Phase 1 Intermediate Design Report
Hudson River PCBs Superfund Site

Attachment F – Design Analysis: Unloading and Waterfront Facilities

General Electric Company
Albany, New York

August 22, 2005

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Attachment F – Design Analysis: Unloading and Waterfront Facilities

1. General

This attachment documents the project objectives and criteria for the design of the unloading and waterfront facilities. The analysis lists the applicable design standards, reference information available, assumptions made during design, relevant site information, and construction materials scheduled to be used for the unloading and waterfront facilities.

Project objectives for designing the unloading and waterfront facilities for Phase 1 include the following:

1. Design a structure for a 200-foot long dredged material barge to berth and be unloaded. The wharf may also need to accommodate berthing of two smaller 100-foot long barges, if needed.
2. The unloading structure must include an impervious wearing surface and be capable of supporting a track mounted crane or hydraulic excavator.
3. The unloading structures must accommodate the unloading of one dredged material barge for Phase 1. The site is capable of supporting a second wharf and unloader for Phase 2 with some additional modifications. The need for a second wharf and unloader for Phase 2 operations will be evaluated during the Phase 1 Final Design.
4. The barge berth must not encroach into the navigation channel.
5. Material removed for the berth construction can be used onsite.
6. Widening of the channel for the berth must include an area for support vessel docking and tug turn-around.

Design standards include the following:

- New York State Building Code, 2000 International Building Code;
- SEI/ASCE 7 Minimum Design Loads For Buildings And Other Structures;
- ACI 318 Building Code And Commentary;
- AISC Manual of Steel Construction, LRFD, Third Edition;
- AWS Structural Welding Code – Steel;
- NY State Canal Corporation Design Standards;
- ASTM A36: Steel Grade (36ksi material); and
- ASTM A572: Steel Grade (50ksi material).

Design survey controls include:

- Vertical Control: NAVD-88.
- Horizontal Control: NAD-83 / New York State Plane – East Zone.

Additional information on the site, design loads, and materials for the waterfront and unloading facilities is provided in the Tables F1 to F3 below.

Table F1 - Relevant Site Information for Design of Unloading and Waterfront Facilities

Existing Conditions and Proposed Elevations	Channel Width (Approximately)	75 feet
	Bottom of Channel Elevation	+117.0 feet +/-
	Low Water Surface (LWS)	+129.0 feet +/-
	Existing Grade Elevation	+133.0 feet +/-
	Proposed Dock Elevation	+136.0 feet

Table F2 - Design Loads for Unloading and Waterfront Facilities

Live Load	Surcharge	800 psf
	Vehicular	N/A
	Equipment	140-ton crane
	Wave	N/A
	Basic Wind Speed	90 mph
	Seismic	Site determined
	Ice/Snow	50 psf deck loading
	Breasting	N/A
	Mooring	N/A
Design Vessel Information	Vessel Type	Unpowered jumbo barge
	Displacement	1,900 tons (loaded)
	Approach Velocity	0.5 ft/s
	Beam	40 feet
	LOA	200 feet
	Draft	9 feet (loaded)
	Freeboard	3 to 10 feet
	Ballast	No
	Site Current	N/A

Table F3 - Material Information for Unloading and Waterfront Facilities

Wharf Structures	Cast-In-Place Concrete	Compressive stress, f'c = 4000 psi
	Steel Reinforcing	Yield stress, Fy = 60,000 psi
	Steel Framing	ASTM A36/A572
	HP-Piles	ASTM A572
	Steel Sheet Pile	ASTM A328/A572

Notes:

f'c is the minimum required compressive strength of concrete after 28 days.

Fy is the yield strength of reinforcing steel for cast-in-place concrete.

2. Dredged Material Barge Staging Requirements

Phase 1 barge staging will require that the waterfront facilities be able to moor up to three barges. The number of barges is predicated upon the following:

- One barge is empty;
- One barge is being unloaded; and
- One barge is full.

A tugboat will bring a loaded barge to the unloading facility through Lock 7, and the barge will be secured. The tugboat will reverse direction and pick up the empty barge for transit back through Lock 7 to the dredge areas.

During the Phase 1 Final Design, a determination will be made as to the need for two barges to be unloaded at any one time and a second wharf for Phase 2. This would be accomplished using two cranes on two unloading wharves that will discharge into two hoppers for processing. An expanded design of the unloading wharves would allow for two barges to be secured to the wharves, a loaded barge to be secured to the dolphins to the north, an empty/full barge to be staged between the wharves, and an empty barge to be secured to the dolphins to the south. A barge haul system will move the barges from the north berth to the south berth, stopping at the unloading wharves.

Although the wharf layout assumes the maximum size barge, actual barges will vary in size and capacity.

3. Offloading Crane Requirements – Productivity

To develop requirements for the offloading crane, assumptions to estimate productivity rates for offloading barges at the unloading and processing facility were developed. Based on these assumptions, a series of spreadsheets was produced. The purpose of the analysis was to evaluate and size a crane and boom, determine the appropriate clamshell bucket size, estimate the number of times the barge will be moved while offloading, and predict the maximum time to unload barges of varying capacity. Assumed sediment volumes are 1,050 cy (for larger barge) and 500 cy (for smaller barge) for inventory dredging. For residuals dredging, sediment volumes are assumed to be 656 cy (for larger barge) and 313 cy (for smaller barge). Free water, over and above these volumes, will also be present in the barges. The free water will be pumped out of the barge while the barge is staged, waiting to be unloaded. "Trash pump" suction hoses would be draped into the barge. The excess water would be pumped ashore to the processing plant for processing.

For the analysis, three periods of downtime were investigated (0, 1, and 2 hours). This rate accounts for breaks for workers and miscellaneous work stoppages that occur during operation over a 24-hour work day. A spill plate will be fixed on the wharf deck to capture spillage during off-loading. Therefore, no time is required to be allotted to shift the position of the spill plate. A 5-cy bucket was assumed for the analysis performed, and an efficiency rate for material captured by the bucket per scoop was assumed to be 90%. This 90% includes consideration of partially filled buckets when the level of material drops within the barge. The swing time for the crane was defined as the time required for the crane operator to scoop material, swing 180°, offload the material into a hopper, and swing back 180° for a new load.

Loading on the cranes was calculated for the crane operating with a clamshell bucket scooping dredged material with a unit weight of 90 pounds per cubic foot (lbs/ft^3). A 5-cy bucket weighs approximately 7,400 lbs empty and 19,550 lbs fully loaded.

Various barge combinations (large, small and debris) are expected to arrive at the facility in a 24-hour period. An analysis was performed in which variables were changed in order to determine the most likely maximum number of barges that could be accommodated at a single wharf with a single crane. Results show that 10 barges (three large barges and seven small barges, with a total volume of 4,668 cy) could be unloaded in a 24-hour period. Taking into account the above variables for the highest number of barges, it would take 18.3 to 24.0 hours to unload 10 barges assuming 1 hour of downtime and 15 minutes to relocate the barges (see Table F4). For a 50-second cycle time (swing time), it will take approximately 21.2 hours to unload the material

barges. Taking into account the above variables for the peak daily volume (from the Dredge Plan) of material to be unloaded (5,106 cy), and a mix of large and small barges, it would take 19.1 to 25.4 hours to unload nine barges assuming 1 hour of downtime and 15 minutes to relocate the barges (see Table F5). For a 50-second cycle time (swing time), it will take approximately 22.3 hours to unload the material barges.

4. Offloading Crane Requirements – Equipment

Based on the analysis for bucket sizing, four major crane manufacturers were identified as possible suppliers for the appropriate crane size to offload the barges. The design for live loading by the cranes was calculated assuming the crane would operate with a 5-cy clamshell bucket. Two types of unloading equipment could be used – lattice boom crawler cranes and excavators (see attached Figures F1 and F2). Although the lattice boom crawler crane is more commonly used, some dredged material processing facilities within the Port of New York and New Jersey use hydraulic excavators for unloading barges (see attached Figure F3). The two options for offloading the material are discussed below.

Option 1

Option 1 is to offload the barges using a lattice boom crawler crane. During operation, the lattice boom crane will be positioned on the upland edge of the unloading wharf with the crawlers parallel to the face of the wharf.

Three lattice boom crane manufacturers were researched: Manitowoc Cranes, Terex/American Cranes, and Liebherr Cranes. Crane selection was based on the bucket weight plus the dredged material weight (19,550 lbs or 9.8 short tons) and the radius required for the boom. The boom of the crane will be required to have a radius that will extend from the crane center pin, over the width of the wharf to the extents of the barge width. Location of the crane with relationship to the barge will also affect the radius required. The unloading wharf, including the fender system, is 32 feet wide and the maximum width of the barge is 40 feet. Distance from the edge of the crawler to the crane center pin varies depending on the crane manufacturer and size.

Optimum positioning for the two lattice boom cranes (needed for Phase 2) was determined to be 51 feet 9 inches from the east and west extents of the unloading wharf to the crane center pin. Based on this positioning and a limit of two barge moves, the required working radius for the cranes would be 80 feet.

Considering the above criteria, the following three cranes have been selected as feasible options to unload the barges:

- **Liebherr HS 855 HD Litronic** – The Liebherr HS 855 HD Litronic is a 143.3-ton capacity crane. The Liebherr crane center pin would be located on the wharf 8 feet from the wharf's upland edge.

- **American HC 165** – The American HC 165 is a 165-ton capacity crane. The American crane center pin would be located on the wharf 10.4 feet from the wharf's upland edge. The American is the largest of the three cranes, with a base dimension of approximately 21 feet by 25 feet.

- **Manitowoc Model 1015** – The Manitowoc Model 1015 is a 132-ton capacity crane. The Manitowoc crane center pin would be located on the wharf, approximately 8 feet from the upland edge.

Some movement of all three types of cranes will be required during operation. The movement will be up to 20 feet parallel to the fender line, aligned with the crawler treads. It is anticipated that this movement would be small, not have a significant impact on production times and be necessary only to reach the further extents of material within the barge.

Option 2

Option 2 is to use Hitachi excavators to offload the barges. An excavator would be located on the water-edge of the unloading wharf with the crawlers parallel to the face of the wharf. Hitachi excavators with 5-cy clamshell buckets were considered for this option. As in Option 1, the loading on the excavator was calculated to be 9.8 short tons. It is anticipated the excavator would be located landward of the wharf curb. Radius requirements were calculated by adding 2 feet for the fenders and 40 feet for the width of the barge, which results in a required excavator radius of approximately 44 feet. Additional reach would be required to dig material off the bottom of the barge; therefore, sizing for the excavator was determined assuming a maximum reach of at least 60 feet.

The Hitachi EX1900 would be a suitable excavator for this application. The excavator is capable of carrying a 24,300-lb load at a maximum reach of 62 feet at an elevation 15 feet below the ground level. The excavator has greater mobility than the lattice boom crawler. Some movement of the excavator will be necessary to offload the barge with two barge moves.

Both a lattice boom crawler crane and an excavator are viable solutions to offload dredged material. Manufacturers of such equipment beyond those mentioned here are also available. Of concern in either case is loading on the wharf structure. Preliminary member sizing for the structure assumed an 800 psf live load on the

deck (heavy-duty working wharf). The above-mentioned lattice boom cranes produce in excess of 2,000 psf live load and the hydraulic excavator produces approximately 3,600 psf live load under the treads. However, since both of these options preclude the 800 psf live load occurring over the entire structure, further analysis will be conducted in the Phase 1 FDR to determine how and if the current design needs to be refined to accommodate these loads. The most probable refinement will be to strengthen only the area of the wharf deck under which the crane will be located.

Tables

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Table F4: Crane Cycle Time Study (10 barges)

	CYCLE TIME - MINIMUM		CYCLE TIME - MEDIAN		CYCLE TIME - MAXIMUM	
	MINUTES	HOURS	MINUTES	HOURS	MINUTES	HOURS
LARGE BARGE						
MOVE IN	15.0	0.25	15.0	0.25	15.0	0.25
RELOCATE	15.0	0.25	15.0	0.25	15.0	0.25
MOVE OUT	15.0	0.25	15.0	0.25	15.0	0.25
TOTAL	45.0	0.75	45.0	0.75	45.0	0.75
SMALL BARGE						
MOVE IN	15.0	0.25	15.0	0.25	15.0	0.25
RELOCATE	0.0	0.00	0.0	0.00	0.0	0.00
MOVE OUT	15.0	0.25	15.0	0.25	15.0	0.25
TOTAL	30.0	0.50	30.0	0.50	30.0	0.50
UNLOAD						
TOTAL	691.6	11.53	864.4	14.41	1037.3	17.29
DEBRIS BARGE						
MOVE IN	15.0	0.25	15.0	0.25	15.0	0.25
UNLOAD	60.0	1.00	60.0	1.00	60.0	1.00
RELOCATE	0.0	0.00	0.0	0.00	0.0	0.00
UNLOAD	0.0	0.00	0.0	0.00	0.0	0.00
MOVE OUT	15.0	0.25	15.0	0.25	15.0	0.25
TOTAL	90.0	1.50	90.0	1.50	90.0	1.50

TOTAL TIME TO UNLOAD	MINIMUM	MEDIAN	MAXIMUM
LARGE BARGES	2.3	2.3	2.3
SMALL BARGES	3.5	3.5	3.5
DEBRIS BARGES	0.0	0.0	0.0
UNLOAD	11.5	14.4	17.3
DOWN TIME	1.0	1.0	1.0
TOTAL HOURS	18.3	21.2	24.0

Notes:
1. From BBL Dredging Day 85
2. 5 cy Bucket at 90% capacity.
3. Fixed drip plate (no relocation).
4. Full barge staged, waiting to be moved into position for unloading.
5. Empty barge staging area clear to accept barge from wharf.
6. Cycle time varies w/MED. DT & MED. RT.

Daily Capacity:	Large Barge:	3	
	Small Barge:	7	
	Debris Barge:	0	
	Total	10	4,668 CY

Crane Cycle Time:	Minimum	40 seconds
	Median	50 seconds
	Maximum	60 seconds
Down Time:	Minimum	0 hour
	Median	1 hour
	Maximum	2 hours
Relocation Time:	Minimum	0 minute
	Median	15 minutes
	Maximum	30 minutes

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Table F5: Crane Cycle Time Study (9 barges)

	CYCLE TIME - MINIMUM		CYCLE TIME - MEDIAN		CYCLE TIME - MAXIMUM	
	MINUTES	HOURS	MINUTES	HOURS	MINUTES	HOURS
LARGE BARGE						
MOVE IN	15.0	0.25	15.0	0.25	15.0	0.25
RELOCATE	15.0	0.25	15.0	0.25	15.0	0.25
MOVE OUT	15.0	0.25	15.0	0.25	15.0	0.25
TOTAL	45.0	0.75	45.0	0.75	45.0	0.75
SMALL BARGE						
MOVE IN	15.0	0.25	15.0	0.25	15.0	0.25
RELOCATE	0.0	0.00	0.0	0.00	0.0	0.00
MOVE OUT	15.0	0.25	15.0	0.25	15.0	0.25
TOTAL	30.0	0.50	30.0	0.50	30.0	0.50
UNLOAD TOTAL	756.4	12.61	945.6	15.76	1134.7	18.91
DEBRIS BARGE						
MOVE IN	15.0	0.25	15.0	0.25	15.0	0.25
UNLOAD	60.0	1.00	60.0	1.00	60.0	1.00
RELOCATE	0.0	0.00	0.0	0.00	0.0	0.00
UNLOAD	0.0	0.00	0.0	0.00	0.0	0.00
MOVE OUT	15.0	0.25	15.0	0.25	15.0	0.25
TOTAL	90.0	1.50	90.0	1.50	90.0	1.50

TOTAL TIME TO UNLOAD	MINIMUM	MEDIAN	MAXIMUM
LARGE BARGES	3.0	3.0	3.0
SMALL BARGES	2.5	2.5	2.5
DEBRIS BARGES	0.0	0.0	0.0
UNLOAD	12.6	15.8	18.9
DOWN TIME	1.0	1.0	1.0
TOTAL HOURS	19.1	22.3	25.4

Notes:
1. From BBL Dredging Day 75
2. 5 cy Bucket at 90% capacity.
3. Fixed drip plate (no relocation).
4. Full barge staged, waiting to be moved into position for unloading.
5. Empty barge staging area clear to accept barge from wharf.
6. Cycle time varies w/MED. DT & MED. RT.

Daily Capacity:	Large Barge:		4	
	Small Barge:		5	
	Debris Barge:		0	
	Total		9	5,106 CY
Crane Cycle Time:	Minimum	40 seconds		
	Median	50 seconds		
	Maximum	60 seconds		
Down Time:	Minimum	0 hour		
	Median	1 hour		
	Maximum	2 hours		
Relocation Time:	Minimum	0 minute		
	Median	15 minutes		
	Maximum	30 minutes		

Figures

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ATTACHMENT F - DESIGN ANALYSIS:
UNLOADING AND WATERFRONT FACILITIES

LIEBHERR LATTICE BOOM CRANE

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FIGURE
F-1

GENERAL ELECTRIC COMPANY
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ATTACHMENT F - DESIGN ANALYSIS:
UNLOADING AND WATERFRONT FACILITIES

HITACHI HYDRAULIC EXCAVATOR

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FIGURE
F-2

GENERAL ELECTRIC COMPANY
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ATTACHMENT F - DESIGN ANALYSIS:
UNLOADING AND WATERFRONT FACILITIES

UNLOADING CRANE

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FIGURE
F-3