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Repository Surface Facilities Primary System Crane Data

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CONTENTS

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TABLES

ACRONYMS

ATS	Assembly Transfer System
Aux	auxiliary
CCHS	Carrier/Cask Handling System
CPB-MHS	Carrier Preparation Building – Materials Handling System
CTS	Canister Transfer System
DC	disposal container
DCHS	Disposal Container Handling System
DOE	U. S. Department of Energy
DPC	dual-purpose canister
ft	foot
HLW	high-level waste
lbs	pounds
MCO	multi-canister overpack
SNF	spent nuclear fuel
SPA	Space Program Analysis
SSC	structures, systems, and components
WHB	Waste Handling Building
WP	waste package
WPRS	Waste Package Remediation System
WTB	Waste Treatment Building

1. PURPOSE

The purpose of this calculation is to compile crane design data for the mechanical primary structures, systems, and components (SSCs) required for the repository Waste Handling Building (WHB) and Carrier Preparation Building (CPB).

The work presented in this document has been prepared in accordance with Office of Civilian Radioactive Waste Management approved program document AP-3.12Q, *Calculations*. This calculation has been developed to supplement information previously prepared using the development plan for *WHB/WTB Space Program Analysis for Site Recommendation* (Reference 5), which concentrates on the primary, primary support, facility support, and miscellaneous building support areas located in the WHB and Waste Treatment Building (WTB). The development plan was completed in accordance with AP-2.13Q, *Technical Product Development Planning*. The work in this calculation is a continuance of the work described in the previous development plan; therefore, in accordance with AP-2.21Q, *Quality Determinations and Planning for Scientific, Engineering, and Regulatory Compliance Activities*, a new Technical Work Plan is not required.

The method used to control the electronic management of data was accomplished in accordance with the controls specified in AP-SV.1Q, *Control of the Electronic Management of Data.*

2. METHOD

A review of existing documents was conducted to determine existing definitions of crane data for the Waste Handling Building and Carrier Preparation Building. Existing information was compiled in Table 6-1. Where there was no existing information, crane data was derived by calculation from known dimensions.

3. ASSUMPTIONS

There are no assumptions used as input in this calculation.

4. USE OF COMPUTER SOFTWARE AND MODELS

Software used in the development of this analysis was limited to standard commercial software (Excel and Microsoft Word) provided by the Yucca Mountain Project and loaded on standard workstation computers. As standard office automation software, this software is exempt from qualification under the requirements of AP-SI.1Q, *Software Management*. No macros or software routines were used or developed to perform this work.

5. CALCULATION

Unless otherwise noted, information in this section is from Reference 3, *WHB/WTB Space Program Analysis for Site Recommendation,* REV 00. Specific sections may be cited, as applicable.

5.1 CARRIER PREPARATION BUILDING – MATERIALS HANDLING SYSTEM

5.1.1 Carrier Preparation Building Bridge Crane

The building is designed to accommodate four parallel tracks/roadways for the passage of both truck and rail carrier over the same surface using recessed/sunken tracks. All paths accommodate both arriving and departing traffic, depending on current needs. External trackage and roadway allows any necessary shunting.

The primary area width is determined by the four roadways, their required separation, and the additional overhang to accommodate the overall span and outside-wall rail supports of the two 10-ton bridge cranes, which run the length of the building and service two sets of tracks. These cranes, in turn, each span a 2-ton gantry, which positions a manipulator with telescoping arm equipped with remote hand tools to remove and replace the bolts which attach the impact limiters to the transportation cask (Reference 1, p. 113).

Number of cranes: 2
Capacity: 10 tons
Span: 58' (Reference 2, p. 30)

5.2 CARRIER/CASK HANDLING SYSTEM

5.2.1 Carrier Bay Bridge Crane

The carrier bay bridge crane is mounted on overhead rails in the carrier bay and consists of a double bridge girder, trolley, main hoist, and auxiliary hoist. The crane main hoist/hook, rated for lifting a 160-ton load, is equipped with an electrically powered rotating hook to rotate the cask, if required. The crane main hoist is used in conjunction with the cask lifting yoke. The auxiliary hoist hook is used for lighter lifting operations (Reference 3, p. 30).

The crane bridge span of 78 ft is based on the carrier bay width of 80 ft minus a 2-ft clearance between the crane rails and the carrier bay walls.

Number of cranes: 1
Capacity: 160 tons
Span: 78' (Reference 3, p. 30)

5.3 ASSEMBLY TRANSFER SYSTEM

5.3.1 Cask Unloading Area Bridge Crane

The cask unloading area bridge crane, PU-CN-110, is used to handle heavy loads in the Assembly Transfer System (ATS). One bridge crane is provided for each ATS line. The bridge crane is an overhead rail-mounted crane that travels along the cask unloading pool area parallel to the ATS lines. The crane consists of a double girder bridge, a rail-mounted trolley, a 160-ton rotating main hook, a 25-ton auxiliary hook, and a maintenance access platform. At the

maximum lift position, the hook elevations are at the bridge crane rail level. The bridge crane trolley and bridge move in a rectangular (x-y) pattern and the main/auxiliary hooks move in a vertical (z) motion. The main function of the bridge crane is to transfer transportation casks and dual-purpose canister (DPC) overpacks between the cask transfer cart, the cask preparation pits, and the cask unloading pool, using a variety of dedicated dry and wet lifting yokes. The bridge crane lifting capacity of 160 tons is based on the combined weights of the heaviest transportation cask (150 tons) and the heaviest lifting yoke (8.5 tons). The bridge crane key dimensions include a bridge span of 43', height from top of rail of 12', trolley rail span of 15', overall width of 25', and a hook vertical travel of 106' furnished by a reputable crane manufacturer.

Number of cranes: 2
Capacity: 160 tons
Aux. Hoist: 25 tons
Span: 43' (Reference 3, Figure I-16)

5.3.2 Assembly Handling Cell Bridge Crane

The assembly handling cell bridge crane, PU-CN-113, is used to support ATS dry fuel handling operations. The assembly handling cell bridge crane is an overhead rail-mounted crane with a 15-ton main hoist and a 5-ton auxiliary hoist. The bridge crane main hoist is used in the assembly handling cell to install and remove the assembly drying vessel lids, the assembly drying vessel shield plugs, and the disposal container (DC) load port shield plug. The main hoist and auxiliary hoist are also used to handle and transfer equipment and components during assembly handling cell maintenance and recovery operations. The crane consists of a rail-mounted trolley, equipped with main and auxiliary hoists, and a double-girder bridge. The main hook is equipped with an electrically powered rotating hook. The bridge and trolley travel in a rectangular (x-y) pattern in the assembly handling cell and the main and auxiliary hooks travel in a vertical (z) direction. The assembly handling cell bridge crane capacity is based on the weight of the heaviest assembly drying vessel shield plug segment (14 tons). A 15-ton crane capacity is selected based on standard crane sizes for several suppliers. The bridge crane key dimensions include a bridge span of 35'-6", height from top of rail of 6'-3", trolley rail span of 7', overall width of 16', and a hook vertical travel of 48'. The 35'-6" span of the bridge crane is based on the 38' width of the assembly handling cell. The 48' lift capability of the crane is based on elevation of the bridge crane in the assembly handling cell and the requirement for the crane hook to reach the assembly drying vessel elevations below the cell floor for removal of the assembly drying vessel lids. The overall design configuration and dimensions of the assembly handling cell bridge crane are based on crane vendor information and best available engineering data.

Number of cranes: 2
Capacity: 15 tons
Aux. Hoist: 5 tons
Span: 35'-6" (Reference 3, Figure I-21)

5.3.3 Non-Standard Fuel Pool Overhead Crane

The mobile work platform is a motorized bridge crane type configuration, straddling the non-standard pool and travelling on 17-ft span rails on top of the pool deck. The mobile work platform is used by the operators for observing, handling, guiding, transforming, packaging, monitoring, and cleaning operations. The 30-ton overhead crane is used for all lifting operations. The non-standard fuel basket transfer canal isolation gate is assumed to be the heaviest load to be handled by the overhead crane and its weight has been conservatively estimated at 27 tons.

A 30-ton crane capacity has been selected. The gate has a trapezoidal shape with 10-ft and 8-ft long bases, a 40–ft height, 1-ft thick, and made of concrete. Therefore the gate weighs 27 tons [((10 ft+8 ft)/2) x 40 ft x 1 ft)) x 150 lbs/ft3 = 54,000 lbs. (27-tons)] (Reference 3, p. 45).

Number of cranes: 1
Capacity: 30 tons
Span: 36' (Reference 3, Figure I-39)

5.3.4 Fuel Basket Storage Pool Overhead Service Crane

Each of the four fuel basket storage pool overhead service cranes has a 20-ton capacity, with a 50-ft span. Other than general maintenance, the crane functions include handling of the storage pool fuel assembly storage racks, the fuel basket transfer carts, and the fuel basket transfer canal isolation gates. The fuel basket transfer canal isolation gates are assumed to be the heaviest load to be handled by the overhead crane, and the weight of each has been estimated at 15 tons. The gate is a trapezoidal shape with 10-ft and 8-ft long bases, 22 ft in height, 1 ft thick, and made of concrete. (Reference 3, p. 41)

Number of cranes: 4
Capacity: 20 tons
Span: 50' (Reference 3, p. 41)

5.4 CANISTER TRANSFER SYSTEM

5.4.1 Canister Transfer Cell Bridge Crane

All radioactive canister transfer operations are performed remotely in the shielded canister transfer handling cell. The canisters are removed from a cask one at a time using in-cell remote equipment and placed either in the DC, the canister staging area, or the off-normal canister port to be transported to the off-normal canister handling cell. Once a DC is loaded, it is transported to the Disposal Container Handling System (DCHS). The empty cask is returned to the cask preparation and decontamination area and the CCHS for off-site shipment. Remote handling equipment in the canister transfer cell includes a 65-ton overhead bridge crane (equipped to handle the large and small canisters) (Reference 3, p. 47).

The width of the crane maintenance bay is 35 ft to match the width of the canister transfer cell. There is adequate space available to perform maintenance on the bridge crane and the DC

loading manipulator.

Number of cranes: 1
Capacity: 65 tons
Span: 35' (Reference 3, p. 50)

5.4.2 Off-Normal Canister Handling Cell Bridge Crane

Department of Energy (DOE) waste is handled by the Canister Transfer System. The largest diameter and heaviest DOE High-Level Waste (HLW) and spent nuclear fuel (SNF) canister is the Hanford Multi-Canister Overpack (MCO) (Reference 4, Figure B-12). The canister weight is approximately 10 tons. The estimated weight of an off-normal overpack for the MCO is approximately 2 tons (Reference 4, Figure B-12). The grapple mechanism is estimated to weigh approximately 1 ton. Therefore, the total hook load for the off-normal canister handling cell bridge crane is approximately 13 tons. A 15-ton crane capacity is selected based on standard crane sizes for several suppliers. The overall design configuration and dimensions of the off-normal canister handling cell bridge crane are based on crane vendor information and best available engineering data.

Number of cranes: 1
Capacity: 15 tons
Span: 30' (Reference 3, Figure I-30)

5.5 DISPOSAL CONTAINER HANDLING SYSTEM

5.5.1 Disposal Container Handling Cell Bridge Crane

The DC handling cell contains two overhead bridge cranes to provide redundancy for the DC handling cell operations. Should a lengthy crane outage occur or a crane failure result in extended periods of crane maintenance, a backup crane is needed to avoid costly delays in waste handling operations. A second crane will prevent the interruption of all surface waste handling operations, ensuring that waste throughput rates are maintained. Both cranes are also provided with independent rails and power supplies to protect the cranes from a common mode failure.

The identical bridge cranes are mounted on separate rails in the DC handling cell, one above the other. Each crane consists of a double-girder bridge and a rail-mounted trolley equipped with main and auxiliary hoists. Each bridge crane is equipped with a 150-ton main hoist and a 10-ton auxiliary hoist. This allows unrestricted access to the DC cell operating areas with either crane. The bridge and trolley travel in a rectangular (x-y) pattern, and the hooks travel in the vertical (z) direction. The 74' span of the bridge crane is based on the 72' width of the DC Handling Cell, exluding corbels. The main hook is capable of power rotation over 360 degrees (Reference 3, p. 54).

Number of cranes: 2
Capacity: 150 tons

Aux. Hoist: 10 tons
Span: 74' (Reference 3, Figure I-32)

5.5.2 Empty DC Preparation Bridge Crane

Empty disposal containers are handled by the Disposal Container Handling System. The largest empty disposal container to be handled in the empty disposal container preparation area is for the DOE HLW and SNF co-disposal canisters. This empty disposal container weighs approximately 36 tons. The estimated weight of the disposal container lifting and base collars is approximately 7 tons. The estimated weight of the disposal container lifting yoke is 9 tons. The estimated weight of the inner lid sealing device is approximately 1 ton. Therefore, the total crane load for the empty disposal container preparation area bridge crane is approximately 53-ton. A 60-ton crane capacity with a 10-ton auxiliary hoist is selected based on size standards for specialty cranes. The 84' span of the bridge crane is based on the width of the empty disposal container preparation area.

Number of cranes: 1
Capacity: 60 tons
Aux. Hoist: 10 tons
Span: 84' (Reference 3, Figure I-36)

5.5.3 Welder Maintenance Bridge Crane

The welder maintenance area bridge crane is used to support DC welding, heat treating, and inspection equipment operations and maintenance. The bridge crane is used in the welder maintenance area for all lifting and handling operations in support welder maintenance and service operations. The crane consists of an overhead double girder bridge and rail-mounted trolley equipped with a 20-ton hoist. The crane and trolley travel in a rectangular (x-y) pattern and the crane hook travels in a vertical (z) direction. The empty welder maintenance cell is a manned area; therefore, the crane is equipped with an access platform for contact recovery and maintenance operations. The welder maintenance cell bridge crane capacity is based on the maximum weight of the DC welding/inspection machine (15 tons). The 36' span of the bridge crane is based on the width of the welder maintenance area. The overall design configuration and dimensions of the welder maintenance area bridge crane are based on crane vendor information and best available engineering data.

Number of cranes: 1
Capacity: 20 tons
Span: 36' (Reference 3, Figure I-32)

5.5.4 Waste Package Horizontal Lifting Machine

Waste packages (WPs) are loaded on the subsurface transporter by the waste package horizontal lifting machine in the Disposal Container Handling System. The largest WP to be handled in the Disposal Container Handling System weighs approximately 80 tons. The estimated weight of the

lifting and base collars for the WP is approximately 7 tons. The estimated weight of the waste package horizontal lifting machine yokes is approximately 3 tons. Therefore, the total crane load for the horizontal lifting machine is approximately 90 tons. A 100-ton crane capacity is selected based on size standards for specialty cranes. The 22' span of this specialized crane is based on the width of WP transporter.

Number of lifting machines: 1
Capacity: 100 tons
Span: 22' (Reference 3, Figure I-34)

5.5.5 WP Transporter Load Cell Bridge Crane

The WP transporter load cell bridge crane is used to support WP transporter loading operations. The bridge crane is used in the WP transporter load cell to remove DC handling collars from the waste package, suspend the DC handling collars during collar decontamination operations, and perform collar handling operations in the load cell. The bridge crane is also used to lift and transfer equipment and components during WP transporter load cell maintenance. The crane consists of an overhead double girder bridge and rail-mounted trolley equipped with a 10-ton hoist. The bridge and trolley travel in a rectangular (x-y) pattern and the crane hook travels in a vertical (z) direction. The WP transporter load cell bridge crane capacity is based on the weight of the largest DC base collar (3.5 tons). The 34' span of the bridge crane is based on the 36' width of the WP transporter load cell. The 30' lift capability of the crane is based on the operating elevation of the bridge crane in the WP transporter load cell and the requirement for the crane hook to reach the DC cart in the WP transporter load cell. The overall design configuration and dimensions of the WP transporter load cell bridge crane are based on crane vendor information and best available engineering data.

Number of cranes: 1
Capacity: 10 tons
Span: 34' (Reference 3, Figure I-34)

5.6 WASTE PACKAGE REMEDIATION SYSTEM

5.6.1 WPRS Manipulator and Hoist

One of the two bridge-mounted trolleys in the Waste Package Remediation System (WPRS) hot cell is equipped with a 4-ton remote manipulator and hoist. The 35' span of the bridge is based on the 37' width of WPRS cell.

Number of cranes: 1
Capacity: 4 tons
Span: 35' (Reference 3, Figure I-38)

5.6.2 Waste Package Remediation System Cutting Machine

One of the two bridge-mounted trolleys in the WPRS hot cell is equipped with a 4-ton waste

package lid cutting machine. The 35' span of the bridge is based on the 37' width of WPRS cell.

Number of cutting machines: 1
Capacity: 4 tons
Span: 35' (Reference 3, Figure I-38)

5.7 PRIMARY SUPPORT AREAS

5.7.1 Equipment Transfer Corridor Bridge Cranes

The purpose of the equipment transfer corridors is to facilitate equipment movement in and out of the maintenance bays and adjacent hot cells. The functional space requirements mandated the design layout to integrate two equipment transfer corridors into the overall WHB in order to provide access to the primary area hot cells where maintenance bays are used for equipment repair, replacement, and recovery operations.

The first corridor traverses the ATS and canister transfer system (CTS) lines and passes directly over their respective maintenance bays. The second corridor location traverses the DCHS and WPRS hot cells and passes directly over the DC handling cell maintenance bay and the multi-purpose remediation work cell. The crane equipment anticipated to be installed above each transfer corridor is a 50-ton overhead bridge crane. Each 50-ton crane requires large unobstructed vertical space that permits large equipment to be removed through hot cell ceiling hatches to contaminated equipment rooms and also allows equipment movement without partial disassembly in the hot cell maintenance bay. The span of each crane is based on the dimensions of the transfer corridors (Reference 3, p. 61).

Assembly Transfer System and Canister Transfer System Equipment Transfer Corridor Bridge Crane

Number of cranes: 1
Capacity: 50 tons
Span: 48' (Reference 3, p. 61)

Disposal Container Handling and Waste Package Remediation System Equipment Transfer Corridor Bridge Crane

Number of cranes: 1
Capacity: 50 tons
Span: 57' (Reference 3, p. 61)

6. RESULTS

The compiled crane capacity and size information for the Surface Facilities is shown on Table 6-1.

Table 6-1. Compiled Crane Capacity and Size Information for the Surface Facilities

System	Equipment Description	Qty	Capacity	Span
CPB-MHS	Carrier Preparation Building Bridge Crane	2	10 tons	58'
CCHS	Carrier Bay Bridge Crane	1	160 tons	78'
ATS	Cask Unloading Area Bridge Crane	2	160 tons Aux. Hoist: 25 tons	43'
ATS	Assembly Handling Cell Bridge Crane	2	15 tons Aux. Hoist: 5 tons	35'-6"
ATS	Non-Standard Fuel Pool Overhead Crane	1	30 tons	36'
ATS	Fuel Basket Storage Pool Overhead Service Crane	4	20 tons	50'
CTS	Canister Transfer Cell Bridge Crane	1	65 tons	35'
CTS	Off-Normal Canister Handling Cell Bridge Crane	1	15 ton	30'
DCHS	Disposal Container Handling Cell Bridge Crane	2	150 tons Aux. Hoist: 10 tons	74'
DCHS	Empty DC Preparation Bridge Crane	1	60 tons Aux. Hoist: 10 tons	84'
DCHS	Welder Maintenance Bridge Crane	1	20 tons	36'
DCHS	Waste Package Horizontal Lifting Machine	1	100 tons	22'
DCHS	WP Transporter Load Cell Bridge Crane	1	10 tons	34'
WPRS	WPRS Cutting Machine	1	4 tons	35'
WPRS	WPRS Manipulator and Hoist	1	4 tons	35'
Primary Support Areas	Assembly Transfer System and Canister Transfer System Equipment Transfer Corridor Bridge Crane	1	50 tons	48'
Primary Support Areas	Disposal Container Handling and Waste Package Remediation System Equipment Transfer Corridor Bridge Crane	1	50 tons	57'

7. REFERENCES

7.1.1 Cited Documents

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8. ATTACHMENTS

There are no attachments to this calculation.