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ACRONYMS AND ABBREVIATIONS

ACC	Accession Number
BSC	Bechtel SAIC Company, LLC
BWR	Boiling Water Reactor
CG	Center of Gravity
CMAA	Crane Manufacturers Association of America
CSNF	Commercial Spent Nuclear Fuel
DHLW	Defense High Level Waste
DIRS	Document Input Reference System
DOE	U.S. Department of Energy
DPC	Dual Purpose Canister
FHF	Fuel Handling Facility
GROA	Geological operations repository area
HLW	High Level Waste
LWT	Legal Weight Truck
ITS	Important to Safety
ITWI	Important to Waste Isolation
MCO	Multi-Canister Overpack
MSC	MGR Site Specific Cask
MSM	Master Slave Manipulator
NFC	Non Fuel Components
NOG	Nuclear Overhead Gantry
OCRWM	Office of Civilian Radioactive Waste Management
ORD	Office of Repository Development
OWT	Overweight Truck
PWR	Pressurized Water Reactor
SC	Safety Category
SNF	Spent Nuclear Fuel
SRTC	Site Rail Transfer Cart
SSC	Systems, Structures, and Components
TIC	Technical Information Center
WP	Waste Package

ft	Feet
g/cm ³	Grams per Cubic Centimeter
in.	Inches
lbs	Pounds
lb/in ³	Pounds per Cubic Inch
ton	2000 Pounds

1. PURPOSE AND SCOPE

This calculation is intended to support the License Application (LA) submittal of December 2004, in accordance with the directive given by DOE correspondence received on the 27th of January 2004 entitled: *Authorization for Bechtel SAIC Company L.L.C. to Include a Bare Fuel Handling Facility and Increased Aging Capacity in the License Application, Contract Number DE-AC28-01RW12101* (Arthur, W.J., III 2004). This correspondence was appended by further correspondence received on the 19th of February 2004 entitled: *Technical Direction to Bechtel SAIC Company L.L.C. for Surface Facility Improvements, Contract Number DE-AC28-01RW12101; TDL No. 04-024* (BSC 2004a). These documents give the authorization for a Fuel Handling Facility to be included in the baseline.

The purpose of this calculation is to establish preliminary bounding equipment envelopes and weights for the Fuel Handling Facility (FHF) transfer areas equipment. This calculation provides preliminary information only to support development of facility layouts and preliminary load calculations. The limitations of this preliminary calculation lie within the assumptions of section 5, as this calculation is part of an evolutionary design process. It is intended that this calculation is superseded as the design advances to reflect information necessary to support License Application. The design choices outlined within this calculation represent a demonstration of feasibility and may or may not be included in the completed design. This calculation provides preliminary weight, dimensional envelope, and equipment position in building for the purposes of defining interface variables.

This calculation identifies and sizes major equipment and assemblies that dictate overall equipment dimensions and facility interfaces. Sizing of components is based on the selection of commercially available products, where applicable. This is not a specific recommendation for the future use of these components or their related manufacturer. A component produced by one manufacturer certainly varies dimensionally from a similar product produced by a different manufacturer. The internal envelope dimensions are dependent on the selection of the individual components. The external envelope dimensions, as well as, key interface dimensions are established within this calculation and are to be treated as bounding dimensions.

2. QUALITY ASSURANCE

This calculation was prepared in accordance with AP-3.12Q, *Design Calculations and Analyses*. The Cask Preparation System has two major functions/subsystems that are classified as Safety Category (SC). These functions/subsystems are Cask Handling and the Trolley (*Q-List*, BSC 2003b, Table A-2), which are two functions that are performed by the Fuel Handling Facility. The Cask Receipt and Return System has two major functions/subsystems that are classified as Safety Category (SC). These functions/subsystems are Cask Receipt and Cask Preparation (*Q-List*, BSC 2003b, Table A-2), which are two functions that are performed by the Fuel Handling Facility. Therefore, this calculation is subject to the requirements of the *Quality Assurance Requirements and Description Document* (BSC 2004).

3. USE OF SOFTWARE

Computer software used in this technical product is classified as exempt from procedure LP-SI.11Q-BSC, Rev. 0, ICN 0, *Software Management*. All exempt software used in this calculation (Microstation v. 07.01.04.07) is listed under sections 2.1.1 and 2.1.2, Exemptions, of LP-SI.11Q-BSC, Rev. 0, ICN 0, *Software Management* (Ref. 168412). Calculations are documented for checking by hand.

4. INPUTS

4.1 DATA AND PARAMETERS

4.1.1 Physical properties of shielding door materials are shown in Table 1 below. The densities were extracted from the *Waste Package Transporter Shielding Design Calculation*, (BSC 2004i)

Table 1 Shielding Material Densities

Material	Density
Stainless Steel	7.745 g/cm ³ or .279 lb/in ³
(NS-4-FR) Neutron Shield	1.68 g/cm ³ or .0605 lb/in ³

4.1.2 Physical properties of the largest, heaviest, lightest, and shortest waste package (WP) types are summarized in Table 2 below. This table was extracted from *Repository Design Waste Package Envelope Dimensions for Facilities & Handling* (BSC 2003c).

Table 2 WP Physical Properties

WP Type	Length	Sleeve Diameter	Barrier Diameter	Loaded Weight
Naval - Long	236.3 in. ^c	79.8 in.	76.6 in.	161,000 lb ^c
5 DHLW/DOE ^a - Long	204.9 in.	86.1 in. ^c	82.9 in. ^c	126,000 lb
5 DHLW/DOE - Short	142.8 in. ^d	86.1 in. ^c	82.9 in. ^c	86,000 lb
24-BWR ^b	203.6 in.	54.9 in. ^d	51.7 in. ^d	62,000 lb ^d

Notes: ^a DHLW/DOE - Defense High Level Waste / U.S. Department of Energy

^b BWR - Boiling Water Reactor

^c Denotes maximum for specific listed property

^d Denotes minimum for specific listed property

4.1.3 Physical properties of the bounding transportation cask size are summarized below in Table 3. The information in this table was extracted from *Naval Nuclear Propulsion Program Technical Baseline Compliance Document* (McKenzie, pg 25,26).

Table 3 Bounding Cask Physical Properties

Cask Type	Length	Diameter	Loaded Weight
Naval - Long	234 in.	108 in with trunnions	Not to exceed 200 tons

4.1.4 Physical properties of bounding canister size are summarized below in Table 4. The information in this table was extracted from *Naval Nuclear Propulsion Program Technical Baseline Compliance Document* (McKenzie, pg 32,33).

Table 4 Bounding Canister Physical Properties

Canister Type	Length	Cross Section Dim.	Loaded Weight
Naval - Long	212 in.	66.5 in Diameter	108,500 lbs

4.1.5 Physical properties of bounding fuel assembly length and weight are summarized below in Table 5. The information in this table was extracted from *DOE and Commercial Waste Package System Description Document* (BSC, 2004b, Table 3, pg 9).

Table 5 Bounding Fuel Assembly Length

Assembly Class	Fuel Assy. Length	Cross Section Dim.	Weight
Naval - Long	180 in.	8.16 in. dia.	1430 lbs

Non Fuel Components (NFCs) do not require special handling considerations and will not be reflected in fuel assembly bounding lengths.

4.1.6 Physical properties of bridge cranes are summarized below in Table 6. The information in this table was extracted from *Overhead Crane Handbook* (Weaver, pg 38,44,72) and a correspondence with PaR Cranes (Weber, D. 2004).

Table 6 Crane Envelopes

Main Hook Approach Main Hook Side	Main Hook Approach Aux. Hook Side	Hook Approach Bridge	Hook Approach Bridge	Top of Rail to High Hook	Top of Rail to Top of Trolley	Crane Weight (lbs)
10 ton Bridge Crane (50'0" Span)						
2'6"	2'9"	5'7"	7'9"	-7" ^b	4'5"	21,300
15 ton Bridge Crane (50'0" Span)						
2'6"	2'9"	5'9"	7'9"	-5" ^b	4'9"	26,500
30 ton Bridge Crane (60'0" Span)						
3'0"	3'6"	7'6"	8'6"	-9" ^b	5'9"	55,800
200 ton/30 ton Aux Bridge Crane (80'0" Span)						
7'0"	9'0"	9'0" ^a	9'0" ^a	11"	13'3"	260,000

^a Additional information supplied by PaR Cranes for this application (Weber, D. 2004)

Crane spans shown are bounding for all FHF applications.

^bNegative values indicate that High Hook position is lower than Top of Rail

4.2 CRITERIA

This section presents the applicable design criteria. The criteria below are deemed applicable to this analysis of the Mechanical Handling Equipment envelopes and/or operation.

- 4.2.1** Provide the required space, layout, and structures required for waste handling operations to receive and package commercial, U. S. Department of Energy (DOE) and U. S. Navy spent nuclear fuel (SNF), and DOE high level waste (HLW) for emplacement in the Geologic Repository (Siddoway, D.W. 2003, Section 1.4-1).
- 4.2.2** Provide design features to ensure that worker and public radiation doses are ALARA (Siddoway, D.W. 2003, Section 2-3-1).
- 4.2.3** Provide design features to control the spread of contamination within and from the facility (Siddoway, D.W. 2003, Section 1.1-6).
- 4.2.4** Provide the required space and layout for tools and equipment (Siddoway, D.W. 2003, Section 1.4.2-3).
- 4.2.5** Provide the required space and layout in support of inspection, testing, calibration, and maintenance activities (Siddoway, D.W. 2003, Section 1.4.2-3).
- 4.2.6** Provide the space and layout for systems and utilities as required to support waste handling operations (Siddoway, D.W. 2003, Section 1.4.2-2).

- 4.2.7 Interface with GROA facilities as required to support related waste handling operations (Siddoway, D.W. 2003, 1-4).
- 4.2.8 Provide design features to preclude moderator intrusion into criticality sensitive areas (Siddoway, D.W. 2003, Section 1.4.1.2.9-9).
- 4.2.9 The facility has the capability at initiation of operations to receive and transfer vertical dual purpose canisters to the aging facility in an MSC. The facility does not have the capability at initiation of operations to receive and process Dual Purpose Canisters (DPC) containing CSNF to emplacement; this capability may be added at a future date (Arthur, W.J., III 2004, Enclosure).
- 4.2.10 FHF Facility shall consist of a large Transfer Cell with a single entrance/exit shield door and appropriate support mechanical & electrical utilities and ventilation systems. FHF design shall be based on the concept of the TAN-607 Hot Shop currently in use at the INEEL site. The cell will be subdivided as needed to maintain function and contamination control (*Addition of a Fuel Handling Facility and Central Control Center*, BSC 2004a, p. 1).
- 4.2.11 FHF shall have a single 200 / 15 Ton overhead bridge crane (single failure proof CMAA NOG 1 fuel handling / lifting device) with appropriate lift sets (grapples, spreaders, bales, and other accessories) for handling the transportation casks. The crane shall be capable of safely handling loaded transportation casks, MSCs, and WPs. Additional cranes will be used in the facility for transferring waste from a transportation cask / MSC into a designated waste package via a dry handling process, performing removal of impact limiters and personnel barriers, supporting closure cell operations, and for permitting certain maintenance and process operations such as removing shielding plugs, port plugs and canister lids. The 200-ton crane will deliver a sealed Waste Package to the load-out area for placement on the waste package transporter in order to accomplish transport from the FHF to a final emplacement position underground (BSC 2004a, p. 1).
- 4.2.12 FHF shall contain a small Crane Maintenance Cell attached to the FHF Transfer Cell. The Crane Maintenance Cell will be separated from the Transfer Cell by shield door(s) such that the crane may be manually retrieved, placed in the crane maintenance cell, and normal crane maintenance may be performed in a lower radiation environment (BSC 2004a, p. 1).
- 4.2.13 FHF shall contain one Waste Package Closure Cell (weld cell). The WP Closure Cell shall be designed to the extent practical to utilize the same standard WP Closure Cell equipment designs as will be used in the Dry Transfer Facility and Canister Handling Facility (BSC 2004a, p. 1).
- 4.2.14 FHF shall include strategically placed wall-mounted manipulators, viewing windows, CCTV cameras, glove boxes, service outlets, and remotely located controls, and associated services required to serve the FHF Transfer Cell and WP Closure Cell (BSC 2004a, p. 1).

- 4.2.15** FHF shall also have a vestibule at the front of the Transfer Cell that will provide for enclosure of the shield door and also provide for weather protection of the rail car or truck trailer that is transporting waste packages or transportation casks. Impact limiters and personnel barriers will be removed in this area (BSC 2004a, p. 1).
- 4.2.16** Fuel Handling Facility (FHF) shall be designed to receive and handle Transportation casks containing Commercial Spent Nuclear Fuel (CSNF), Department of Energy Spent Nuclear Fuel (DOE SNF) except MCOs, and Department of Energy High Level Waste (DOE HLW). The Fuel Handling Facility shall be designed to receive all aforementioned waste types upon delivery by legal weight truck (LWT), Overweight Trucks (OWT), or railcar (BSC 2004a, p. 1).
- 4.2.17** Fuel Handling Facility (FHF) shall be designed to receive and handle Dual Purpose Canisters (DPCs) containing CSNF (BSC 2004a, p. 1).
- 4.2.18** Fuel Handling Facility (FHF) shall be designed to receive and handle Navy or Department of Energy (DOE) standard canisters containing waste (BSC 2004a, p. 1).
- 4.2.19** Fuel Handling Facility (FHF) shall be designed to receive and handle new empty Waste Packages. Waste Packages shall be received on a rail or truck conveyance (BSC 2004a, p. 1).
- 4.2.20** Fuel Handling Facility (FHF) shall be designed to receive and handle new empty MGR Site Specific Casks (MSCs) for aging waste (BSC 2004a, p. 1).
- 4.2.21** Fuel Handling Facility (FHF) shall be designed to receive and handle various required support equipment for the processing and handling of the various shipping casks / devices, the overhead handling equipment, and the mechanical/electrical services required to support the various operations contained within the FHF (BSC 2004a, p. 1).
- 4.2.22** FHF shall be designed to handle and prepare empty Transportation Casks, loaded Waste Packages, and loaded MSCs for removal from the FHF facility (BSC 2004a, p. 1).
- 4.2.23** FHF shall be designed to handle only one transportation cask or MSC at a time for unloading and one WP or MSC for loading at a time (BSC 2004a, p. 2).
- 4.2.24** FHF ventilation systems design shall be based on cascading airflow from an area of lower contamination potential to an area of higher contamination potential. Therefore, diesel engine prime movers (truck cabs or rail locomotives) shall not be used within the vestibule that will serve as the transportation airlock (BSC 2004a, p. 2).
- 4.2.25** FHF Transfer Cell will be isolated from the adjacent vestibule level to avoid the spread of contamination to broad areas of the facility. A survey and cleanup of the secondary area where personnel enter will be made after each loading evolution (BSC 2004a, p. 2).

- 4.2.26 FHF shall be designed such that the facility can be constructed and made operational by the end of May, of Calendar year 2010 (BSC 2004a, p. 2).
- 4.2.27 FHF design shall not be based on any specific throughput requirements (BSC 2004a, p. 2).
- 4.2.28 FHF design shall not include receipt of any DOE Multi-canister Overpack (MCO) SNF (BSC 2004a, p. 2).
- 4.2.29 The FHF will include manipulators at various locations to serve the Transfer Cell and dry waste remediation work may be performed within the FHF Transfer Cell (BSC 2004a, p. 2).
- 4.2.30 FHF shall have the capability to remotely perform WP radiological surveys (BSC 2004a, p. 2).
- 4.2.31 FHF will have decontamination systems. WPs will be surveyed and decontaminated per the Functional and Operational requirements. In the event that the transportation casks, MSCs, and waste packages are found to have surface contamination, decontamination shall be performed by the limited capability afforded in the FHF (BSC 2004a, p. 2).
- 4.2.32 Internal cask cleanout is not currently anticipated as a function within the FHF. FHF shall not have the capability for cask flushing, but must be capable of removing fissile material to support transport requirements (BSC 2004a, p. 2).
- 4.2.33 FHF will not be connected to the on-site buffer facilities, i.e., to the Site Rail Transfer Cart (SRTC) system. To do so would require the laying of additional track in the building (SRTC runs on a wider track) and the distance from the cask receiving is substantial. The FHF will be designed to receive truck and rail conveyances directly and will not go through the intermediate SRTC transfer step (BSC 2004a, p. 2).
- 4.2.34 MCOs will not be handled in the FHF as currently designed. The MCOs constitute the most restricted handling scenario due to the need to keep lift heights (drop heights) to a very small distance (2 feet maximum). By precluding MCO handling from FHF, the overall lift height restrictions can potentially be relaxed from the current 6 feet maximum. If MCOs are desired to be handled at FHF in the future, addition of energy absorbing decking around all lift points to minimize the drop height may be possible (BSC 2004a, p. 2).
- 4.2.35 Support site infrastructure (roads and rail services) and services including electrical power, water and fire utilities, central control center, security, etc. shall be available to support the construction and operation of FHF (BSC 2004a, p. 2).
- 4.2.36 Water services and any other materials that act as a moderator will be excluded to the extent practical from both the FHF Transfer Cell and WP Closure Cell since these two cells will have fissile materials present. Fire protection for these two areas will consist

of strict control of combustible materials and passive design features (BSC 2004a, p. 2).

- 4.2.37** The transportation cask impact limiters and personnel barriers will be removed and stored outside the FHF Transfer Cell (BSC 2004a, p. 2).
- 4.2.38** FHF shall be sized such that adequate lay down is available for the FHF WP Closure Cell equipment and cask welding, inspection equipment etc. In addition FHF shall be sized with consideration given for adequate lay down for crane / lifting device grapple sets, rigging, slings, fixtures, and tooling, and various other auxiliary items required to perform the required functions within the FHF Transfer Cell (BSC 2004a, p. 2).

5. ASSUMPTIONS

- 5.1** *Assumption:* Safe operational clearance distance above cranes is two (2) ft.

Basis: This distance describes the space or clearance used to ensure room is given for utilities.

Used In: Sections 6.1.2.2, 6.1.5.4, 6.1.5.5

- 5.2** *Assumption:* All lifted equipment will be placed within the crane hook approach plus an additional six (6) in. for all operational and maintenance activities.

Basis: Equipment must be placed to allow crane hook approach for transfer operations and maintenance.

Used In: Section 6.1.2.1

- 5.3** *Assumption:* All fuel transfer area equipment door rough openings will be sized for bounding equipment envelopes plus an additional one (1) ft. of clearance.

Basis: This sizing is in current use on the Plant Design model. This clearance can be safely be maintained by the use of rail transfer for all equipment moving through these doors.

Used In: Sections 6.1.5.1, 6.1.5.3

5.4 *Assumption:* Canister handling grapple lengths are bound to four (4) ft.

Basis: This device will be electrically or contact activated with secure lock up and associated safety devices. The capacity is at least 49 tons (Table 4) and will capture and secure lifting for a specific canister type. This device is bounded by four (4) ft. in length, measured from hook to engagement device.

Used In: Sections 6.1.2.2, 6.1.2.3

5.5 *Assumption:* Canister handling operation will occur with the Cask/MSC/WP resting on the floor or equivalently placed so the top opening of any Cask/MSC/WP is bounded at the 19'6" building elevation.

Basis: This configuration minimizes operational and drop heights and creates a simple stack up for crane rail and ceiling heights.

Used In: Section 6.1.2.2

5.6 *Assumption:* Canister handling operational lift clearance will be six (6) in.

Basis: This clearance is considered the minimum lift clearance that will ensure a collision of the canister and cask will not occur.

Used In: Section 6.1.2.2

5.7 *Assumption:* Equipment shield doors will extend one (1) ft. beyond rough opening.

Basis: This dimension is used for consistency with other facilities: from *Sliding Shield Door for Equipment Passage* (BSC 2004f).

Used In: Table 9, Table 10

5.8 *Assumption:* Equipment shield doors thickness will be equivalent to ten (10) in. of steel and seven (7) in. of Poly neutron shielding.

Basis: The thickness represents a bounding case for doors shown in *Sliding Shield Door for Equipment Passage* (BSC 2004f).

Used In: Section 6.3.1

- 5.9** *Assumption:* Personnel shield doors thickness will be equivalent to ten (10) in. of steel and seven (7) in. of Poly neutron shielding.

Basis: The thickness represents a bounding case for doors shown in *Sliding Shield Door for Equipment Passage* (BSC 2004f).

Used In: Section 6.3.2

- 5.10** *Assumption:* Work Station weights will be bounded at 3.75 tons in current configuration.

Basis: The Work Station comprises of a 24 in. X 36 in. window, two (2) master slave manipulators and, a wall mounted work table. The window weight is represented by shielding this opening with the equivalent shielding stated in Assumption 5.8. The resulting weight is roughly 2615 lbs. Accounting for weights associated with the frame, the window weight is bounded at 3500 lbs. With limited information on the master slave manipulators, a rough estimation of 2000 lbs is given for each manipulator. The associated work table presented is considered negligible for the weight assumption. Information for the work station layout was based on the *Canister Handling Facility Manipulator Work Station Mechanical Equipment Envelope* (Cogema. 2004a).

Used In: Table 11

- 5.11** *Assumption:* The port plug will be ten (10) ft. in diameter, five (5) ft. in height and weigh up to 20 tons.

Basis: With limited information regarding the port plug and associated components, the sizing assumption was made to bound the external diameter of the port plug at 10 ft. The transfer bay floor (port interface) is four (4) ft. thick and by adding one (1) ft. this height is bounded at five (5) ft. The basis for weight is generated by shielding an area of a 10 ft. diameter circle with equivalent shielding thickness given in Assumption 5.8 and, shielding material densities found in Table 1. The resulting 17 tons of needed shielding is bounded by adding 15 percent to arrive at 20 tons.

Used In: Section Table 8

- 5.12** *Assumption:* The port plug stand will be ten (10) ft. in diameter, five (5) ft. in height and weigh 1.8 tons.

Basis: The stand was sized to roughly match the port plug. The basis for weight is generated by simplifying the port plug stand to a steel cylinder with material densities found in Table 1, above dimensions and, a wall thickness of .5 in. The resulting 1.57 tons is bounded by adding 15 percent to arrive at 1.8 tons.

Used In: Table 8, 6.1.5.4

- 5.13** *Assumption:* The port plug grapple will be four (4) ft. in length.

Basis: This device will be electrically or contact activated with secure lock up and associated safety devices. The capacity is 30 tons and will capture and secure lifting for three independent port plugs. This device is bounded by four (4) ft. in length, measured from hook to engagement device.

Used In: Section 6.1.5.4

- 5.14** *Assumption:* Grapple approach for the Fuel Handling Machine will be 9'10" and 6'10" for the grapple to the north and south walls respectively and, 5'0" and 5'0" for the grapple to east and west walls of the Fuel Transfer Room.

Basis: This grapple approach configuration is derived from a commercial use fuel handling machine with powered manipulator. Other fuel handling configurations are under consideration and will be suited to function under space constraints and the specific layout of the Fuel Transfer Room.

Used In: Section 6.1.5.2

- 5.15** *Assumption:* The bounded floor print size and weight for the Trunnion Collar Stand is 10 ft by 10 ft and 2 tons.

Basis: This simple rack is to hold two (2) sets or 4 trunnion collars in an upright position. A floor space of 10 ft. by 10 ft. is equitable for this arrangement. An equitable bounding weight of 2 tons is assigned for this fabricated piece of equipment of this size.

Used In: Table 7

- 5.16** *Assumption:* The bounded size for the Canister Transfer Station is 15 ft wide by 26 ft long by 32 ft tall.

Basis: The Canister Transfer Station will allow transfer between two casks. It is sized by the largest cask in which it will contain during canister transfer. Table 3 shows the bounding Navy Cask having an operational diameter of 108 in. accounting for the trunnions. By adding two (2) ft. of clearance for trunnion capture devices around the operational diameter of each cask and adding one (1) ft. to represent the wall thickness that surround the transfer area, a footprint of 15 ft. by 26 ft. is needed for the basic canister handling structure.

The Canister Transfer Station height is constrained by the lifted canister. The Canister Transfer Station must be sized to contain all canister transfer operations. The walls must be higher than the center of gravity of a canister lifted to its highest position. A bounding Canister Transfer Station height is set at 32'0" building elevation and satisfies the above criteria.

A weight will not be calculated for the Canister Transfer Station. This structure is not movable and all serviceable parts are within the capacity of the 200-ton Main Transfer Room Crane.

Used In: Table 7

- 5.17** *Assumption:* The Transport Cask, MSC, and Waste Package Preparation and Transfer functions of the Fuel Handling Facility are based upon the functions outlined below from the Dry Transfer Facility Level 2 Block Flow Diagrams for the SNF/HLW Transfer System (Cogema 2003e). WPs, MSCs, and Casks will be received from the Preparation Room on the Import/Export Trolley with personnel barriers, impact limiters and outer lids removed and, inner lids prepared by the removal of fastening bolts.

Input: (D4) Empty WP from Cask/MSC/WP Preparation

(4.1) WP Docking (Dry Transfer Subsystem)

To Waste Transfer (Dry Transfer Subsystem)
From Waste Transfer (Dry Transfer Subsystem)

(4.3) WP Undocking (Dry Transfer Subsystem)

(4.4) Remove WP Docking Ring (Dry Transfer Subsystem)

To WP Closure (WP Closure System)
From WP Closure (WP Closure System)

(4.5) WP Surface Inspection & Radiological Survey (WP Loadout Subsystem)

(4.7) Tilt WP to Horizontal Position on Emplacement Pallet (WP Loadout Subsystem)

(4.8) Remove WP Trunnion Collars (WP Loadout Subsystem)

(4.19) Perform Radiological Survey (WP Loadout Subsystem)

(4.9) Place WP & Emplacement Pallet on Transporter (WP Loadout Subsystem)

To Cask/MSC/WP Preparation

Input: (B4) Loaded Cask, Loaded/Unloaded MSC, Empty MSC from Cask/MSC/WP Preparation

(4.10) Cask/MSC Docking (Dry Transfer Subsystem)

To Waste Transfer (Dry Transfer Subsystem)
From Waste Transfer (Dry Transfer Subsystem)

(4.16) Cask or MSC Undocking (Dry Transfer Subsystem)

To Cask/MSC/WP Preparation

Input: (A4) DPC Cask from Cask/MSC/WP Preparation

(4.12) DPC Cask Docking

To Waste Transfer (Dry Transfer Subsystem)
From Waste Transfer (Dry Transfer Subsystem)

To Cask/MSC/WP Preparation

Basis: (Criteria 4.2.11) for transferring waste from a transportation cask / MSC into a designated waste package via a dry handling process, and (Criteria 4.2.15) which refers to a vestibule at the front of the Transfer Cell that will provide for enclosure of the shield door and also provide for weather protection of the rail car or truck trailer that is transporting WPs or transportation casks. Impact limiters and personnel barriers will be removed in this area.

Used to develop operations described in Section 6.1

- 5.18** *Assumption:* Building configuration will be based on Plant Design General Arrangement Drawings for the FHF. Preliminary room dimensions, room elevations, door positions and rough openings and, crane rail heights are used for a basis to determine equipment position and operational feasibility.

Basis: The most current information available for building configuration.

Used In: Sections 6.1.2.1, 6.1.5.2 and Figures 1,2,3,4

6. CALCULATION

6.1 SNF/HLW TRANSFER AREAS

The SNF/HLW Waste Transfer System transfers SNF/HLW from a loaded cask or MSC to an empty waste package or empty MSC. Preparation begins in the Main Transfer Room by staging casks and WPs and placing them onto trolleys prepared for fuel transfer docking. The trolleys then move the casks and WPs through shielded doors to dock to Fuel Transfer Bays. Transfer operations are based on the Dry Transfer Facility Level 2 Block Flow Diagrams for the SNF/HLW Transfer System (Cogema 2003e) listed in assumption 5.17.

Fuel transfer will occur between three bays. This allows an incoming transportation cask to be transferred into an empty WP, and due to mismatching Cask/WP capacities, any overflow can be transferred into a third bay with an available MSC. The MSC is also used for fuel that cannot be placed into the WP such as fuel designated for aging. When transfer is complete, the Cask/MS/WP will undock and exit the same direction in which it came in. The exit paths will constitute the same paths used for entering the Transfer Area. Fuel Transfer operations are based on the Dry Transfer Facility Level 2 Block Flow Diagrams for the SNF/HLW Transfer System (Cogema 2003e) in assumption 5.17.

The SNF/HLW Transfer System processing rooms are: (see Figure 1, Figure 2)

- Area 1003, Main Transfer Room
- Area 1004, 5, and 6, Fuel Transfer Bay 1, 2, and 3 respectively
- Area 2001, Fuel Transfer Room
- Area 2002, Fuel Transfer Control Room
- Area 3002, Fuel Transfer Crane Maintenance Room

Figure 1 FHF Transfer Areas and Major Equipment at Elevation 0'

Ref: Assumption 5.18.

Equipment dimensions are shown in Table 7

6.1.1 Main Transfer Room

FHF Facility Transfer Area will consist of a large transfer cell with a single entrance/exit. FHF design is based on the concept of the TAN-607 Hot Shop currently in use at the INEEL site (Criteria 4.2.10). This cell concept is operationally subdivided as needed to maintain function and contamination control (Criteria 4.2.3). Five shielded openings lead to additional operational areas. Three openings lead to fuel transfer bays (Criteria 4.2.1), a single leads to a Waste Package Closure Room (Criteria 4.2.13), and lastly, a Crane Maintenance Room (Criteria 4.2.12).

The Main Transfer Room is a two story concrete cell located between the Preparation Room (Area 1002) and Transfer Bays 1, 2, and 3 (Areas 1004, 1005, and 1006 respectively). Located adjacent to Area 1003 is the WP Closure Transfer Room (Area 1013) and the Main Transfer Operating Gallery (Area 1015). Floor mounted rails connect Area 1002 with Area 1003. Trolley rails connect Area 1003 with the three Transfer Bays and Closure Room. Shield doors separate Areas 1002, 1004, 1005, 1006, and 1013 from Area 1003. A 200-ton overhead bridge crane with 30-ton auxiliary crane (based on Criteria 4.2.11) runs the length of Area 1003.

6.1.1.1 Preparation Operations

Cask/MSD/WD preparation for fuel transfer occurs in the Main Transfer Room (Area 1003) by installing a vertical positioning pedestal onto a transfer trolley. This produces the correct height for proper fuel transfer docking with various sized casks and WDs. A loaded cask is brought into Area 1003 with the outer lid, sample port access cover, and inner lid bolts removed and a lid docking fixture attached to the inner lid. Using the 200-ton crane and MSD/Cask/WD lifting yoke, the loaded cask is lifted from the Import-Export Trolley to the Transport Cask Transfer Trolley. A mobile, elevated platform is moved into place next to the loaded cask for personnel to install a docking ring. The 30-ton auxiliary crane moves a docking ring into the Main Transfer Room (Area 1003) for installation on the cask. The Transport Cask Transfer Trolley is moved into Transfer Bay 2 (Area 1005) and adjusted into position for subsequent SNF/HLW transfer operations. Identical operations will occur with a WD and WD Transfer Trolley moving into Transfer Bay 1 (Area 1004) and a MSD and MSD Transfer Trolley moving into Transfer Bay 3 (Area 1005).

6.1.1.2 Cask Load Out Operations

When a cask or MSD is returned from a transfer bay to Area 1003, or when transfer operations within Area 1003 are completed, the operational steps performed within Area 1003 are reversed. Docking rings are removed, swipe surveyed, decontaminated as necessary and returned to the staging stand.

6.1.1.3 Waste Package Load Out Operations

When a loaded WD is returned from fuel transfer operations to Area 1003, or with canister transfer operations within Area 1003, operations will occur remotely as the WD is unshielded. The external docking ring is removed remotely using the 30-ton auxiliary crane and grapple device. The internal docking ring is removed remotely using the 30-ton auxiliary crane and an internal docking ring removal device. When the loaded WD has been moved into the WD Closure Transfer Room (Area 1013) on the Closure Trolley and the shield door is closed, the docking ring is decontaminated and returned to staging.

Once the loaded WD is in the WD Closure Transfer Room (Area 1013) and the door closed for closure operations, the subsurface WD Transporter enters the Main Transfer Room (Area 1003) through the Entrance Vestibule (Area 1001) and is positioned by the Transporter Positioner for WD loading. The shield door(s) on the transporter are opened, and the bedplate with the WD Emplacement Pallet is extended. The Emplacement Pallet is lifted from the transporter bedplate using the 30-ton auxiliary crane and the WD/Pallet Yoke and placed onto the WD Turntable located within Area 1003 and made ready to receive the closed WD. The system interface activities are further discussed in *Emplacement and Retrieval System Description Document* (BSC 2004c).

When the WD is welded closed and the emplacement pallet and subsurface transporter are in position, the shield door between Area 1003 and the Preparation Room (Area 1002) is closed, the shield door of the WD Closure Transfer Room (Area 1013) is opened, and the WD is returned to

the Main Transfer Room (Area 1003). The WP is moved from the Closure Trolley to the survey-decon station using the 200-ton crane and WP Indexing Yoke, remotely inspected for damage and, surveyed for contamination. If necessary, limited dry, wipe decontamination is remotely performed to clean the WP of loose contamination. If WP is found to be within acceptable surface contamination limits, the WP is moved to the WP Tilting Device within Area 1003 and down-ended to a horizontal position onto the emplacement pallet. The WP Turntable repositions the WP for remote removal of trunnion collars by the Trunnion Collar Removal Machine. The collars are removed and placed into a holding rack within Area 1003 using the 30-ton crane and WP Trunnion Grapple.

The WP emplacement pallet with WP is lifted from the WP Turntable, moved to the transporter using the 200-ton crane and the WP/Pallet Yoke, and lowered into place onto the transporter bedplate. The transporter bedplate is retracted into the subsurface transporter, the shield door(s) of the transporter are closed, and the subsurface transporter is removed from FHF. The system interface activities are further discussed in *Emplacement and Retrieval System Description Document* (BSC 2004c).

6.1.1.4 Canister Handling Operations

Canister transfer operations are conducted within the Main Transfer Room (Area 1003) at the Canister Transfer Station. Using the 200-ton crane and MSC/Cask/WP Lifting Yoke, the MSC, Cask, or WP are moved from the Import/Export Trolley, placed into position on the floor at the Canister Transfer Station, and secured for canister transfer operations. The mobile elevated platform is moved in place next to the loaded cask for personnel to install a protective collar. The 30-ton auxiliary crane with a lid grapple device is used to remove the inner lids to a staging location within Area 1003. The 30-ton auxiliary crane is re-rigged with a sling to move a protective collar into Area 1003 for installation on the cask. This collar is designed to protect the cask sealing surfaces during canister transfer operations. The 200-ton crane with the appropriate canister grapple is used to lift and transfer the canisters.

Canister Transfer of DOE SNF/HLW can create a mismatch of canister types and numbers. A waste package can accept 5 DOE HLW canisters and 1 DOE SNF canister. Therefore either one transportation cask containing 5 HLW canisters and 1 SNF canister must be staged in Area 1003, or two transportation casks, one containing HLW canisters and one containing SNF canisters, must be staged in Area 1003.

After transfer operations, the protective collar is removed from the empty MSC or Cask for decontamination and re-staging. The MSC or Cask is then returned to the Import/Export Trolley using the 200-ton crane to then be moved to the Preparation Room for survey/decon prior to removal from FHF.

Following completion of canister transfer operations into a WP, the protective collar is removed remotely and, the inner lid is returned to the WP remotely using the 30-ton auxiliary crane and necessary grapples. The WP is then lifted using the 200-ton crane and MSC/Cask/WP Lifting Yoke from the floor of the Area 1003 to the Closure Trolley. The Closure Trolley is then moved into the WP Closure Transfer Room (Area 1013).

6.1.2 Main Transfer Area Sizing

The Main Transfer area is sized to provide the required space, layout, and structures required for waste handling operations to receive and package commercial, DOE SNF/HLW (Criteria 4.2.1). The following sections discuss the room sizes and crane heights to ensure operational feasibility. Preparation lift activities are further described in Section 6.1.1.1 and the *Cask/MSR/WRP Preparation System Description Document* (Cogema 2004c).

6.1.2.1 Main Transfer Room Footprint

The current Plant Design configuration sizes the Main Transfer Room at 61'0" wide by 100'0" long, (assumption 5.18). These dimensions and the crane hook approach for the 200-ton/30-ton aux Main Transfer Bridge Crane (Table 6) with an additional operating clearance of six (6) in. (Assumption 5.2), gives a final lift envelope of 45'0" by 82'0". The equipment list needed to support FHF Preparation activities is presented in Table 7. Major equipment needed to support mechanical handling activities in the Main Transfer Room is shown in Figure 1. Because a specific throughput is not dictated (Criteria 4.2.27), all non-essential equipment will be stored either in the Cask Preparation Room, Vestibule or outside the building. It is considered feasible using Criteria 4.2.23, to stage all necessary lifting yokes, slings, docking rings and trolley pedestals and, decontaminate and remove non-essential equipment before each transfer event.

Table 7 Major Equipment Footprint in Main Transfer Room

Equipment	Envelope (ft)	Weight (Tons)	Reference
Trunnion Collar Removal Machine	10.5 X 20.5	15	Areva. 2004b
WP Turntable	20 dia.	25	Cogema 2004g
WP Tilting Device	8 X 16.75	20	Cogema 2003d
WP/Pallet Lifting Yoke	8.75 X 12.5	12	Cogema 2003b
Trunnion Collar Stand	10 X 10	2	Assumption 5.15
Transporter Positioner	3 X 60	2	Cogema 2004f
Import/Export Trolley	12 X 20	35	Areva 2004a
WP Transfer Trolley	12 X 20	35	Areva 2004a
Transport Cask Transfer Trolley	12 X 20	35	Areva 2004a
MSC Transfer Trolley	12 X 20	35	Areva 2004a
Closure Trolley	12 X 20	35	Areva 2004a
WP Survey Remote Manipulator	6.5 radius	.75	BSC 2003a
Canister Transfer Station	15 X 26	N/A	Assumption 5.16

All equipment listed is at building elevation 0'

Refer to Figure 1 for layout in Main Transfer Room.

6.1.2.2 Main Transfer Room Elevation

The Main Transfer Room height (low ceiling) is constrained by the height envelope of a Cask/MS/WP placed on the Import/Export Trolley (*Cask/MS/WP Preparation System WP Trolley Mechanical Equipment Envelope*, Areva 2004a). Using this bounded height and (Assumption 5.1 and 5.5), the low ceiling (bottom of structural steel) height must be at least 28'3" building elevation to allow this bounding operation to occur.

The Main Transfer room height (high ceiling) is constrained by canister transfer operations. Starting with Assumption 5.5 that canister transfer will occur with the Cask/MS/WP resting at floor level a basic stack-up can begin a 0' building elevation. The Navy Long SNF cask taken from Table 3 is 234 in. long and the Navy Long SNF canister taken from Table 4 is 212 in. long. These two measurements plus a safe operating clearance (Assumption 5.6) of six inches will bound the canister handling operation height envelope at roughly 37'8" measured from the floor. Assumption 5.4 of four (4) feet for the canister handling grapple length and (Assumption 5.1) of two (2) ft. for crane operational clearance is added to the Main Transfer Bridge Crane operational envelope of 12'4" (Table 6) measured from the hook at high position to get an additional 18'4" of needed crane operational height envelope. These bounded canister handling and crane envelopes add for a total of 56'0" measured from the floor. The high ceiling (bottom of structural steel) height in the Main Transfer Room must be at least 56'0" building elevation to allow this bounding operation to occur.

6.1.2.3 Main Transfer Bridge Crane Rail Height

Given a bounding height for crane operations (canister transfer), the Main Transfer Bridge Crane rail height can be set. Canister transfer operation height of 37'8" added with Assumption 5.4 that sets the bounding canister handling grapple at 4' gives a total of 41'8" for high hook elevation. Using Table 6 for the high hook to top of rail dimension gives -11" and sets the minimum top of rail elevation at roughly 40'9". Therefore, this value when rounded to the nearest foot, yields 41'0".

6.1.3 Fuel Transfer Bays

The Fuel Transfer Bays (Areas 1004, 1005, and 1006 respectively) are single story concrete cells located between the Main Transfer Room (Area 1003) and the Remote Filter HEPA Room (Area 1007). Located adjacent to Area 1004 is the Gas Sampling Room (Area 1009). Floor mounted rails connect the three transfer bays with Area 1003 and shield doors (Criteria 4.2.25) separate them. Each Transfer Bay will contain a trolley to import/export a Cask/MS/WP and a docking port through which spent fuel transfer will take place.

6.1.3.1 Transfer Bay Operations

SNF/HLW transfer involving a loaded cask begins with the Transportation Cask Transfer Trolley with loaded Transportation Cask moving into Transfer Bay 2 and positioning under the docking port for subsequent transfer operations. Transfer involving a WP begins with the WP Transfer Trolley with empty WP moving into Transfer Bay 1 and positioning under the docking port for subsequent transfer operations. Transfer involving an MSC begins with the MSC Transfer

Trolley with a partially empty or empty MSC moving into Transfer Bay 3 and positioning under the docking port for subsequent transfer operations.

Figure 2 Fuel Transfer Areas Elevation View

Ref: Assumption 5.18.

6.1.4 Fuel Transfer Room

The Fuel Transfer Room (Area 2001) is a two story cell located between the Main Transfer Room (Area 1003) and the Fuel Transfer Control Room (Area 2002). Located adjacent to the Fuel Transfer Room (Area 2001) is the WP Closure Operating Gallery (Area 2005). At the third floor, building elevation 52'0", an equipment shield door separates the Fuel Transfer Room (Area 2001) from the Fuel Transfer Crane Maintenance Room (Area 3002)(Criteria 4.2.12). An area at the third floor level is reserved for docking plug stands. This area is created by recessing the equipment door into the Transfer Crane Maintenance Room (Area 3003).

6.1.4.1 Fuel Transfer Operations

Transfer of commercial SNF assemblies is conducted between transfer bay docking ports. When an empty WP (or empty MSC) and a loaded cask are positioned for docking under a docking port, the respective port docking operations can commence. The operation uses the Fuel Transfer Maintenance Bridge Crane and Docking Port Plug Grapple to lower the docking port onto the docking ring and establish radiological confinement with the floor of the Fuel Transfer Room (Area 2001). The WP (or Cask/MSC) inner lid is grappled by the docking port plug. The docking port plug with inner lid is lifted into the Fuel Transfer Room and placed on a port plug stand located at the third floor area adjacent to the crane maintenance door. SNF transfer operations between a loaded cask and an empty WP (or empty MSC) may begin once their inner lids and port plugs are removed and placed into the port plug stands.

Following completion of transfer operations, the docking port plug with inner lid attached is returned to the port. The inner lid is released from the port plug to the WP. The docking port is raised and disengaged and the transfer trolley is moved from the transfer bay to the Main Transfer Room (Area 1003).

6.1.5 Fuel Transfer Area Sizing

The Fuel Transfer area is sized to provide the required space, layout, and structures required for waste handling operations to receive and package commercial, DOE SNF/HLW (Criteria 4.2.1). The following sections discuss the room sizes and crane heights to ensure operational feasibility. Fuel transfer activities are further described in Section 6.1.4.1 and the *SNF/HLW Transfer System Description Document*, Cogema 2004e.

6.1.5.1 Fuel Transfer Bay Footprint

Fuel Transfer Bay dimensions will be bounded by the trolleys that operate in them. The trolley dimensions are 12'W X 20'L (Table 7). Adding an operational gap of one (1) ft. (Assumption 5.3) for the door rough opening in the current Plant Design model, gives a transfer bay size of at least 14'W X 22'L.

6.1.5.2 Fuel Transfer Room Footprint

The Fuel Transfer Room is sized to provide the space and layout for systems and utilities as required to support waste handling operations (Criteria 4.2.6). The equipment list needed to support these activities is presented in Table 8 and shown in Figure 3.

The current Plant Design configuration sizes the Fuel Transfer Room at 22'0" by 61'0" at the second floor level elevation 32'0", (assumption 5.18). These dimensions and the grapple approach for the Fuel Handling Machine (Assumption 5.14) gives a final fuel transfer envelope of 12'0" and 44'4". Figure 3 shows the current room configuration allowing for the space needed to conduct fuel transfer operations.

Plant Design configuration at the third floor level (elevation 52'0") sizes the Fuel Transfer Room at 56'0" and 61'0". These dimensions and the hook approach dimensions for the Fuel Handling Maintenance Bridge Crane given in Table 6 produces a final operational envelope of 36'4" and

53'6". Figure 3 shows the current room configuration allowing for the space needed for equipment maintenance activities.

Figure 3 Plan View of Fuel Transfer and Crane Maintenance Rooms

Ref: Assumption 5.18.

Table 8 Major Equipment Footprint in Fuel Transfer Room

Equipment	Envelope	Weight (tons)	Reference
Port Plug for Transfer Bay 1	10' dia. X 5'	20	Assumption 5.11
Port Plug for Transfer Bay 2	10' dia. X 5'	20	Assumption 5.11
Port Plug for Transfer Bay 3	10' dia. X 5'	20	Assumption 5.11
WP Transfer Port Plug Stand	10' dia. X 5'	1.8	Assumption 5.12
Transport Cask Transfer Port Plug Stand	10' dia. X 5'	1.8	Assumption 5.12
MSC Transfer Port Plug Stand	10' dia. X 5'	1.8	Assumption 5.12

6.1.5.3 Transfer Bay Elevation

The Fuel Transfer Bays are constrained by the height envelope of a Cask/MSD/WP placed on a Trolley (*Cask/MSD/WP Preparation System WP Trolley Mechanical Equipment Envelope*, Areva 2004a). Using this bounded height, and a one (1) ft. clearance for the door envelope (Assumption 5.3), the ceiling height must be at least 27'3" building elevation.

6.1.5.4 Fuel Transfer Room Elevation

The Fuel Transfer Room height dimension will be bounded by an equipment stack-up beginning with a port plug stand placed adjacent to the crane maintenance door at the 52'0" building elevation. Taking Assumption 5.12, which sizes the port plug stand at 5'0" tall and adding a safe operating clearance of 2'0" (Assumption 5.1), size of the port plug at 5'0" (Assumption 5.11) and, size of the port plug grapple at 3'0" (Assumption 5.13), the high hook dimension of the Fuel Transfer Maintenance Bridge Crane must be at least 67'0" building elevation.

Using Table 6, a high hook to top of crane operation envelope for a 30-ton crane is found. This dimension of 7'5", and a safe operating clearance (Assumption 5.1) of 2'0" is added to the 67'0" high hook dimension to give a minimum room elevation for the Fuel Transfer Room at 76'5".

6.1.5.5 Fuel Transfer Machine Rail Height

The Fuel Transfer Machine rail height is dictated by the longest fuel assembly shown in Table 5. The fuel assembly length of 180" is added to the Assumption 5.1 of 2'0" for safe operational clearance to yield a fuel transfer operational envelope of 17'0". This dimension is referenced from the Fuel Transfer Room floor which is at 32'0" building elevation. Using the *SNF/HLW Transfer System Spent Fuel Transfer Machine Mechanical Equipment Envelope* (Cogema, 2003f) for the high grapple to top of rail dimension, 2'9" is used and added to the operation envelope of 17'0" to get a top of rail of 19'9" above the Fuel Transfer Room floor or 51'9" building elevation.

6.1.5.6 Fuel Transfer Maintenance Bridge Crane Rail Height

The operational high hook dimension of 67'0" building elevation for the Fuel Transfer Maintenance Bridge Crane is given in Section 6.1.5.4. Table 6 shows a -1'5" top of rail to high hook dimension for the 30-ton crane. These two dimensions are added together to set a minimum rail height of 68'5".

6.2 CLOSURE SUPPORT EQUIPMENT

6.2.1 WP Closure Areas

FHF will contain one WP Closure Cell (weld cell). The WP Closure Cell shall be designed to the extent practical to utilize the same standard WP Closure Cell equipment designs as will be used in the Dry Transfer Facility and Canister Handling Facility (Criteria 4.2.13). FHF shall be sized such that adequate lay down is available for the FHF WP Closure Cell equipment and cask welding, inspection equipment etc, (See Figure 4). In addition FHF shall be sized with consideration given for adequate lay down for crane / lifting device grapple sets, rigging, slings, fixtures, and tooling, and various other auxiliary items required to perform the required functions within the FHF Transfer Cell (Criteria 4.2.38).

The WP Closure System provides safe, controlled, accurate, and consistent closure operations of WPs. WP closure begins once the Closure Trolley and WP are positioned in the WP Closure Transfer Room (Area 1013) and the shielded equipment door closes. The WP Closure System assumes control and conducts closure operations. When WP closure operations conclude, the shielded equipment door opens and the Closure Trolley and sealed WP will move back into the Main Transfer Room (Area 1003) for WP load out operations (See Section 6.1.1.3).

The WP Closure System processing areas supported by mechanical handling equipment are:

- Area 1013, WP Closure Transfer Room
- Area 2005, WP Closure Operating Gallery
- Area 2006, WP Closure Room
- Area 2008, WP Closure Support Room
- Area 3001, WP Closure Peening Equipment Room

Closure operations and the equipment needed for these activities lie outside the scope of this calculation. Equipment support for Closure operations is addressed by the Mechanical Handling Closure Group. Closure activities are also further described by the *Waste Package Closure System Description Document* BSC (Bechtel SAIC Company 2004h).

Only the mechanical equipment needed to support Closure activities will be address in this calculation. The equipment types include maintenance cranes (See Table 12), shielded equipment doors (See Table 9), and work stations for survey and decontamination (See Table 11).

Figure 4 Closure Areas Elevation View

Ref: Assumption 5.18

6.3 SUPPORTING MECHANICAL EQUIPMENT

Supporting mechanical equipment is positioned through the Main Transfer, Fuel Transfer and Closure areas. The equipment is standardized to the extent possible with assumptions stated in each of the following sections. Information regarding dimensions, weights, and building position are presented in tabular format.

6.3.1 Shielded Equipment Doors

Shielded equipment doors are shown in Table 9 below. Using Assumption 5.7 and the door rough opening to bound the door size, assumption 5.8 for the bounding door thickness and Table 2 for material densities, a bounding weight is found.

Table 9 Equipment Shield Doors

Shielded Equipment Doors	Dimensions (ft)	Type	Position in Building	Bounding Weight (Tons)
WP Transfer Equipment Door	18W X 28T	Single leaf Swing	1003/1004	117
Transportation Cask Transfer Equipment Door	16W X 28T	Single leaf Vertical	1003/1005	103.5
MSC Transfer Equipment Door	16W X 28T	Single leaf Swing	1003/1006	103.5
Closure Equipment Door	16W X 28T	Single leaf Horizontal	1003/1013	103.5
Fuel Transfer Crane Maintenance Door	60W X 8T	Double leaf Vertical	2001/3002	111.5
Filter Handling Maintenance Door	22W X 7T	Double leaf Vertical	1005/1007B	36
Filter Handling Equipment Door	16W X 12T	Single leaf Swing	1007B/1007C	44.5

Door location and rough opening discussed in Assumption 5.18

6.3.2 Shielded Personnel Doors

Shielded personnel doors are shown in Table 10 below. Using Assumption 5.7 and the door rough opening to bound the door size, assumption 5.8 for the bounding door thickness and Table 2 for material densities, a bounding weight is found.

Table 10 Shielded Personnel Doors

Shielded Personnel Doors	Dimensions (ft)	Type	Position in Building	Bounding Weight (Tons)
Main Transfer Personnel Egress Door	5W X 8T	Single leaf Horizontal	1003/Egress	9.5
Main Transfer Personnel Door	5W X 8T	Single leaf Horizontal	1003/1015	9.5
Fuel Transfer Personnel Door No. 1	5W X 8T	Single leaf Horizontal	2001/3002	9.5
Fuel Transfer Personnel Door No. 2	5W X 8T	Single leaf Horizontal	2001/2002	9.5

Door location and rough opening discussed in Assumption 5.18

6.3.3 Work Stations

Work stations are used in several locations in FHF supporting survey/decon in the Main Transfer Room, Fuel Transfer Room and, Closure Cell (Criteria 4.2.14). Work stations are comprised of the items addressed below. The items shown are initial configurations only, work stations will be adapted to suit specific support needs. Work station manipulator operational envelopes are based on the *Canister Handling Facility Manipulator Work Station Mechanical Equipment Envelope* (Cogema. 2004a).

The Work Station equipment includes:

- (1) 24" X 36" Shielded window
- (2) Master Slave Manipulators
- (1) Wall Mounted Work Table

Table 11 Work Stations

Manipulator Work Station	Operation	Position in Building	Weight (Tons)
Main Transfer MSM Work Station No. 1	Survey/Decon	1003/1015	3.75
Main Transfer MSM Work Station No. 2	Survey/Decon	1003/1015	3.75
Fuel Transfer MSM Work Station No. 1	Survey/Decon	2001/2002	3.75
Fuel Transfer MSM Work Station No. 2	Survey/Decon	2001/2002	3.75
Fuel Transfer MSM Work Station No. 3	Survey/Decon	2001/2002	3.75
Closure Cell MSM Work Station No. 1 (Single MSM)	Survey/Decon	2005/2006	3.75
Closure Cell (Window only)	Survey/Decon	2005/2006	1.75
Closure Cell (Window only)	Survey/Decon	2005/2006	1.75
Closure Cell (Window only)	Survey/Decon	2005/2006	1.75

Work Station locations are discussed in Assumption 5.18. Work Stations weights are addressed in Assumption 5.10.

6.3.4 Cranes/Handling Machines

Cranes and Handling Machines traveling on elevated crane rails are shown below in Table 12.

Table 12 Crane/Machine Rail Elevations

Crane Description	Capacity (Tons)	Rail Elevation	Weight Empty (lbs)
Main Transfer Bridge Crane	200/30aux	41'0"	260,000
Fuel Handling Machine	1.5	52'0"	10,000
Fuel Transfer Maintenance Bridge Crane	30	68'6"	50,000
Closure Operations Bridge Crane	15	55'0"	39,300
Upper Closure Maintenance Bridge Crane	15	86'0"	39,300
Filter Handling Machine	10	21'10"	34,000

Crane elevations and capacities discussed in Assumption 5.18

Crane weights are taken from information given in Table 6.

7. RESULTS

The purpose of this task is to establish bases for the dimensions and operational envelopes for the Main Transfer and Fuel Transfer areas in the Fuel Handling Facility. The resulting envelopes are the minimum envelopes that allow the required functionality of these areas in the Fuel Handling Facility. The results given in this calculation are reasonable in regards to the given criteria and present a case for operational feasibility. The equipment types and dimensions described in this calculation are based solely on the inputs described in Table 7, Table 8, Table 11, Table 12 and, the assumptions in section 5. The equipment described here are considered adequate for the operational processes outlined in Section 6. Major equipment needed to support operations is discussed in Section 6. The following table addresses the resulting envelopes and an equipment list is included in Attachment I.

Table 13 Results

Description	See Section/Figure	Result
Main Transfer Room dimensions	6.1.2.1	Room Footprint
	6.1.2.2	Low Ceiling Height
Fuel Transfer Bay dimensions	6.1.5.1	Room Footprint
	6.1.5.3	Ceiling Height
Fuel Transfer Room dimensions	6.1.5.2	Room Footprint
	6.1.5.4	Ceiling Height
Supporting Mechanical Equipment	6.3.1	Shielded Equipment Doors
	6.3.2	Shielded Personnel Doors
	6.3.3	Work Stations
Cranes and Handling Machines	6.3.4	Capacity
		Rail Elevation

8. REFERENCES

Ref. #	Reference
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ATTACHMENT I

Current Mechanical Handling Equipment List

The following tables describe the current Mechanical Handling and Mechanical equipment lists needed to support FHF activities. The equipment list will be updated as more information is available.

Table A-1 Main Transfer Area Mechanical Handling Equipment

Main Transfer Area Equipment (Mechanical Handling)		
Equipment Number	Item	Room Location
210-MJ-HEW0-WPTS0001	WP Tilting Device	1003
210-MJ-HLT0-LB000001	WP/Pallet Lifting Yoke	1003
210-MJ-HM00-LB000001	Docking Ring Lifting Device	1003
210-MJ-HM00-LFYK0001	MSC/Cask/WP Lifting Yoke	1003
210-MJ-HMH0-LFYK0002	Navy Cask Lifting Yoke	1003
210-MJ-HMH0-LFYK0003	Navy Cask Pedestal Lifting Yoke	1003
210-MJ-HMH0-PDL00001	Cask Trolley Pedestal	1003
210-MJ-HMP0-GRPL0001	WP Lid Grapple	1003
210-MJ-HMP0-PDL00001	WP Trolley Pedestal	1003
210-MJ-HTD0-LFYK0001	DPC Lifting Yoke	1003
210-MJ-HTL0-PSNR0001	Transporter Positioner	1003
210-MJ-HTL0-TURN0001	WP Turntable	1003
210-MJ-HTT0-GRPL0001	Navy Canister Grapple	1003
210-MJ-HTT0-GRPL0003	Navy Cask Lid Grapple	1003
210-MJ-HTT0-GRPL0004	WP Inner Lid Grapple	1003
210-MM-MRA0-MMW00001	WP Survey Remote Manipulator	1003
210-MX-HMH0-STND0001	Personnel Stand	1003
210-MX-HTL0-CRM00001	Trunnion Collar Removal Machine	1003
210-AK-HM00-SHDR0006	WP Transfer Equipment Door	1003/1004
210-AK-HM00-SHDR0007	Transport Cask Transfer Equipment Door	1003/1005
210-AK-HM00-SHDR0008	MSC Transfer Equipment Door	1003/1006
210-MQ-HMH0-TT000001	WP Transfer Trolley	1003/1004
210-MQ-HMH0-TT000002	Transport Cask Transfer Trolley	1003/1005
210-MQ-HMH0-TT000003	MSC Transfer Trolley	1003/1006
210-AK-HW00-SHDR0009	Closure Equipment Door	1003/1013
210-MQ-HMH0-TT000004	Closure Trolley	1003/1013
210-MJ-HMH0-CRN00003	Main Transfer Bridge Crane	1003/2013
210-MQ-HMH0-TT000005	Import/Export Trolley	1002/1003

Table A-2 Main Transfer Area Mechanical Equipment

Main Transfer Area Equipment (Mechanical)		
Equipment Number	Item	Room Location
210-AK-HM00-SHDR0011	Main Transfer Personnel Egress Door	1002/1003
210-AK-HM00-SHDR0005	Main Transfer Personnel Door	1003/1003B
210-AD-HM00-ADGS0001	Main Transfer Survey Operations Window No. 1	1003/1015
210-AD-HM00-ADGS0002	Main Transfer Survey Operations Window No. 2	1003/1015
210-N0-HM00-MSM00001	Main Transfer MSM No. 1	1003/1015
210-N0-HM00-MSM00002	Main Transfer MSM No. 2	1003/1015
210-N0-HM00-MSM00003	Main Transfer MSM No. 3	1003/1015
210-N0-HM00-MSM00004	Main Transfer MSM No. 4	1003/1015
210-NE-MRD0-GBOX0001	Closure Decon Posting Port	1003/1015

Table A-3 Fuel Transfer Area Mechanical Handling Equipment

Fuel Transfer Area (Mechanical Handling)		
Equipment Number	Item	Room Location
210-MJ-HTT0-CRN00006	Fuel Transfer Maintenance Bridge Crane	2001/3002
210-MJ-HTT0-SFTM0001	Fuel Transfer Machine	2001
210-MX-HTT0-PORT0001	Port Plug for Transfer Bay 1	1004/2001
210-MX-HTT0-PORT0002	Port Plug for Transfer Bay 2	1005/2001
210-MX-HTT0-PORT0003	Port Plug for Transfer Bay 3	1006/2001
210-MJ-HTT0-GRPL0002	Docking Port Plug Grapple	2001
210-MJ-HTT0-GRPL0005	FTM PWR Grapple	2001
210-MJ-HTT0-GRPL0006	FTM BWR Grapple	2001
210-MJ-HTT0-GRPL0007	FTM Grapple No. 1	2001
210-MJ-HTT0-GRPL0008	FTM Grapple No. 2	2001

Table A-4 Fuel Transfer Area Mechanical Equipment

Fuel Transfer Area (Mechanical)		
Equipment Number	Item	Room Location
210-AD-HT00-ADGS0004	Fuel Transfer Operations Window No. 1	2001/2002
210-AD-HT00-ADGS0005	Fuel Transfer Operations Window No. 2	2001/2002
210-AD-HT00-ADGS0006	Fuel Transfer Operations Window No. 3	2001/2002
210-AK-HT00-SHDR0014	Fuel Transfer Personnel Door No. 1	2001/3002
210-AK-HT00-SHDR0015	Fuel Transfer Personnel Door No. 2	2002/2010

210-AK-HT00-SHDR0016	Fuel Transfer Equipment Door	2001/3002
210-MJ-HTT0-CRN00010	Fuel Transfer Window Maintenance Hoist No. 1	2002
210-MJ-HTT0-CRN00011	Fuel Transfer Window Maintenance Hoist No. 2	2002
210-MJ-HTT0-CRN00012	Fuel Transfer Window Maintenance Hoist No. 3	2002
210-MJ-HTT0-STND0001	WP Transfer Port Plug Stand	2001
210-MJ-HTT0-STND0002	Transport Cask Transfer Port Plug Stand	2001
210-MJ-HTT0-STND0003	MSC Transfer Port Plug Stand	2001
210-MJ-HTT0-STND0004	FTM PWR Grapple Stand	2001
210-MJ-HTT0-STND0005	FTM BWR Grapple Stand	2001
210-MJ-HTT0-STND0006	FTM Grapple No. 1 Stand	2001
210-MJ-HTT0-STND0007	FTM Grapple No. 2 Stand	2001
210-N0-HT00-MSM00001	Fuel Transfer MSM No. 1	2001/2002
210-N0-HT00-MSM00002	Fuel Transfer MSM No. 2	2001/2002
210-N0-HT00-MSM00003	Fuel Transfer MSM No. 3	2001/2002
210-N0-HT00-MSM00004	Fuel Transfer MSM No. 4	2001/2002
210-N0-HT00-MSM00005	Fuel Transfer MSM No. 5	2001/2002
210-N0-HT00-MSM00006	Fuel Transfer MSM No. 6	2001/2002
210-NE-MRA0-GBOX0001	Fuel Transfer Survey Posting Port	2001/2002

Table A-5 Closure Area Mechanical Equipment

Closure Area (Mechanical)		
Equipment Number	Item	Room Location
210-MJ-HW00-CRN00004	Closure Operations Bridge Crane	2008
210-MJ-HWW0-CRN00005	Upper Closure Maintenance Bridge Crane	3001
210-MJ-HWW0-CRN00016	Closure Window Maintenance Hoist No. 1	2005
210-MJ-HWW0-CRN00017	Closure Window Maintenance Hoist No. 2	2005
210-MJ-HWW0-CRN00018	Closure Window Maintenance Hoist No. 3	2005
210-MJ-HWW0-CRN00019	Closure Window Maintenance Hoist No. 4	2005
210-AD-HW00-ADGS0007	Closure Operations Window No. 1	2005/2006
210-AD-HW00-ADGS0008	Closure Operations Window No. 2	2005/2006
210-AD-HW00-ADGS0009	Closure Operations Window No. 3	2005/2006
210-AD-HW00-ADGS0010	Closure Operations Window No. 4	2005/2006
210-N0-HWW0-MSM00001	Closure MSM	2005/2006

Table Remote HEPA Filter Room Mechanical Equipment

HVAC (Mechanical)		
Equipment Number	Item	Room Location
210-MJ-VN00-HFHM0001	Filter Handling Machine	1007
210-AK-VN00-SHDR0012	Filter Handling Equipment Door	1007C/1007B
210-AK-VN00-SHDR0013	Filter Handling Maintenance Door	1005/1007B