-H-013 A-B	2	Container transfer machine	Surface storage vaults
	212-H-202 A-B	2	CTM container grapple	"
	212-S-086 A-B	2	Container storage racks (135 each)	"
<u>Emplacement</u>				
4.1	212-H-013 A-B	2	Container transfer machine	Transfer tunnels and transfer bays
	212-S-031 A-D	4	Container transfer car	"
	212-S-086 A-B	2	Container storage rack	"
	212-N-250 A-D	4	Shield valve with drive	"
			Remote viewing system in transfer tunnel	"
4.2	--	3	Facility transporter with cask	Transfer bays
	212-N-021 A-B	2	Ventilation roll-up door	"
4.3	--	3	<u>Vertical</u> Facility transporter with cask	Transfer bays
	212-N-250 A-D	4	Shield valve with drive	"
	--	3	<u>Horizontal</u> Facility transporter with cask	"
	212-N-250 A-D	4	Shield valve with drive	"
		4	Remote viewing system in transfer tunnel	"
4.4	--	3	Mobile floor robot with visual inspection and radiological survey equipment	Transfer bays

EQUIPMENT LIST
(Concluded)

<u>Operation Number</u>	<u>Equipment Number</u>	<u>Total Quantity</u>	<u>Description</u>	<u>Location</u>
<u>Emplacement (cont.)</u>				
4.5	--	4	<u>Vertical</u> Facility transporter with cask	Transfer bays
	212-N-250 A-D	4	Shield valve with drive	"
	--	4	<u>Horizontal</u> Facility transporter with cask	"
4.6	--	4	Facility transporter with cask	Transfer bays
	212-N-021 A-B	2	Ventilation roll-up door	"
4.7	--	4	Facility transporter with cask	Transfer bays/waste ramp
	212-N-021 A-B	2	Ventilation roll-up door	access control station
4.8	--	3	Facility transporter with cask	Subsurface waste operations area
4.9, 4.10	--	4	Facility transporter (vertical and horizontal)	Emplacement drift
	--	--	Shielding closures	"
4.11	--	4	Facility transporter (vertical and horizontal)	Emplacement drift
4.12	--	--	Facility transporter (vertical and horizontal)	Subsurface waste operations area

APPENDIX C
CONCEPTUAL ENGINEERING DRAWINGS
AND
TIME LINES

CONTAINER TRANSFER CAR
TRAVEL TO & FROM WASTE
HANDLING BUILDING (TYP. 2 PLE.)

CONTAINER TRANSFER
MACHINE (CTM) IN PARKED/
MAINTENANCE POSITION
(TYPICAL @ ENDS OF BLDG.)

AT GRADE
1'-0"

O 8-21-79 ISSUED FOR SNL APPROVAL		BNL	BNL	BNL	BNL	BNL	BNL	BNL	BNL
REV	DATE	DESCRIPTION				BY	CHKD	APPV	PS
PROPERTY OF SANDIA NATIONAL LABORATORIES DEVELOPED BY BECHTEL, SAN FRANCISCO SNL CONTRACT NO. 23-9599: CHANGES REQUIRE PRIOR APPROVAL OF THE PROCURING AGENCY									
TITLE YUCCA MOUNTAIN PROJECT PASSIVE VENTILATION SURFACE STORAGE VAULT GENERAL ARRANGEMENT, PLAN									
DWG APPROVED		DATE		DWG APPROVED		DATE		SIZE	
SNL <i>Allderson</i>		2-17-90		BNL <i>Allderson</i>		2-17-90		D	
BECHTEL JOB NO		DWG CLASS		DWG PROJ		PAGE NO.		PAGE TOTAL	
18020 - 100		UNC		14213		N/A			
BECHTEL SHEET NO		REV		SNL FC		TYP		I	
BK - 210 - P - 111		0

SECTION **A**
SCALE 1/16"=1'-0" SK-210-P-III

SECTION **C**
SCALE 1/4"=1'-0" SK-210-P-III

O 9349		ISSUED FOR SNL APPROVAL		SNL	RES	FOR	CLAS
REV	DATE	ISSUE DESCRIPTION				BY	CHK'D BY
PROPERTY OF SANDIA NATIONAL LABORATORIES DEVELOPED BY BECHTEL, SAN FRANCISCO SNL CONTRACT NO. 23-9599; CHANGES REQUIRE PRIOR APPROVAL OF THE PROCURING AGENCY							
TITLE YUCCA MOUNTAIN PROJECT PASSIVE VENTILATION SURFACE STORAGE VAULT GENERAL ARRANGEMENT, SECTIONS							
DWG APPROVED SNL <i>Altman</i> 2-19-90		DATE DWG APPROVED 2-19-90		DATE 2/19/90	SIZE D		
BECHTEL JOB NO 19039 - 100		DWG CLASS UNC		SNL FROM 14213	PAGE NO N/A		
BECHTEL DWG NO BK - 210 - P - 112		REV 1		SNL FC	QA 1

D		DESIGNED FOR SHL APPROVAL		DATE	BY
E		REVISED		DATE	BY
PROPERTY OF SANDIA NATIONAL LABORATORIES DEVELOPED BY BECKTEL SAN FRANCISCO SHL CONTRACT NO. 85-0048 CHANGES REQUIRE PRIOR APPROVAL OF THE PRODUCING AGENCY					
YUCCA MOUNTAIN PROJECT WASTE HANDLING BUILDING GENERAL ARRANGEMENT SECTIONS, CASE A					
NO. SHEET	DATE	REV. NO.	REV. DATE	REV. BY	REV. FOR
10000-100	10/1/80	1	10/1/80	1	1
SHL P-110 BK-210-P-110			10/1/80 10/1/80

SURFACE FACILITIES	
NO	FACILITY NAME
1000A	WATER STORAGE TANKS (NOT SHOWN)
1000B	UTILITY ELECTRICAL SUBSTATION
210	WASTE HANDLING BUILDING
210B	WATER MILLER
210C	WASTE TREATMENT BUILDING
210D	PERFORMANCE CONFIRMATION BUILDING
2201A	HEALTH PHYSICS STATION NO. 1
2201B	MEDICAL CENTER
2201C	FIRE STATION
2201D	SECURITY STATION NO. 1
2201E	SECURITY STATION NO. 2
2201F	HEALTH PHYSICS STATION NO. 3
2201G	SECURITY STATION NO. 3
2201H	SHOPS
2201I	MATERIALS STORAGE
2201J	WASTE OPERATIONS AREA GARAGE
2201K	ADMINISTRATION BUILDING
2201L	FOOD SERVICE FACILITY
2201M	TRAINING AUDITORIUM
2201N	WATER W/ BUILDING
2201O	CENTRAL WAREHOUSE
2201P	VISITORS CENTER (NOT SHOWN)
2201Q	MAIN SUBSTATION & STANDBY GENERATOR BUILDING
2201R	SEWAGE TREATMENT LAGOONS (NOT SHOWN)
2201S	COMPUTER BUILDING

DATE	BY	CHKD BY	APP'D BY
10/1/80	J. M. [Signature]	[Signature]	[Signature]

PROPERTY OF			
SANDIA NATIONAL LABORATORIES			
DEVELOPED BY			
BECHTEL SAN FRANCISCO			
SAC CONTRACT NO. 23-9599 CHANGES REQUIRED			
PRIOR APPROVAL OF THE PROCURING AGENCY			
YUCCA MOUNTAIN PROJECT			
CENTRAL SURFACE FACILITIES			
PLOT PLAN			
CASE B			
SCALE	DATE	BY	CHKD BY
1/4" = 100'	10/1/80	J. M. [Signature]	[Signature]
DATE	BY	CHKD BY	APP'D BY
10/1/80	J. M. [Signature]	[Signature]	[Signature]

APPENDIX D

REFERENCE INFORMATION BASE

This report contains no candidate information from, or for inclusion in, the Reference Information Base.

SITE AND ENGINEERING PROPERTIES DATA BASE

This report contains no candidate information for the Site and Engineering Properties Data Base.

END

DATE FILMED

01 / 22 / 91