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ENCLOSURE 1

**Nuclear Development Project
Conceptual Barge Facilities and Haul Roads Report**



**Nuclear Development Project
Conceptual Barge Facilities and Haul Roads**

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CONTENTS

1.0	Purpose / Background / Limitations and Assumption.....	5
1.1	Purpose.....	5
1.2	Background.....	5
1.3	Limitations and Assumptions.....	6
2.0	Scope.....	8
2.1	Develop Conceptual Layout for New Barge Facility.....	8
2.2	Develop Conceptual Layout for Widening the Hope Creek Barge Slip.....	8
2.3	Develop Conceptual Layouts for Construction Haul and Plant Access Roads.....	9
3.0	Evaluation of Existing Barge Facilities, New Barge Facilities and Haul Roads.....	10
3.1	Evaluation Existing Barge Facilities.....	10
3.1.1	Available Equipment Barge Sizes.....	10
3.1.2	Approximate Weight of Loads to be Transported.....	11
3.1.3	Equipment Barge Draft.....	11
3.1.4	Elevations of the Plant and Tides.....	12
3.1.5	Removal of Equipment from Barges.....	13
3.1.6	Existing Hope Creek Barge Slip (Not Widened).....	14
3.1.7	Existing Hope Creek Barge Slip (Widened).....	14
3.1.8	Berthing Full and Empty Barges at Existing Hope Creek Docks.....	16
3.2	Proposed Barge Storage and Unloading Facility.....	16
3.2.1	General Description	16
3.2.2	Raw/Bulk Material Barges.....	17
3.2.3	Proposed Barge Facility Layout.....	19
3.2.3.1	Proposed Barge Storage Area.....	19
3.2.3.2	Proposed Barge Unloading Area.....	20
3.3	Construction Haul and Plant Access Roads.....	21
3.3.1	Location of Haul Roads.....	21
3.3.2	Types of Haul and Plant Access Roads.....	21
3.3.3	Considerations for Roads.....	22
4.0	Material Quantity Takeoffs.....	23
4.1	Unwidened Hope Creek Barge Slip.....	23
4.2	Widened Hope Creek Barge Slip.....	23
4.3	Proposed Barge Storage Area.....	24



4.4	Proposed Barge Unloading Area.....	25
4.5	Construction Haul Roads.....	26
5.0	Conclusions and Summary.....	27
5.1	Available Barge Types.....	27
5.2	Existing Hope Creek Barge Slip (Unwidened).....	27
5.3	Existing Hope Creek Barge Slip (Widened).....	27
5.4	Barge Storage Area and Unloading Facility.....	28
5.5	Construction Haul and Plant Access Roads.....	29
5.6	Dredge Quantity Summary.....	29
6.0	References.....	30
7.0	Attachments.....	31



1.0 Purpose / Background / Limitations and Assumptions

1.1 Purpose

The overall purpose of this assessment is to describe, evaluate and develop conceptual layouts and details required to support the following:

- Construction of a new barge storage and unloading facility approximately 1000' north of the proposed new plant location.
- Widening of the existing Hope Creek (HC) barge slip located approximately 1000' south of the proposed new plant location.
- Construction haul and plant access roads that are required to be constructed onsite to support the movement of equipment, modules and materials to the new plant location.
- Development of dredge volumes/quantities associated with the proposed barge facilities and existing barge facility upgrades.

The information provided in this report will be utilized in part, to support the ongoing Early Site Permit Application (ESPA) development being performed for the PSEG Nuclear Site in Hancocks Bridge, NJ.

1.2 Background

As part of the ongoing PSEG Nuclear Development ESP effort, ESP RFI No.'s 42, 43, 45 and 46 have requested the following information to support the development of the ESPA Environmental Report (ER):

- RFI No. 42R1 - Request information regarding the configuration and construction activities related to improvements to the existing barge facility at Hope Creek.

Information requested includes:

- Facility Conceptual Design (location, dimensions, encroachment into river, etc.).



- Construction/shoreline stabilization practices (pile driving, excavation, riprap placement, etc.).
- RFI No. 43R1 - Request information regarding the configuration and construction activities related to construction of a new barge facility along the Army Corps of Engineers (ACOE) Confined Disposal Facility (CDF) to support development of the North Site.

Information requested includes:

- Facility Conceptual Design (location, dimensions, encroachment into river, etc.)
- Construction/shoreline stabilization practices (pile driving, excavation, riprap placement, etc.).
- RFI No. 45 - Request information regarding the configuration and construction activities related to improvements to the existing Hope Creek barge facility.

Information requested includes:

- The need for dredging (location/extent, proposed disposal methods).
- RFI No. 46 - Request information regarding the configuration and construction activities related to construction of a new barge facility along the ACOE CDF cell to support development of the North Site.

Information requested includes:

- The need for dredging (location/extent, proposed disposal methods).

1.3 Limitations and Assumptions

The following are limitations and assumptions associated with the scope of this report. The limitations and assumptions may not be all inclusive:


- The layouts and sketches provided for the proposed new barge facility; the proposed upgrades of the existing HC Barge slip and; the proposed construction haul and plant access roads are conceptual in nature for the purpose of showing the extent of the



footprint and for determining dredge/material quantities to support the ESP Environmental Report. Design calculations were not performed and will not be provided.

- The proposed barge facilities and upgrades will be based on an equipment barge size of 250' long x 72' wide x 16' deep* and a material handling barge (hopper barges) size of 200' long x 35' wide x 13' deep. Information on 250' long x 54' wide x 11' deep equipment barges is also provided and evaluated in this report. This barge size could be utilized with the existing 300' long x 60' wide Hope Creek barge slip. However, smaller structural/equipment module sections would have to be brought to the site via the river access.

* Note: The barge depth is not the same as the barge draft.

- Elevations will be established utilizing the Salem 2008 Topography Surveys and Boundary drawing within the PSEG property and digitized Geographical Information System (GIS) Topographical Maps off the PSEG property.
 - The bathymetric data used to calculate dredging is from the US Army Corps of Engineers, 2001. New data must be obtained before dredging is started.
 - No detailed topographic survey data is available for the proposed facilities. A survey will be required to set grades for the new plant and surrounding site.
 - No geotechnical data is available at the proposed barge facility location or existing barge slip area.
 - No as-builts of the existing dock are available. The defined material quantities are based on the conceptual layouts and details.
 - A structural assessment of the existing barge slip and adjacent docks should be performed prior to being utilized for new nuclear development.
 - The current bottom elevation of the existing barge facility is not known (i.e. due to potential silting). A bathymetric survey is required to determine the existing elevation.
 - This report does not address permit requirements for the proposed changes.
 - No estimates for material or construction costs are included.
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2.0 Scope

The following will be performed as part of this report:

2.1 Develop Conceptual Layout for New Barge Facility

Details relative to development of the conceptual barge facility were requested per ESP RFI Nos. 043 & 046). The new barge facility would be parallel with the river as shown on Figure 1. Based on discussions with the various reactor vendors and constructors (Bechtel, Shaw, URS), they indicated a barge storage area that could moor a minimum of 4 to 5 barges with a barge unloading area would be desirable.

- Barge Storage Area (See Figures 1 and 15) - This area would allow for five (5) 200' long x 35' wide x 13' deep material barge sets* to be moored. A spare mooring would be provided to allow storage of an empty barge set. Barge moorings would be a pile/caisson design constructed parallel to the shoreline.

*Note: A barge set consists of three barges strung together side-by-side. The 250' long x 72' wide x 16' deep could also be moored in this area if desired.

- Barge Unloading Area (See Figures 1, 16 and 17) - This area would allow for one (1) 200' long x 35' wide x 13' deep barge set to be moored. This area would be utilized for off-loading raw/bulk materials and smaller commodities and components by crane. A concrete pad would be provided at the unloading area for the crane. This area would be located adjacent to the proposed concrete batch plant area.
- Evaluate the barge draft and clearance requirements.
- Determine dredge area and quantities (if required) based on the river depth at the proposed barge facility location (See Figures 1 and 15 and Sections 3 & 4) for barge access.

2.2 Develop Conceptual Layout for Widening the Hope Creek Barge Slip

- Details relative to the development of a conceptual layout for widening the existing Hope Creek barge slip were requested per ESP RFI Nos. 042 & 045. Widening of the existing barge slip from 60' to 80' wide would maximize, to the extent practical, the use of this slip for equipment and structural/equipment module deliveries to the site, by allowing the

use of the proposed 250' long x 72' wide x 16' deep equipment barges. The Hope Creek barge slip would be utilized for off-loading large structural commodities and components by rolling/driving off the barge (See Figure 7). The adjacent dock areas would also be utilized for mooring barges.

- Evaluate the barge draft and clearance requirements.
- Determine dredge area and quantities (if required) based on the river depth at the existing Hope Creek barge slip location (See Figures 1 and 15 and Section 3 and 4) for barge access.

2.3 Develop Conceptual Layouts for Construction Haul and Plant Access Roads

Develop conceptual roadway plans and details for construction haul and plant access roads that are required to be constructed onsite to support the movement of equipment, modules and materials to the new plant location (See Figures 1, 20, 21 and 22).



3.0 Evaluation of Existing Barge Facilities, New Barge Facilities and Haul Roads

3.1 Evaluation Existing Barge Facilities

3.1.1 Available Equipment Barge Sizes

The barges used to transport equipment and modules have a solid top on which the equipment is mounted. The sizes that are available include:

Table 3.1-1-1: Available Equipment Barge Sizes				
Size	Empty Weight	Barge Design Load Per Square Foot	Ocean Going or Inland Deck	McDonough Marine CAD File
54' wide x 180' long x 12' deep	N/A	2000 lbs/ft ²	ABS	CAD U800
54' wide x 200' long x 11' deep	N/A	1500 lbs/ft ²	ABS	No Figure
54' wide x 250' long x 11' deep	568 tons	2000 lbs/ft ²	Inland Deck	CAD M 971
54' wide x 250' long x 11' deep	615.6 tons	2000 lbs/ft ²	Inland Deck	CAD M960
54' wide x 250' long x 11' deep	663 tons	6000 lbs/ft ²	Inland Deck	CAD H970
60' wide x 250' long x 11' deep	N/A	2000 lbs/ft ²	N/A	No Figure
72' wide x 250' long x 16' deep	1400 tons	2000 lbs/ft ²	ABS	CAD S-1-1 9-14
72' wide x 260' long x 16' deep	N/A	4500 lbs/ft ²	ABS	CAD S-1-1 21

N/A = Not Available

ABS = Ocean Going Deck

See Figures 2 through 6 for the plan and cross-section of some of the equipment barges. All details came from the web site for McDonough Marine (Reference 6.1). The barges shown, as well as many other figures and pictures of barges being hauled, can be seen on the web site.

McDonough Marine is the largest owner of barges in the world. In a discussion with Ron White of McDonough Marine (Reference 6.1), it was stated that 54' wide by 180' long, 54' wide x 200' long, or 54' wide x 250' long barges are primarily used on the east coast and the 72' x 250' long barges are primarily used on the gulf coast. However, arrangements could be made to have the 72' x 250' long barges available for use on the east coast if needed.

3.1.2 Approximate Weight of Loads to be Transported

The weight of components that will be unloaded at the barge slip will be:

- Reactor Pressure Vessel 940 tons
- Central Module (reactor base) 630 tons
- Composite Module (for the lower RPV pedestal) 600 tons
- Transformer 771 tons
- Stator 485 tons
- Condenser (lower) 408 tons
- Large Component (generic) 1150 tons
- Condenser (lower assembly) 793 tons

Data is from ALE HEAVY LIFT Haulers (Reference 6.2) and Sargent and Lundy.

McDonough Marine (Reference 6.1) was asked to comment on the ability to use 54' wide barges to carry these loads. It was stated that 54' wide barges can carry even the heaviest load. McDonough Marine also indicated that the draft of a barge would be about 5 to 6 feet (depending on the barge length) when loaded with the heaviest load. Consequently, the size of the existing slip would be acceptable. Note, when moving a large component (module), the component cannot extend beyond the width or length of the barge. This could possibly limit the size of the structural module delivered to the site.

3.1.3 Equipment Barge Draft

The draft of the barges is dependent on the surface area at the bottom of the barges and the load placed on the barge. The following provides data on barge draft:

Table 3.1.3-1: Equipment Barge Data			
Barge Size	Empty Weight	Empty Draft	Additional 1 foot of draft for every (xx) tons placed on deck (1)
54' x 250' (2000 lbs/ft ³)	568 tons	1.6	415 tons
54' x 250' (6000 lbs/ft ³)	663 tons	1.75'	415 tons
72' x 250' x 16' deep (ABS deck)	1400 tons	2.5'	480 tons

⁽¹⁾ Rule of thumb



One item that is not available at this time is information on the weight of the rigging that will be used to tie down a load on the barge. Because each of the loads is a different size and has different rigging requirements, the weight of the rigging will vary. The weight of the rigging will have to be added to the weight of the load to get the total load placed on the deck.

As shown in Table 3.1.3-1 above, the empty barge draft for a 72' wide equipment barge is 2.5 feet. In addition, a weight of 480 tons/foot of draft for added load is the rule-of-thumb given by McDonough Marine for a 72 feet wide barge.

If rigging is taken as 10% of the weight of the equipment, then the heaviest module, which weighs 1150 tons, could be taken as weighing $1.1 \times 1150 = 1265$ tons. A 72' wide barge, carrying the heaviest module, would have a draft of 2.5 feet (empty barge draft) plus (load draft) $1265/480 = 2.65$ feet for a total barge draft = ~5.15 feet of draft. The draft for a fully loaded 54' wide x 250' long barge would be ~5 feet.

If 5.15 feet was subtracted from El. 86.4, which is mean low water El. -2.6 NAVD, the bottom of the barge would be at Elevation 81.25. Assuming the bottom of the existing slip is El. 79.0, the bottom of the barge clears the bottom of the slip by 2.25 feet. However, because the drafts are based on rule-of-thumb values, a draft of 6' is used for this report, thereby putting the bottom of the barge at ~El. 80.4.

3.1.4 Elevations of the Plant and Tides

Using the NGVD (1929) and PSEG Datum, the elevations in the barge slip are as follows:

	<u>NGVD(2)</u>	<u>NAVD(3)</u>	<u>PSEG Datum(1)</u>
Finish Floor Grade HC Plant	El. 13.0'	El. 12.17'	El. 102.0'
Finish Floor Grade Salem Plant	El. 11.0'	El. 10.17'	El. 100.0'
Average Site Grade	El. 12.5'	El. 11.67'	El. 101.5'
Site Grade @ Barge Slip	El. 9.0'	El. 8.17'	El. 98.0'
Higher High Water	El. 8.5'	El. 7.67'	El. 97.5'
Mean High Water	El. 3.2'	El. 2.37'	El. 92.2'
Mean Tide	El. 0.3'	El. 0.53'	El. 89.3'
Mean Sea Level (MSL)	El. 0.0'	El. 0.83'	El. 89.0'
Mean Low Water (MLW)	El. -2.6'	El. -3.43'	El. 86.4'
Bottom of the existing Barge Slip	El. -10.0'	El. -9.17'	El. 79.0'
Dredged Area in Front of Barge Slip	El. -19.0'	El. -18.17'	El. 70.0'

(1) PSEG equals Public Service Electric and Gas Datum

(2) NGVD-29 equals National Geodetic Vertical Datum (1929)

- (3) NAVD-88 equals North American Vertical Datum (1988)
- (4) The conversion from NAVD-88 datum to PSEG Plant Elevation is shown on Figure 24.
- (5) The relationship between NGVD and PSEG elevations is shown on Figure 23.

The data on the NGVD (1929) and PSEG Elevations are from Bechtel Drawings (Reference 6.4 and 6.5). Hydrographic Survey Data was obtained from maps produced by the US Army Corps of Engineers (Reference 6.9), which is shown on Figures 18 and 19. The data contains many underwater points plotted using the NAVD(1988) (North American Vertical Datum). The ACOE map states that the data given is the Mean Low Water Elevation, which is 3.4 feet below the NAVD-88 datum. The computer program VERTCON 2.0 (Reference 6.7) can be used to determine the conversion of NAVD-88 to NGVD-29 or the reverse. From the computer program VERTCON 2.0, NAVD-88 is 0.83 feet below NGVD-29 for N 39.4705, W 75.5435, which is the latitude and longitude of the plant. NAVD-88 was only used to convert the hydrographic survey to NGVD-29. A copy of VERTCON 2.0 can be obtained from Google at the following website: http://www.ngs.noaa.gov/cgi-bin/VERTCON/vert_con.pr1

3.1.5 Removal of Equipment from Barges

Heavy equipment and modules will be removed from the barges in the barge slip over the narrow end of the barge. The equipment or modules will be mounted on beams (wooden or steel) and sit on the deck of the barge. When the equipment is ready to be removed, it will be jacked up and wheeled carriers will be placed under the equipment. Then the equipment will be lowered to sit on the wheeled carriers, a transporter will be connected to the front of the string of carriers, and the equipment driven off the barge. The company doing the heavy hauling has the ability to raise or lower the wheeled carriers as necessary before they are driven off the barge. A heavy duty bridge is used to span the gap between the barge and the barge dock. See Figure 7 for a picture of a barge ready to be unloaded.

The carriers will be pulled straight off the barge. Figure 1 shows that, over the years, PSEG has built facilities on either side of the slip. Consequently, once the carrier has been pulled off the barge, the transporter may have to disconnect from the lead end of the carrier and driven around and reconnect to the rear of the carrier. Then the carrier can be pulled forward and into the plant or into the temporary lay down area.



When the equipment is unloaded, a tug is placed behind the barge to push it against the forward end of the dock. Otherwise the barge would tend to slip backwards as the equipment moves forward off of the barge. As the unloading takes place, the barge gets lighter and the rear end of the barge will tend to rise. The barge ballast tanks will be filled with water to compensate for the removal of this weight. A barge has 14 to 27 ballast tanks to which water can be added. Oceangoing barges have the most tanks. The ballast tanks can be seen on the McDonough Marine web site (Reference 6.1). There are rows of 2 to 4 tanks along the length of the barge, but this varies from barge to barge. When the unloading takes place, water is added to the rear tanks, proceeding forward as weight is removed.

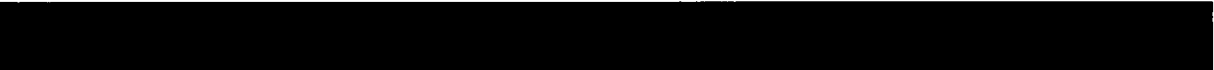
3.1.6 Existing Hope Creek Barge Slip (Not Widened)

Based on Section 3.1.3 above, the draft of a loaded 54' wide equipment barge was taken to be 6.0 feet. A barge this size was assumed to enter the slip when the water level is at mean tide or higher (See Figure 9). Then, the depth of a 54' wide x 11' deep barge was checked when the water level drops to mean low tide. As can be seen from Figures 10 and 11, the barge will not sit on the bottom of the slip when the water level is at mean low tide. McDonough Marine Services stated that, if necessary, a barge could sit on the bottom of a slip, provided there were no rocks or debris in the bottom of the slip. However, to account for any rocks, debris or wind driven wave action, a minimum of 3 feet clearance between the bottom of the barge and the bottom of the slip was provided. To provide this clearance, approximately two feet of dredging would be required within the slip.

The Hope Creek barge slip would not be dredged to accommodate the material barges discussed in section 3.2.2 below. The material barges have a much deeper draft (approximately 11 feet) which is almost twice as deep as the equipment barges. However, the material barges could be moored and off-loaded at the docks adjacent to the barge slip if desired.

3.1.7 Existing Hope Creek Barge Slip (Widened)

Figures 12, 13, and 14 were prepared to show a widened barge slip. The maximum width of modules will not be known until a vendor is chosen for the plant. If modules wider than 54 feet would be anticipated, a cost analysis should be made to determine if it is cost effective to widen the barge slip as compared to limiting the barge size used by the selected vendor.



If it is deemed cost effective to widen the slip, the south side of the barge slip would be widened so that the slip is 80 feet wide. The slip would be widened to the south since this side is less congested and would allow more room to the north for maneuvering the transporters. The widened barge slip would then be capable of handling 72' wide equipment barges. The entire 50' of the reinforced concrete pad adjacent to the south side of the slip is assumed to be removed. Sheet piling would then be driven into the ground and the interior of the widened barge slip would be dredged to remove the excess earth. The interior of the barge slip would then be dredged out an additional 2 feet to remove any rock and debris and provide additional clearance between the bottom of the barge and bottom of the slip. The riprap would be replaced at the front end of the slip (river end).

A single row of sheet piling was considered to not be strong enough to hold the slip in place. Consequently, a second row of sheet piling has been assumed to be driven about 55 feet behind the front row, channels (walers) will be welded to the sheet piling, and tie rods placed on 7 feet centers will be used to hold the two rows of sheet piling together. The rear row of sheet piling would act as dead men to hold the front row in place.

Rows of stone columns will be placed between the two rows of sheet piling to stiffen the soil to provide adequate bearing for a crane. Approximately 294 stone columns would be required. Prior to the start of a detailed design, a subsurface investigation should be performed in the vicinity of the dock. The borings will show whether or not the stone columns are required.

As shown in Section 3.1.3, the draft of a loaded 72' wide equipment barge is taken to be 6 feet. A barge this size was assumed to enter the slip when the water level is at mean tide or higher. Then, the depth of a 72' wide x 16' deep barge was checked when the water level drops to mean low tide. As can be seen from Figure 13, the barge will not sit on the bottom of the slip when the water level is at mean low tide. McDonough Marine Services stated that, if necessary, a barge could sit on the bottom of a slip, provided there were no rocks or debris in the bottom of the slip. However, to account for any rocks, debris or wind driven wave action, a minimum of 3 feet clearance between the bottom of the barge and the bottom of the slip was provided. To provide this clearance, approximately two feet of dredging would be required within the slip.



3.1.8 Berthing Full and Empty Barges at Existing Hope Creek Docks

North and south of the barge slip are docks that can be used to berth empty or full barges. The south dock is 600 feet long. When the Hope Creek Plant was built, it was used to store barges loaded with sand or gravel. That material would have been used to make concrete in the concrete batch plant. The existing dock was designed to berth 2 barges wide loaded with sand or gravel, for a total of 4 barges.

The north dock is 250 feet long. It was used to berth loaded equipment barges that would be unloaded in the barge slip. The dock can be used to store two fully loaded equipment barges.

The river beneath the barge docks has been dredged to Elevation 70 feet. Even if there is sediment that has accumulated in the past 30 years, it is unlikely to have built up high enough to drag the bottom of the barge on the river bed. The elevation of the river bottom in that area will need to be verified before the dock is used.

Per the Bechtel Specification (Reference 6.6), the barge slip and the north dock were designed for berthing loads imposed by the greater of a rail ferry with a gross weight of 1500-1600 tons or a Union Mechling 4501 barge loaded with 800-900 tons of reactor pressure vessel components. These loads are about the same as the loads that the slip will experience for the new unit. The south dock was designed for four aggregate barges having a combined weight of 8000 tons. This loading will allow barges of any reasonable weight to berth at the dock. Consequently, the docks should be structurally sound to take the loads that will be placed on it for the new unit. However, a structural evaluation should be performed on the existing barge slip and adjacent docks before they are utilized for new nuclear development.

3.2 Proposed Barge Storage and Unloading Facility

3.2.1 General Description

This facility will be primarily used to off-load raw/bulk materials and smaller commodities by crane and will be located approximately 1000' north of the proposed new plant location. In addition, this facility will be located adjacent to the proposed concrete batch plant and construction laydown areas (See Figure 1). It will consist of a barge off-loading facility as well as a barge storage area to allow mooring of barges waiting to be off-loaded.



3.2.2 Raw/Bulk Material Barges

Typical sizes of barges used to haul raw/bulk materials are as follows:

Table 3.2.2-1: Material Barge Data			
Number	Capacity	Size	Loaded Draft
1	1500 tons	200' long x 35' wide x 12' deep	9 feet
2	2000 tons	200' long x 35' wide x 13' deep	10 to 11 feet

The barges identified in Table 3.2.2-1 are from a paper titled "Barges" (Reference 6.3). The barges can either be 195 feet or 200 feet long. The paper was written to describe barges that are used on the Mississippi, Ohio, Delaware, and other large rivers. That web site also has articles on tug boats, river terms, styles of tow boats, etc.

A barge with the dimensions of 300' long x 46' wide x 12' deep is listed in the Bechtel Specification 10855-C-003 (Reference 6.6) for carrying sand and gravel materials. The specification was written for construction of the dock in 1977. This size barge is no longer utilized to carry materials.

Satish Madan (Reference 6.8), the S&L Material Handling Group lead, was contacted to define the size of barges that can handle 2000 tons. Mr. Madan said a 2000 ton barge is the same size as a barge used to haul 1500 tons, except that the depth of the barge is slightly deeper and the barge has more draft. See Figure 8 for data on materials barges.

Based on the Hydrographic Survey Data from the ACOE (See Reference 6.9 and Figures 18 & 19), the river area (the area where the barge unloading and barge storage area is to be located) must be dredged to provide clearance between the bottom of the barge and the bottom of the river so that the barge does not bottom out at Mean Low Water (MLW). Additional clearance should also be provided due to any wind driven wave action. As shown in Table 3.2.2-1, a barge loaded with 2000 tons of material has a draft of 11 feet. Based on the MLW elevation of 86.4', this area would need to be dredged to El. 73.4' in order to provide at least two feet of clearance (El. 86.4' MLW -11.0' barge draft - 2.0' clearance = El 73.4, See Figure 1).



The following provides a perspective on the potential raw material handling that may be required to backfill and raise the proposed new plant site to PSEG El. 128.0'. This does not include any raw material required for the concrete batch plant(s). Utilizing the structural and general fill quantities provided in Table 4.1.1-2 (EPR Fill Quantities) of reference 6.10, the following shows the number of truck loads versus barge loads that would be required to transport the fill material to the PSEG Nuclear site:

Table 4.1.1-2 Fill Quantities:

Net Structural Fill: 8,260,000 yd³
General Fill: 519,500 yd³
8,779,500 yd³ say 8,800,000 yd³

Dump Truck Delivery:

Truck Size: Assume a 20 yd³ trailer type dump truck*

*This could vary based on the NJDOT limits for Gross Vehicle Weight (GVW).

Truck Loads = $\frac{8,800,000 \text{ yd}^3}{20 \text{ yd}^3/\text{truck}}$ = **440,000 truck loads**

Barge Delivery:

Barge Size: 200' long x 35' wide x 13' deep = ~3400 yd³

Barge Loads = $\frac{8,800,000 \text{ yd}^3}{3400 \text{ yd}^3/\text{barge}}$ = **2,600 barge loads**

Utilizing a five string barge set* (See Section 3.2.3.1 below)

*Note: A barge set consists of three barges strung together side-by-side

Barge Set Loads = $\frac{2600}{15}$ = **175 barge set loads**

As can be seen above, it will be critical to identify borrow site locations that are located close to waterways that can utilize barge delivery as the means of transporting the material to the PSEG Nuclear site. This could include borrow sites situated in relative close proximity to the Delaware and New Jersey Coasts, Delaware Bay/River as well as the Chesapeake Bay which can be accessed via the C&D canal.

3.2.3 Proposed Barge Facility Layout

On most large rivers in the US, except the lower Mississippi River, the materials barges are transported in a maximum of 15 barge strings. The locks on most rivers are 110' wide, which is wide enough for 3-35 foot wide barges plus 5 feet clearance. On the lower Mississippi River below St. Louis, the barge strings can be considerably wider and longer because there are no locks south of St. Louis. On the lower Delaware River/Bay, the barge strings could also be larger. However, we do not know where the barges will be coming from, so, for this study, the barge strings will be limited to 15 barges. The barges can be delivered in any combination up to 15 barges.

3.2.3.1 Proposed Barge Storage Area

The barge storage area would be constructed to store 15 material barges. This would consist of a string of five (5) 200' long x 35' wide x 13' deep material barge sets* to be moored. The barge moorings would be a pile/caisson design constructed parallel to the shoreline. McDonough Marine was asked about fenders for the piles or caissons. They stated the use of aircraft tires or large farming equipment tires are the best fenders. They stated that you could buy an expensive fender system, but the tires work just as well. The tires are chained to the piles or caissons and hung down to act as a fender.

*Note: A barge set consists of three barges strung together side-by-side.

For mooring material barges, piles or caissons would be placed approximately 195 feet or 200 feet on center. The length chosen is dependent on the length of the barges that are anticipated. For this study, they are shown in Figure 15 as 200 feet apart. One extra set of piles or a caisson are provided to store the first set of barges to be unloaded. This is so the tugs aren't trying to fit a set of empty barges between two sets of moored barges with very little clearance.

The 250' long x 72' wide x 16' deep equipment barges could also be moored at this area if desired. Figure 15 shows a five set material barge string, and also a single 250 feet long equipment barge. All of the equipment barges have cleats at 41 feet to 45 feet centers, which are used to tie up a barge.



3.2.3.2 Proposed Barge Unloading Area

The barge unloading area would be constructed to moor one (1) set of 200' long x 35' wide x 13' deep barges. A tug boat would leave up to 15 full barges in the barge storage area. A tug would then move a barge set up to the unloading area. The barges would stay connected together when placed in the unloading area. See Figure 16 for a conceptual layout of the unloading area. This area would be located adjacent to the proposed concrete batch plant and construction laydown areas (See Figures 1 and 17).

The materials barges would be unloaded using a crane. When all of the three barges are empty, the tug would take the 3 empty barges and place them in storage and move 3 full barges into the unloading spot. When all of the barges are empty, a tug would move the empty barges back to the borrow area. Another barge string would then be delivered after the storage area is empty. This would be repeated as needed to deliver sand and gravel or other raw materials.

Equipment can also be unloaded at the north unloading area. Barges carrying items such as pipe, valves, pumps and electrical equipment that can be unloaded by crane can be moored at this facility.

The unloading area for materials barges is just to the south of the barge storage area. The unloading area consists of a concrete pad on which a large crane sits. Bechtel (Reference 6.6) specified the use of a Manitowoc 4600 crawler crane for unloading barges during construction of Hope Creek. Larger cranes are now in use, but a crane of that size would work. To unload, the crane reaches into a barge and removes material with a clamshell digger. The crane would then turn and dump the material into a hopper. A conveyor would move the material from the hopper to a specified pile or hopper. See Figure 17 for a conceptual layout of the batch plant. The crane would empty each barge, back and forth, from front to back, so that the load is removed evenly from all barges.

Once the barge is nearly empty and the clamshell doesn't work efficiently, the crane would place a small wheel loader (front end loader) inside the barge to clean the bottom of the barge. The wheel loader would push material into piles for the clamshell to remove. This enables the barge to be nearly emptied of all material.



Figure 17 shows a conceptual layout of the batch plant. That figure shows four storage piles, one each for 3 different sizes of gravel, and one for sand. Hoppers could be used in place of circular piles. The conveyor from the barge unloading facility loads the material into the pile. The conveyors would have trippers to direct the material to the correct pile. The batch plants (two are assumed) would be loaded using a wheel loader and a conveyor. The wheel loader would take material from a pile and place it into a hopper. A conveyor would then deliver the material to the correct batch plant. A silo containing cement would be part of the batch plant.

3.3 Construction Haul and Plant Access Roads

3.3.1 Location of Haul Roads

Haul roads are required in numerous areas to:

- Move materials from the barge unloading area to the plant.
- Move materials from the barge unloading area to the modular assembly area.
- Move sand, gravel and cement to the batch plant.
- Move concrete from the batch plant to the power plant for placement.
- Move materials received by truck to the plant.
- Move people to the plant.

The location of the construction haul and plant access roads are shown on Figure 1.

3.3.2 Types of Haul and Plant Access Roads

Three major types of roads have been identified. They are shown on Figures 20, 21 and 22:

- Type 1 Construction Road - 100 feet wide haul road for moving heavy machinery and equipment. A Type 1 road will be surfaced with 8" of Asphalt pavement over 18" of crushed rock (See Figure 20).
- Type 2 Construction Road - 32 feet wide haul road for moving concrete trucks and equipment by truck. A Type 2 road will be surfaced with 12" of crushed rock. Additional surfacing may be required during the life of the plant construction (See Figure 21).
- Type 1 Permanent Plant Road – This road would be utilized as a construction access road during construction and would be surfaced with 18" of crushed rock (See Figure 22). After construction is complete, this road would be utilized as the access road to the

plant protected area. The road would be a 48 feet wide asphalt surfaced access road with shoulders and walkways for personnel entering the plant from the plant parking lot. The road would be surfaced with 4" of asphalt pavement over 8" of crushed rock (See Figure 22).

3.3.3 Considerations for Roads

ALE Heavy Haulers (Reference 6.2) stated that the preferred maximum slope for a heavy haul road is 3%. The haul becomes much more difficult at steeper grades.

The widest heavy haul road is 100 feet wide. This width is needed where turns will be made. However, straight sections of road could be reduced to 80' wide. Only 100' wide roads are considered in this evaluation.

Figure 1 shows roads to and from the batch plant in a circular pattern. The concrete trucks would use roads in a one-way circular pattern when traveling to and from the batch plant.

Depending on the final security arrangement between the new and existing plants (e.g. Protected Area (PA) fence boundary), Figure 1 shows a road on the east side of the power block between the power block and the switchyard. This would be a permanent road utilized during construction. After construction is complete, this road would then be utilized to access the new plant switchyard, cooling towers, barge unloading facility and ACOE Confined Disposal Facility (CDF) located to the north of the PSEG property line.

The main access road (Figure 22) to the power block would climb up the hill at a maximum of a 5% slope. The road would have a sally port constructed at the security fence to interface with the fence when it is installed. This road has 8' wide walkways on both sides of the road for workers to use.

A sally port is a fenced area with a gate at each end. This is for use by vehicles that are entering the plant PA. The outer gate is opened and cars or trucks enter the area. Then the outer gate is shut and the vehicle(s) is/are inspected. The inner gate into the plant is not opened until vehicles pass inspection.





4.0 Material Quantity Takeoffs

4.1 Unwidened Hope Creek Barge Slip

Existing Barge Slip (Unwidened): The bottom of the existing barge slip will be dredged 2 feet to lower the grade of the slip to El. 77.0.

Dredging:	1350 cu yds
Riprap:	45 cu yds
Bedding:	23 cu yds

4.2 Widened Hope Creek Barge Slip

The widened barge slip requires the use of two rows of sheet piling. The inner row shapes the barge slip. The outer row, which is about 55 feet behind the inner row, is used as a dead man to hold the inner row in place. Tie rods are used to tie the two rows of piling together. Channels (walers) are tack welded to each row of piling to connect the rods to the piling.

The existing reinforced concrete pavement slab on the south side is removed before the sheet piling is driven.

Stone Columns are installed between the two rows to stiffen the soil if required. Dredging is required to remove material from the slip and to lower the bottom of the existing slip an additional 2 feet.

Dredging: (Inside barge slip)	5800 cu yds
Replace Riprap:	100 cu yds
Riprap Bedding:	50 cu yds
Remove 50 feet Reinforced Concrete:	770 cu yds

Drive inner row of sheet piling

Type:	PZ-35, PZC-26, or AZ-26 50-ksi, hot rolled
Height:	50 feet
Length:	320 feet
Area:	16,000 square feet

Drive outer row of sheet piling

Type:	PZ-35, PZC-26, or AZ-26 50-ksi, hot rolled
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Height:	15 feet
Length:	320 feet
Area:	4,800 square feet
Excavate to install the rods:	8500 cu yds
Install channels (4 rows of 2 sets, C 8 x 11.5):	1280 linear ft
Tie Rods (2 each, 1-3/4" dia., 75ksi, 60 feet long, 7 feet apart):	92 rods
Sand backfill:	7300 cu yds
Crushed rock backfill (top 2 feet):	1200 cu yds

Pave concrete ramp on west side

18" reinforced concrete pad, 20' wide x 72' long:	80 cu yds
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Stone columns between the two rows of sheet piling

Stone surfacing 3 feet thick:	1950 cu yds
3 layers of BX-1300 Geogrid reinforcing:	5400 sq yds
7 rows of 42 columns, 30 feet long:	294 columns
Fenders:	1 Lot
Pull existing sheet piling (320' x 50'):	16,000 sq ft

4.3 Proposed Barge Storage Area

The barge berthing area should be placed so that the bottom of the barge will not set on the bottom of the river at mean low water level. Caissons, that will be used to tie up the barges, will be placed on approximately 200 feet centers.

Diameter of caissons:	20 feet
Top of Caisson (4.5 feet freeboard above Higher High Tide:	EI 102.0
Average interior grade (Existing River Bottom):	EI. 80.0

Sheet Piling

Height:	50 feet
Type:	PZ-35, PZC-26, or AZ-26 50-ksi hot rolled
Area per caisson:	3140 sq ft
Fill with sand per caisson:	220 cu yds
Cover top 3 feet with concrete:	35 cu yds
Place cleats on 40 foot centers:	1 Lot



Total number of caissons:	7
Area of sheet piling (total):	21,980 sq ft
Interior sand fill (total):	1540 cu yds
Concrete Caps (total):	245 cu yds

4.4 Proposed Barge Unloading Area

Consider the barge unloading area is constructed using sheet piling. A set of sheet piling is placed about 55 feet behind the outer row of sheet piling to act as a dead man. The area behind the sheet piling is excavated about 5 feet to remove brush and topsoil. Then the area is filled with granular material, compacted to 95 percent per ASTM D 1557. A concrete slab is placed on top of the fill. The area on the river side of the unloading area is dredged to obtain an Elevation of 76 feet so that no barges will hang up on the bottom of the river.

Top of piling:	El. 102.0
Existing Grade inside piling (average):	El. 85

Drive inner row of sheet piling

Type:	PZ-35, PZC-26, or AZ-26 50 ksi, hot rolled
Height:	50 feet
Length of piling:	420 feet
Area	21,000 sq ft

Drive outer row of sheet piling (Dead Men)

Type:	PZ-35, PZC-26, or AZ-26 50 ksi, hot rolled
Height:	15 feet
Length:	300 feet
Area:	4,500 sq ft

Excavate to install the rods:	N/A
Install channels Two C8 x 11.5 (tack weld to sheet piling):	1200 linear ft
Tie Rods ((2 each, 1-3/4" dia., 75ksi, 60 feet long, 7 feet apart):	86 rods
Sand backfill:	13,300 cu yd
Concrete Paving – 15" reinforced concrete:	830 cu yd
Dredging:	



Dredge the area outside of the barge loading area and the barge storage area to Elevation 73.4 (See Figure 1).

Volume of Dredging: 441,000 cu yd

4.5 Construction Haul Roads

Type 1 - 100 feet Wide Haul Road: The length of the haul road is shown on Figure 1. The thickness is 8 inches of asphalt pavement over 18 inches of crushed rock base course. The amount of fill to construct the road is not included. It is assumed to be included with the fill required to construct the plant.

Length of Road:	~7,000 linear feet
Widened Road Areas: 1-1/2" asphalt surface course	220,000 Square Feet
2-1/2" asphalt binder course	for each component
4" asphalt base course	
18" Crushed rock	

Type 2 - 32 feet Wide Haul Road: The length of the road is shown on Figure 1. The thickness of crushed rock surfacing is 12 inches. The amount of fill required to construct the roads is not included. It is assumed that the fill is included with plant fill.

Length of Road:	5,000 linear feet
Surface with Crushed Rock Material compacted to 95% per ASTM D 1557:	6,000 cubic yards

No quantities of materials were calculated for the Type 1 Permanent Plant Road since most of these roads will be constructed as part of the general plant fill construction.



5.0 Conclusions and Summary

5.1 Available Barge Types

An assessment was made of the types of barges that are available to transport equipment on the East Coast waterways (See Section 3.1.1). There are numerous barges available from 54' wide x 180' long x 11' deep to 72' wide x 260' long x 16' deep. The barges used on the East Coast to transport equipment are typically 54' wide x 250' long x 11' deep. Figures 2 through 7 are included which show an example of the 54' wide and 72' wide barges. The 72' wide barges are primarily used on the Gulf Coast. However, arrangements can be made to have a barge of this size available for use on the East Coast.

5.2 Existing Hope Creek Barge Slip (Unwidened)

The existing Hope Creek barge slip is 60' wide x 300' long. There are also two existing berthing docks adjacent to the slip. The south dock is 600 feet long and the north dock is 250 feet long. These docks can be used to berth empty or full equipment barges as well as material barges.

Based on the 6' draft as discussed in Section 3.1.3, the existing slip has adequate depth at mean low water to accept a 54' wide x 11' deep barge. However, it would be dredged an additional 2 feet to provide added clearance between the bottom of the barge and bottom of the slip to account for any wind driven wave action. Figures 1, 9, 10 and 11 are included to show this slip and the adjacent berthing docks.

Based on lowering the bottom of the existing barge slip by 2 feet, the total dredge volume would be approximately 1350 cu. yds.

See section 4.1 for material quantities associated with dredging the existing barge slip.

5.3 Existing Hope Creek Barge Slip (Widened)

If it is determined that a wider barge would be more economical, then the barge slip would be widened to 80' wide so that 72' wide barges could be utilized. Sheet piling would be utilized to widen the slip. A subsurface investigation would be required prior to performing a detailed sheet pile design. In addition to widening the slip, the bottom of the slip would also be dredged an additional two feet to provide added clearance between the bottom of the barge and bottom

of the slip to account for any wind driven wave action. Figures 1, 12, 13 and 14 are included to show this scope of work.

Based on widening the existing slip by 20' and lowering the bottom of the slip by 2 feet, the total dredge volume would be approximately 5800 cu. yds.

See section 4.2 for material quantities associated with widening the existing barge slip.

5.4 Barge Storage Area and Unloading Facility

A barge unloading dock would be constructed north of the proposed new plant. It would be 300 feet long with a 60' wide reinforced concrete pad for use by a large crane. This dock would be constructed utilizing a sheet pile design (See Figure 16). The dock would be utilized for unloading raw/bulk materials or equipment barges that can be unloaded using a crane. A barge storage area for this dock will be located immediately north of the unloading area. It would be constructed using pile groups or caissons. There would be 7 groups of piles or caissons placed 200 feet apart (See Figure 15).

The barge storage facility would be capable of storing five sets* of full material barges (200' long x 35' wide x 13' deep) with space provided for storing an empty set of barges. These barges have a 1500 ton capacity, but can carry as much as 2000 tons. The draft on barges of these capacities would be approximately 9' and 11', respectively.

*Note: A barge set consists of three barges strung together side-by-side.

The 250' long x 72' wide x 16' deep equipment barges could also be moored in this area if desired.

Figures 1, 15 16, and 17 show the barge unloading area, the barge storage area, and the batch plant.

As discussed in Section 3.2.2 and shown on Figure 1, the river bottom due west of the proposed barge storage and unloading facility would have to be dredged to approximately El. 73.4' to provide sufficient water depth and clearance to allow barge access and storage during mean low water (El. 86.4'). This would equate to approximately 441,000 cu. yds. of dredged material.



See sections 4.3 and 4.4 for the material quantities associated with the constructing the proposed barge facilities.

5.5 Construction Haul and Plant Access Roads

Heavy haul roads, which will be used to transport heavy equipment and modules, are 100 feet wide. Narrower construction roads, which are 32 feet wide, will be used by trucks to transport materials and equipment. The steepest desirable slope on a haul road used to haul heavy equipment is 3%. The steepest desirable slope on a construction road used by trucks is 5%. The main access road into the plant would be 48 feet wide with shoulders and walkways adjacent to the road for personnel access to the plant.

See section 4.5 for material quantities associated with constructing the proposed roads

5.6 Dredge Quantity Summary

The following provides a summary of the required dredge quantities associated with each of the proposed facilities and facility upgrades:

- Existing Hope Creek Barge Slip Unwidened: **1350 cu yds**
(Inside the barge slip only)
- Existing Hope Creek Barge Slip Widened: **5800 cu yds**
(Primarily inside the barge slip area)
- Proposed Barge Storage and Unloading Facility: **441,000 cu yds**
(River and Shoreline)

There is no dredging associated with the construction haul or plant access roads.



6.0 References

- 6.1 Discussion with McDonough Marine on May 08, 2009. Ron White, Vice President.
Tel.: 281-452-5887 e-mail Address: rowhite@marmac.net, McDonough Marine web site:
<http://www.mcdonoughmarine.com>
- 6.2 Discussion with ALE Heavy Haulers, Mr. Juan Falipe Correa, March 2009.
- 6.3 Publication titled "Barges", dated Oct. 02, 2009. web site:
<http://www.olddriverbillsunwald.members.ktis.net/barges.htm>
- 6.4 Bechtel Drawing C-01820-0, Rev. 3, dated 08/04/1977.
- 6.5 Bechtel Drawing C-01821-0, Rev. 3, date 08/04/1977.
- 6.6 Bechtel Technical Specification for Contract for Barge Facilities, Spec. No. 10855-C-003, dated 10/10/1975.
- 6.7 Computer Program "VERTCON Rev 2", written by the U S Army Corps of Engineers (available on Google).
- 6.8 Discussion with Satish Madan (S&L Materials Handling Group), May 8, 2009.
- 6.9 U.S. Army Corps of Engineers District, Philadelphia. Delaware River, Philadelphia to the Sea, Reedy Island & Baker Ranges Examination, Sta. 255+00 to Sta. 275+057.48, Sept. 27, 2001.
- 6.10 **"Proprietary & Confidential"** Sargent & Lundy^{LLC}, "New Build Project Feasibility Study" Report No. SL-009251, Rev. 0 November 29, 2008.



7.0 Attachments

- Figure 1 Conceptual Layout Barge Unloading and Haul Roads
- Figure 2 Cargo Barges by McDonough Marine
- Figure 3 54' wide x 250' long x 11' deep Equip. Barge
- Figure 4 54' wide x 250' long x 11' deep Equip. Barge
- Figure 5 54' wide x 250' long x 11' deep Equip. Barge – Inland Deck
- Figure 6 72' wide x 250' long x 16' deep Equip. Barge - Ocean Going
- Figure 7 Unloading an Equipment Barge
- Figure 8 Hopper Barges
- Figure 9 Existing Barge Slip – Plan (Unwidened)
- Figure 10 Section A Existing Barge Slip Looking East
- Figure 11 Section B Existing Barge Slip Looking North
- Figure 12 Widening of Existing Barge Slip – Plan
- Figure 13 Section A Widened Barge Slip Looking East
- Figure 14 Section B Widened Barge Slip Looking North
- Figure 15 Barge Storage Area
- Figure 16 Materials Unloading Area
- Figure 17 Conceptual Layout of Batch Plant
- Figure 18 USACE Hydrographic Survey at Plant Area
- Figure 19 USACE Hydrographic Survey at Plant Area
- Figure 20 Type 1 Asphalt Paved Heavy Haul Road
- Figure 21 Type 2 Crushed Rock Surfaced Construction Road
- Figure 22 Main Access Road
- Figure 23 Datum and Water Level Relationship
- Figure 24 Conversion of Hydrographic Survey Maps From NAVD Datum to PSEG Plant Elevation



