Constructability Report: Option 2 & 3 Proposals
2021 SAA Proposal Window to Support NJ OSW

September 19, 2022

For Public Use

The information contained herein is based on information provided in project proposals submitted to PJM by third parties through its 2021 SAA Proposal Window. PJM analyzed such information for the purpose of identifying potential solutions for NJ BPU's consideration as contemplated under the SAA Agreement, FERC Rate Schedule No. 49. Any decision made using this information should be based upon independent review and analysis, and shall not form the basis of any claim against PJM.

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Introduction

Background

As part of the 2021 SAA Proposal Window to support NJ Offshore Wind (“OSW”), PJM received proposals to meet New Jersey’s goal of interconnecting up to 7,500 MW of offshore wind. The proposals were categorized into four options according to the function and location of the proposal.

- Option 1a proposals: Onshore transmission upgrades to resolve potential reliability criteria violations on PJM facilities in accordance with all applicable planning criteria (PJM, NERC, SERC, RFC, and Local Transmission Owner criteria).
- Option 1b proposals: Onshore new transmission connection facilities
- Option 2 proposals: Offshore new transmission connection facilities
- Option 3 proposals: Offshore new transmission network facilities

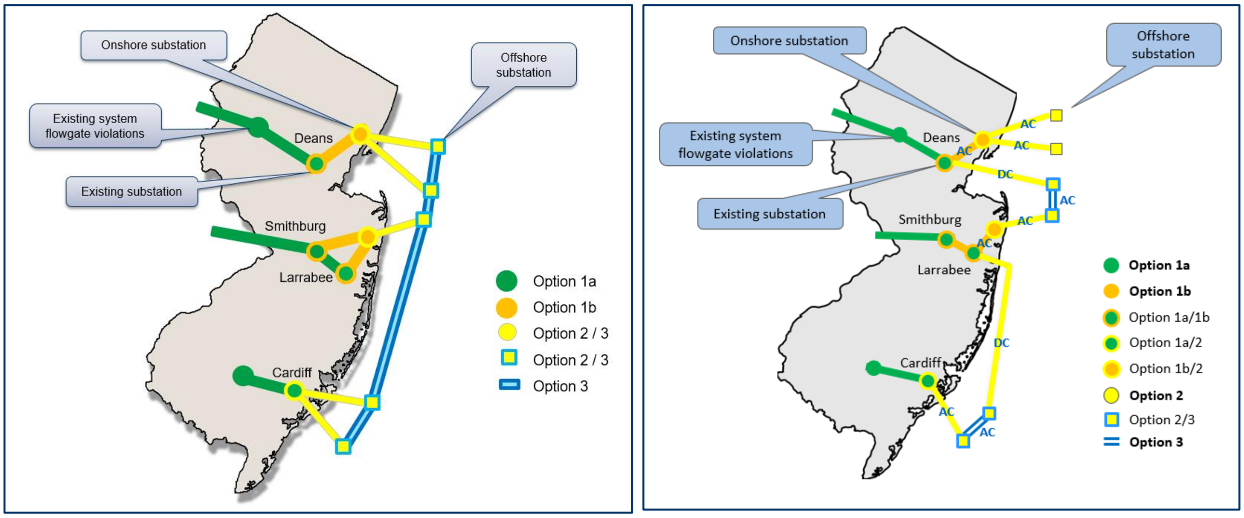

Figure 1 Potential Options for the NJ Offshore Wind Transmission Solution (Concepts depicted are for illustration purposes only; details of new lines and facilities are to be provided by sponsors in proposals to meet objectives of this solicitation.)

Altogether, PJM received a diverse set of 80 proposals submitted by 13 different entities each falling into one or more of the four Options described above.

Option 2 & 3 Problem Statements

This report focuses projects that were submitted to address the Option 2 and Option 3 problem statements, which are stated below:

Option 2 Proposals: These shall include a new offshore substation and all necessary greenfield solutions connecting the new offshore substation to an onshore substation either contemplated in response to the Option 1b problem statement, or to a default or alternative point of injection (POI) where onshore substations are not needed.

A complete proposal will fully detail the connection between one proposed onshore substation (or a default or alternative POI), and new offshore substation(s) to collect offshore wind energy from one or more wind farms. Proposals must be complete and responsive in fully addressing the transfer of offshore wind generation from any new offshore substation(s) to the proposed onshore substation (or a default or alternative POI), and include all tie-in work to that substation(s). Unless otherwise specified in the proposal, Option 2 proposals shall include capability to accommodate the default injection amounts in the Proposal Window Overview document. Proposers should submit separate Option 2 proposals to address different POIs or different solutions related to single POIs. Any interdependence issues or benefits relative to proposals for Options 1a, 1b, 3, or other Option 2 proposals (for different POIs) should be clearly described in the proposal.

Option 3 Proposals: These shall include all necessary greenfield upgrades between the offshore substations proposed in response to the Option 2 problem statement. Proposals should seek to achieve additional benefits of a networked offshore transmission system, including improved availability of offshore wind deliverable to onshore POIs, improved access by future offshore wind generation projects likely to be selected by New Jersey, and any market efficiency benefits that may be associated with linking the selected POIs.

Objective

This report incorporates the results of reviews performed by PJM and its consultants to evaluate the extent to which each submitted Option 2 or Option 3 proposal identified, addressed, and mitigated the constructability, environmental, and permitting challenges of the proposed solution. These reviews included evaluation of project scope, complexity and constructability factors that impact the project cost and/or schedule including but not limited to right-of-way acquisition, land acquisition, siting and permitting requirements, project complexity, project coordination complexity, outage coordination and project schedule.

General Approach

PJM reviewed the information submitted by the proposing entities for each proposal, which included the following:

- Completed PJM Proposal Submittal Template (including project description, value proposition to NJ and cost control and risk mitigation measures)
- Completed BPU Supplemental Offshore Wind Transmission Proposals Data Collection Form – consisting of supplemental information related to proposals, including: a narrative description of the proposed project(s) and options; documentation of the projected benefits in terms of design, flexibility, ratepayer costs, and environmental impacts; an identification of major risks of (such as delay or non-completion risks, including the project-on-project risks created by the interdependence of the proposed project(s) and those of other transmission and offshore wind projects); strategies to limit risks to NJ customers; and cost recovery and containment provisions.
- Project diagrams and schedules
- Technical analysis files and documentation

With the submitted information, PJM and its consultants conducted a detailed review of each project, and the findings are detailed in this report. The following is an outline of the general approach followed for evaluation of the projects:

1. Environmental (Regulatory) Analysis: Examine each Project utilizing available public-sector data, aerial photographs, and internet based real estate records to determine if the Project is feasible and to identify potential regulatory permitting risks. The following is a list of the subtasks that are performed as part of this task:

a) Conduct a desktop review to identify significant barriers that might add additional risk to the Project and determine whether the proposed Project area (a Study Area which is defined for each project) can support the economical construction of the electric transmission and/or substation facilities

The following target information will be referenced by as required and as allowable by available public data sources:

- National Wetland Inventory mapping from United States Fish and Wildlife Service (USFWS), which will include counts and acreages of:
  - Total Wetlands;
  - Non-Tidal (Non-Forested) Wetlands;
  - Non-Tidal (Forested) Wetlands;
  - Total Non-Tidal Wetlands;
  - Wetlands of Special State Concern; and
  - Subaqueous Lands.
- Mapping of specially designated wetlands, streams, or rivers, which will include:
  - Non-Tidal Waterbodies (Count/Acres);
  - 100-Year Floodplain (Acres);
  - Watershed Boundaries (Count);
  - Outstanding and Exceptional Waters (Count);
  - Wild and Scenic Rivers (Count); and
  - United States Geologic Survey Blue Line Streams (Count).
- United States Department of Agriculture(USDA)/The Natural Resources Conservation Service (NRCS) Land Cover mapping, which will include acreages of:
  - Sub-Aquatic Vegetation;
  - Forested Uplands;
  - Unforested Uplands; and
  - Agricultural Lands.
- Land Use Mapping, which will include:
  - Residences within 100 feet (Count);
  - Residences within 250 feet (Count);
  - Land Zoned Conservation (Acres);
  - Rural Legacy (Acres);
  - Program Open Space (Acres);

- Private Conservation Easements (Acres & Count);
- Public Land (Acres & Count);
- Parcels Crossed (Count);
- Green Infrastructure/Green Acres program (Acres);
- National Estuarine Research Reserve Project Areas (Acres & Count);
- Natural Heritage Areas (Acres & Count);
- Environmental Trust Easements (Acres & Count);
- Forest Legacy Easements (Acres & Count); and
- Tidelands.

For projects located in NJ, using the NJDEP's Bureau of GIS' "State, Local and Nonprofit Open Space of New Jersey" dataset (2022) each Study Area was reviewed for US National Parks, NJ State Forests and Parks, NJ Fish and Wildlife management areas, Natural Lands Trust Preserves, and County, Municipal, and nonprofit preserves, conservation areas, parks, and recreation areas. This database was also used to identify NJ Green Acres Program encumberment status. NJ Farmland Preservation Program's preserved farmland database (2022) was reviewed for agricultural easements. NJ Coastal Management Program's list of Excluded Federal Lands was reviewed as was New Jersey Public Access Locations Search Tool for NJDEP's lands and waters subject to public trust rights.

- Public Lands Mapping Review, will include the types, counts, and acreages of the following:
  - State/National Forests;
  - Natural Areas;
  - Preserves;
  - Game Lands; and
  - Recreation Areas
- Cultural Resources Mapping Review, including the count of previously identified resources, which will include the types, counts, and acreages of the following:
  - Listed and Eligible Historic Structures;
  - Listed and Eligible Historic Districts; and
  - Listed and Eligible Archeological Sites.

  For projects located in NJ, the NJ Historic Preservation Office's data sets for historic districts, historic properties, and archaeological site grids were used to determine the presence of cultural resources in each the Study Area.

   - Aquatic Resource Mapping, including the count of Submerged Historic Resources (if applicable);
   - Online distribution data of Rare, Threatened, and Endangered species within a 0.5 mile radius of the Study Area;
     - This review was conducted utilizing the United States Fish and Wildlife Service (USFWS) maintained Information for Planning and Consultation (IPaC) online tool, NatureServe Explorer Pro online mapping tool, and the List of TE Species of NJ published by the NJDEP.
   - Major utility and transportation (roads and rail lines) corridors.

b) Identify those permits and agency consultations that are complex and require long lead times, therefore, potentially significantly affecting the project in-service date. Specifically, evaluate federal and state authorizations required for potential impacts to sensitive environmental resources such as wetlands, rivers and streams, coastal zone management areas, critical habitats, wildlife refuges, conservation land, rare, threatened, and endangered species The assessment will result in a preliminary list of potential siting issues and permits that could impact cost and/or schedule including estimated Agency review times. Anticipated permit requirements may include the following:

   - U.S. Army Corps of Engineers (USACE) – Section 404 Clean Water Act and Section 10 Rivers and Harbors Act;
   - U.S. Fish and Wildlife Service (USFWS) – Section 7 Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Acts;
   - U.S. Forest Service – National Forest Special Use Permit and Archaeological Protection Resources Act;
   - National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service - Magnuson-Stevens Fishery Conservation and Management Act (MSA);
   - U.S. Bureau of Ocean Energy Management
   - U.S. Bureau of Land Management – Right-of-Way Grant and Archaeological Protection Resources Act;
   - Federal Aviation Administration (FAA) – Obstruction Determination and FAA Hazard Evaluation;
   - U.S. Coast Guard – Aids to Navigation;
   - State Commission approvals;
   - State Agency – Rare, threatened, and endangered species issues and clearance requirements;
   - State Historic Preservation Office (SHPO) and clearance requirements;
   - State Agency - Section 401 Water Quality Certifications and other applicable water permits;
   - State Agency – National Pollutant Discharge Elimination System permit;

   - Local and/or State floodplain permit requirements; and
   - State Department of Transportation and clearance requirements.

   c) Identify potential high-level risks and items that may require protracted permitting timeframes or that may raise serious issues during the permitting process.

2. Transmission Line Analysis: Review of transmission line modifications proposed based on desktop reviews investigating routing, conductor size and length, rights-of-way (ROW) and easements, structures, and construction required.

3. Substation Analysis: Review of substation modifications proposed based on industry practices to estimate the equipment, bus and general layout required.

4. Construction Schedule: Prepare a preliminary Project schedule for each Project. The Project schedule will be broken into four (4) project phases: Engineering; siting and major permit acquisition; long lead equipment procurement; and construction and commissioning. Any significant risks to the Project schedule will be discussed.

5. Cost Review: Prepare preliminary estimate for each project based on engineering expertise and the most recent material and equipment costs. Costs will be broken into seven (8) categories, as required: materials and equipment; engineering and design; construction and commissioning; permitting/routing/siting; right of-way (ROW)/land acquisition; construction management; company overheads and other miscellaneous costs; and project contingency. Prepare a summary of the cost estimating technique and assumptions used for the costs.

Executive Summary

PJM and its consultants performed a detailed constructability review of projects with offshore components, Option 2 (landfall to offshore platform) and Option 3 (platform interlinks) proposals. This report documents the results of those reviews for each proposing entity, detailing the constructability results for both the offshore and the onshore components of their projects. The reviews assessed potential risks to achieve a project's scope, cost, and schedule based on information provided in each proposal, as well as PJM and its consultants' industry experience and knowledge of the technology involved, typical challenges of permitting and construction of facilities in offshore and landfall environments, and equipment supply chain constraints. This executive summary provides an overview of some of the common risks and issues identified across the projects, and also some proposal-specific risks.

Common Offshore Risks and Issues

Overall Project Risks

The constructability reviews determined that all projects are feasible and that no fatal flaws were found based on information provided in the proposal documentation. Additionally, all proposed projects are reasonably capable of being constructed in an offshore environment provided that proper design and construction methods are used. Note that the proposals provided varying levels of information ranging from general descriptions of project concepts to detailed studies of potential submarine cable routes and platform locations. Detailed cable routing, platform siting, and design development which would be performed after a project is awarded may uncover issues that were not apparent in the proposals as presented.

Schedule Risks

A primary risk associated with most HVDC-based proposals is use of HVDC systems rated at 1,400 MW or above using ±400 kV as the transmission voltage. Systems of this voltage and power rating are not in widespread use. Specifying use of these systems needs to take into account time for their development to achieve readiness as a commercial offering. There is low risk that these systems will not ultimately be developed as HVDC technology advances.

A second significant risk is application of HVDC systems in an offshore environment, and more specifically installation of an HVDC converter and its related equipment on an offshore platform. Several such installations already exist worldwide, but few are of the general scale being considered for these proposals. As such additional development time will likely be needed to achieve the designs needed for the proposed systems. Like the HVDC system risk described above, there is low risk that HVDC converters and related equipment will not ultimately be successfully deployed on offshore platforms.

Permitting Risks

In general, all proposals seeking to install submarine cables and platforms in the offshore New Jersey marine environment will be subject to the same general risks associated with obtaining the federal, state, and local permits needed to construct and operate these facilities, e.g. Bureau of Ocean Energy Management (BOEM) permits. These risks include avoidance of sensitive seabed areas, fisheries, charted and uncharted obstructions, and disruption of recreational uses during construction activities.

These risks may be more pronounced for cable routes that traverse more congested waterways to reach their landfalls, such as those that are routed through Raritan Bay. Historical uses of this waterway and higher concentrations of marine traffic can create additional risks to both installation and operation that may not be as prevalent in the open ocean.

HVDC Systems

Schedule and cost risks associated with HVDC systems include the limited universe of suppliers of this equipment. This is amplified by the development risk associated with installation and operation of platform-based HVDC converters in a marine environment as well as commercial readiness of ±400 kV systems proposed by several developers.

Submarine Cables

A prominent risk related to high voltage submarine cables is that there are only a limited number of manufacturers and limited production capability on a global basis. This can cause both schedule risk as well as pricing/cost risk should the demand for these cables outpace supplier capabilities. This may be particularly acute when considering the limited availability of cable installation vessels, and further exacerbated when considering the demand for not only transmission cables but also those used for offshore wind collection systems. Note that several other offshore wind projects in neighboring regions may also be active during the same timeframe as those related to New Jersey's offshore wind resources which may further elevate this risk.

Offshore Platforms

Offshore platforms to be used for HVDC converters or HVAC substations will rely on the same supply chain as what is used for offshore oil and gas exploration and production. This presents risks of supplier scarcity as well as scarcity of the vessels required to install the platforms. The cyclical nature of oil and gas exploration efforts may also exacerbate the situation should an uptick in demand for platforms coincide with the timeframe for procurement and installation of platforms for offshore wind projects.

Operational Risks

Two main risks are present when considering operational issues for the proposed transmission systems. First, most proposals rely on common submarine cable corridors and common landfall locations which could result in up to approximately 6,000 MW of transmission connectivity in close proximity, potentially exposed to a common point of failure. These submarine issues can also extend to land routes and POIs. Measures can be taken in detailed design to reduce the possibility of a common failure in these circumstances. An assessment of these risks attempts to recognize the amount of MW that could be exposed in its relative risk ratings. Note that these risks can be balanced by the fact that common cable corridors confine seabed disturbances due to cable installation to a single linear route and could be considered an environmental and permitting risk benefit.

The second operational risk is mainly related to Option 3 proposals that use HVDC ties as interlinks between platforms. Since HVDC circuit breaker technology for the voltages and systems contained in the NJ SAA proposals is still in early development by HVDC suppliers, none of the HVDC interlink cables can be switched while energized. This limits reconfiguration of offshore transmission systems to only when the entire system can be de-energized. This will require curtailment of all offshore wind generation prior to full de-energization and coordinated startup between the transmission system and available wind generators. Further, it appears that HVDC breakers will require their own offshore platform due to the size and configuration of the equipment involved which would further increase the cost of the interlinked system when this technology becomes available.

Proposal-Specific Offshore Risks

Anbaric Proposals

Anbaric's proposals are based on HVDC technology. Most of their proposals are rated at 1,400 MW or higher and use ±400 kV as an operating voltage. This level of HVDC technology will require additional development to achieve a full commercial product, and as such presents some additional schedule risk relative to projects using ±320 kV HVDC systems.

Anbaric offers several options for interconnection, and depending on the particular proposals that may be chosen, there would be areas where submarine cables share common seabed corridors. For example, a number of Anbaric Option 2 proposals would make landfall in Raritan Bay and proceed inland to Deans substation. Should multiple proposals from these group of Deans POI projects be selected the risk of simultaneous outages of the cable circuits should be evaluated.

The seven Option 3 platform interlink proposals submitted by Anbaric will be HVDC cables connecting through HVDC switchgear located on Option 2 proposal platforms. Since no HVDC circuit breakers are available the use of the interlink cables would require shutdown of the interconnected HVDC systems to reconfigure the network and subsequent re-energization before any offshore generation could be delivered to shore. Furthermore, when interlinks are in use, any fault on the interconnected HVDC cables would cause an outage of the entire connected HVDC system. This presents an operational risk that is not applicable for Option 2 proposals that are radial in nature.

Atlantic Power Transmission Proposals

Atlantic Power Transmission (APT) presents a unique permitting strategy for their project. The strategy involves identifying "cable convergence areas" where two HVDC transmission cables will come together from separated offshore platforms and follow a combined cable corridor to landfall. APT is proposing to permit the submarine cable route from landfall to this cable convergence area and will leave permitting of cable routes to individual platforms to the offshore wind developers to which the offshore generation will connect at 66 kV. APT states that this allows the offshore generator to select the location of their platform and eliminates the risk of having permits obtained for offshore wind generation but not the transmission system. APT would still construct the full length of each submarine cable and offshore platform with its HVDC converter and 66 kV switchgear.

APT's proposal includes landfall at the National Guard Training Center at Sea Girt, NJ. This site has advantages in that it helps avoid residential areas and could minimize disruption to recreational uses during construction, but it is also a historically active area for landfall of telecommunication cables. There are several such cables making landfall in this area, and many are no longer in use and are slated to be removed according to discussions with the National Guard. However, there does exist a risk of encountering these facilities, and perhaps older cables which are uncharted, in this area. This would be true for not only APT's project but also other projects seeking landfall at his same location.

LS Power Proposals

LS Power's proposal differs from all the other proposals that were reviewed in that it proposes a 345 kV AC solution using conventional 345 kV AC cables and switchgear. This approach has some operational advantages in that the loss of a single cable would not necessarily reduce the overall capability of the system to deliver power to land. It does, however, require careful consideration of voltage regulation and the use of reactive power resources to manage system voltages under varying load conditions.

Note that this proposal shares some risks common to other proposals. First, it uses a common cable corridor which could expose the overall system to a single contingency of up to approximately 6,000 MW depending on the detailed design of the submarine, landfall, and land cable portions of the route. Second, it proposes making landfall at Sea Girt, NJ which has additional risk described above from the presence of numerous existing telecommunication cables.

It also should be noted that this proposal would require offshore wind developers to connect to LS Power's platforms using 345 kV circuits in contrast to other proposals' connections which directly accept 66 kV or 275 kV turbine array cables on the same platform as the transmission voltage equipment. This in effect places the transformation from 66 kV to 345 kV (likely on a separate offshore platform) in the scope of the offshore wind developer, significantly increasing that developer's cost when compared to connecting to other transmission proposals' projects.

Con Edison Transmission Proposal

Con Edison Transmission's Clean Link New Jersey (CLNJ) proposal includes two 1,200 MW HVDC systems using the Sea Girt, NJ landfall location for both submarine cable circuits. As such it is exposed to the same risks as other proposals using the Sea Girt landfall, namely potential installation interference from existing submarine telecommunications cables.

CLNJ also proposes an option to use 66 kV platform interlink cables to tie the offshore AC turbine array collection systems together between platforms. This does provide some flexibility in routing offshore generation to shore, but the 66 kV voltage level for these interlinks would likely be limited to 200-400 MW of transfer capability.

MAOD Proposals

MAOD's Option 2 proposals have similar risks to other proposals. These include use of common cable corridors and landfalls which could present a single point of failure totaling several thousand MW. MAOD also proposes to make landfall at Sea Girt, NJ which presents potential risks of installation interference from existing submarine telecommunications cables as described above.

MAOD's proposals include HVDC interlink cables between both platform and land HVDC converters. As with other HVDC interlinks, no DC circuit breakers are used so these cables need to be switched in and out of service with the full HVDC system de-energized (also resulting in unavailability of connected wind generation). When energized, the entire HVDC portion of the interlinked system would be exposed to a full outage for any cable fault, requiring locating and isolating the faulted cable before the remaining healthy system can be re-energized

NextEra Proposals

NextEra's proposals are targeting commercial operation dates (CODs) in the 2028-2029 timeframe. Given the nature of these projects, risks related to supplier scarcity for platforms and HVDC converters/cables and the vessels needed for installation, and potential for difficulties in permitting and construction, these CODs seem optimistic.

NextEra's proposal uses Voltage Source Converter (VSC) HVDC technology rated from 1,200 to 1,500 MW at ±400 kV operating voltage. This level of HVDC technology will require additional development to achieve a full commercial product, and as such presents some additional schedule risk relative to projects using ±320 kV HVDC systems.

These proposals also have potential operational risks in routings that use common cable corridors, a risk described above in relation to many other proposals.

NextEra also proposes an option for connection to the Cardiff POI that is an alternate to the Atlantic Shores / Ocean Wind project and proposes converter platforms in the Atlantic Shores/Ocean Wind lease areas. Coordination with these projects and use of an alternate interconnection plan for a previously awarded project would present some additional schedule and cost risks above those applicable to other NJ SAA proposals.

Each of NextEra's proposed Option 3 platform connectors offers some level of redundancy up to a capacity of 800 MW, but this redundancy is after post contingent or planned switching. This provides partial redundancy for each platform up to 53% of each platform's output if all 4 platform connectors were constructed.

PSEG/Orsted Coastal Wind Link Proposals

PSEG/Orsted's Coastal Wind Link (CWL) proposal will require wind generators to connect to CWL's platforms using 275 kV AC circuits in contrast to all but one other developer proposals that directly accepts 66 kV turbine array cables on the same platform as the transmission voltage equipment.

CWL's proposal uses HVDC technology at a 1,400 MW power level and ±400 kV operating voltage. This level of HVDC technology will require additional development to achieve a full commercial product, and as such presents some additional schedule risk relative to projects using ±320 kV HVDC systems.

The CWL project also targets the Sea Girt, NJ landfall location for one of its landfalls which presents risks described above common to other proposals associated with the presence of many submarine telecommunication cables.

Atlantic Power Transmission Proposals

Atlantic Power Transmission LLC (APT) proposed three 1,200MW High Voltage Direct Current (HVDC) offshore wind transmission systems, or circuits, providing a total offshore transmission solution to connect 3,600MW into the 500kV backbone of New Jersey's power grid at Deans Substation. Each 1,200MW system is being offered as its own project proposal, enabling the BPU to select either a 1,200MW, 2,400MW or the full 3,600MW solution.

Table 1. **APT Proposals 210, 172 and 769**

Proposal ID(s)	Description(s)	Capability (MW)
210 172 769	APT First 1200 MW APT Second 1200 MW APT Third 1200 MW	1200 MW HVDC 1200 MW HVDC 1200 MW HVDC

Onshore Project Overview

Each of these proposals includes the installation of one new 1,200 MW high voltage direct current (HVDC) transmission circuit for the interconnection of off-shore wind energy projects into the 500kV Deans Substation in South Brunswick, NJ. To facilitate an increase in power transfer from the off-shore wind generation area to 2400MW or 3600MW, Proposal 210 would need to be combined with Proposal 172, or with Proposal 172 and Proposal 769 sequentially. Each Project will consist of an on-shore HVDC converter station with equipment to connect to the NJ power grid at Deans Substation, an off-shore platform with equipment to receive power from one or several off-shore wind farms, a HVDC circuit consisting of two buried power cables running from the off-shore platform to the on-shore converter station to deliver the wind energy to the Grid, and a 500kV AC circuit consisting of three buried power cables running from the new converter station to the existing Deans Substation. From the landfall in South Amboy, there will be an approximately 20-mile-long HVDC underground cable route to the new on-shore converter station near the existing Deans substation in South Brunswick, NJ (Middlesex County). Alternative routes for the HVDC underground cable were provided for the Project, however, only the Primary Routes have been analyzed in this review.

Offshore Project Overview

Each Atlantic Power Transmission (APT) proposal is an HVDC link from an offshore platform in the New York Bight offshore wind area to a Point of Interconnection (POI) at Deans 500 kV substation. The HVDC systems are rated 1,200 MW and ± 320 kV; systems of this power rating and voltage are relatively well established. Offshore wind generators would connect to each APT system at 66 kV switchgear situated on the platforms.

Routing for each APT project beyond state waters is not specified beyond what APT terms a "cable convergence area". One cable corridor extends easterly to an area that would serve lease areas (or future lease areas) north of Hudson Canyon; the other corridor extends in a generally southerly direction to serve current or future lease areas south of Hudson Canyon.

The proposed landfall for APT's HVDC cable is currently an unused former industrial pier on the south shore of Raritan Bay in South Amboy, NJ just east of the NJTransit railroad bridge. APT has developed a conceptual plan to develop the pier post construction as a public space including a boardwalk, park, and amphitheater.

The main risks associated with each APT proposal are related to supply chain and supplier scarcity issues for the offshore HVDC converter, HVDC cables, and offshore platform. These risks are similar to those that apply to other NJ SAA proposals.

APT has a unique permitting strategy whereby APT will route and permit the transmission cables from landfall to the cable convergence area described above. The offshore wind developer to whom APT's system will connect would obtain permits from the convergence area to the offshore platform as part of its overall permitting process for its wind

generation. APT claims this eliminates some project-on-project risk with the offshore wind developer; further review of this permitting arrangement is recommended if APT's proposals is under consideration for selection.
With offshore wind generators connecting their turbine array cables at 66 kV on APT's offshore platform, the system described in APT's proposal provides a complete path for delivering offshore wind generation to an onshore POI on the existing PJM transmission system. Note that no AC harmonic filters are included in the offshore converter station and related switchgear. It is assumed that all necessary harmonic mitigation will be by the wind generators. AC harmonic filters are included in the onshore converter station; ratings of the included filter are selected based on assumptions related to the POI and will need to be reviewed and refined during detailed design.

Onshore Constructability Review

Proposals 210, 172 and 769

Environmental (Regulatory) Analysis

Desktop Review for Proposals 210, 172 and 769

The on-shore portion of each of the three Project is comprised of the construction of a new conversion station near Deans Substation, a HVDC underground cable route starting at the land fall at Radford Ferry Road and extending to the new conversion station, and a HVDC underground cable route from the new conversion center to the existing Deans Substation.

For proposal 210, four alternatives were provided for the HVDC underground cable route from the land fall to new conversion station. The Primary Route initially follows a railroad right-of-way (ROW) for approximately 13 miles and then turns into an existing transmission line ROW which it follows to the new conversion station (four miles). Three alternatives were provided for the HVDC underground cable route from the land fall to new conversion station. One diverges from the Primary Route where the railroad ROW intersects Maple Street where it departs from the railroad ROW and joins the road ROW and follows various road ROWs into the new conversion station (4.3 miles). The second alternative diverges from the Primary Route where the railroad ROW intersects with Bordentown Turnpike where it departs from the railroad ROW and joins the road ROW and follows various road ROWs into the new conversion station (5.3 miles). The third alternative diverges from the Primary Route where the railroad ROW intersects Snowhill Street where it departs from the railroad ROW and joins the road ROW and follows various road ROWs into the new conversion station (5.6 miles).

For proposals 172 and 769, the Primary Route initially follows a railroad right-of-way (ROW) for approximately 13 miles and then turns into an existing transmission line ROW which it follows to the new conversion station (four miles). An alternative route was also provided, this route is the same as the Primary Route which follows the railroad ROW for the first 10 miles until the intersection of Snowhill Street where it departs from the railroad ROW and follows various road ROWs into the new conversion station (5.6 miles). The focus of this desktop review is on the Primary Route.

Study Area

An analysis of the Primary Route, new converter station, and HVDC underground cable connecting the Deans Substation and converter station was performed to assist in the identification of major environmental and socioeconomic features and to provide a base for the extrapolation and derivation of future construction, permitting, mitigation, and land costs studies for the overall Project. A summary of the environmental and socioeconomic features are presented in Appendix A -Tables 8 and 9.

Those features that have a particularly significant direct or indirect bearing on the Project's development are discussed further below. As the on-shore HVDC underground cable route components (Primary Route and cable between converter station and Deans Substation) are proposed to be constructed within existing ROWs, it is not anticipated that their alignments will deviate significantly from the proposed locations. Therefore, the Study Area is a 100-foot buffer centered on the Primary Route, the HVDC underground cable between the Dean Substation and planned converter station, and the parcel for the planned converter station.

Land Use

Aerial Imagery was used to develop a high-level review of land use and cover in the Project Study Area. The Primary Route utilizes existing ROWs for its entire alignment, therefore, the land use impacted by the Primary Route is railroad and transmission line ROW. These ROWs cross various types of commercial, residential, forested, and agricultural land. From the on-shore landing in the city of South Amboy, the Primary Route follows an existing railroad ROW through a mixture of commercial and residential areas which transitions into a mixture of mostly residential and forested land. The Primary Route intersects an existing transmission line ROW that traverses a mixture of forested, agricultural, and commercial land and utilizes this ROW before entering the new converter station at Fresh Ponds Road. The converter station is located adjacent to forested land, residential land, and commercial land. The same existing ROW is used by the HVDC underground cable to enter the Dean Substation.

The Project is compatible with the land uses crossed. However, coordination with municipalities, railroad companies, and transmission line companies holding the existing ROW easements would need to be conducted to negotiate use of their ROW. These negotiations can be unpredictable regarding a willingness to collocate facilities and the requirements of the existing easement language.

Public and Protected Lands

Crossing of public or protected lands, especially federal and state owned or managed lands, invariably requires additional scrutiny regarding regulatory requirements, consultations, ROW approvals, easement acquisition, and subsequent operation and maintenance activities. This concern is heightened by the environmental sensitivity attached to areas that support sensitive natural resources and/or recreational usage.

The desktop review of these sources showed that the Primary Route crosses four public lands including the Julian Capik Nature Reserve in Sayreville Borough, Deep Run Preserve in Old Bridge Township, Jamesburg Park in East Brunswick Township and Pigeon Swamp in South Brunswick Township. In addition to these public lands, a review of the NJ Public Access Locations Search Tool showed that three waterways along the Primary Route are subject to public trust rights including Raritan Bay, Raritan River and South River.

The review of NJ Coastal Management Program's list of Excluded Federal Lands showed that no excluded federal lands are crossed by the Project. Review of NJ Farmland Preservation Program's preserved farmland database shows that farmland conservation easements are not anticipated to be crossed.

Special Regulation Regions

Certain urban areas within NJ are deemed as "Special Areas" due to their importance for human use or stringent planning requirements. According to the Division of Land Resource Protection, these areas include Atlantic City, The Hudson River Waterfront Area, and "Special Urban Areas" which are areas the NJ Department of Community Affairs (DCA) defines as municipalities in urban aid legislation qualified to receive state aid to enable them to maintain and upgrade municipal services and offset local property taxes. The Project is not located within the boundaries of either Atlantic City or the Hudson River Waterfront Area. However, the Project crosses one municipality, Old Bridge Township, that qualifies as a Special Urban Area (DCA 2022). NJ Admin Code 7:7-9.41 states that any development that would adversely affect the economic wellbeing of these areas is discouraged, when an alternative which is more beneficial to the Special Urban Area is feasible.

With the portion of the Project that runs through Old Bridge Township being underground within an existing railroad ROW, impacts to the economic wellbeing of the township are likely minimal in nature.

Certain ecological regions have special protections and regulations administered by the State of NJ. The Pinelands Protection Area is designated for state regulation by the Pinelands Protection Act and the Hackensack Meadowlands

District is designated for state regulation by the Hackensack Meadowlands Reclamation and Development Act. The Project is not located within either of these regions.

Based on the desktop review it is not anticipated that the Project will have adverse effects on Special Regulations Regions.

Special Landscape or Hazard Areas

Special hazard areas are areas that the DEP deems as having a known actual or potential hazard to public health, safety, and welfare, or to public or private property (NJDEP 2021). These areas include the navigable airspace around airports and seaplane landing areas, potential evacuation zones, hazardous material disposal sites, and areas of hazardous material contamination. Review of special hazard areas within the Study Area showed that no seaplane landing areas or airports were in the vicinity of the Project. The Study Area does cross a portion of the Garden State Parkway which is a hurricane evacuation route.

Although not crossed directly by the Project, the Stavola Old Bridge Materials, a Class B solid waste recycling facility is within approximately 0.25-mile of the Primary Route in Old Bridge Township.

The review showed that there are nine sites along the Primary Route where historic fill sites overlap with mapped wetlands and or streams and would constitute a filled water's edge. USACE data also showed that the on-shore landing site of the Project is located within the South Amboy (North) and South Amboy (South) Dredged Material Public Processing and Storage Facility sites (USACE 2007).

NJ Geodetic Controls are established as reference points used for mapping and charting activities. Review of the control locations showed that a total of eight marks were located within the Project's Study Area with an additional 11 marks in close proximity (within 100 feet of the Study Area).

Federal Emergency Management Agency's Floodplains and Floodways data was reviewed for coastal high hazard areas and flood hazard areas. A coastal high hazard floodplain is crossed by the Primary Route adjacent to the Raritan Bay. Additional floodplains and floodways are crossed by other components of the Project as well.
Based on the desktop review it is anticipated that the Project will cross Special Landscape or Hazard Areas. This may result in more rigorous permitting processes or special construction requirements.

Waterbodies and Wetlands

The presence of wetlands can impact Project permitting and construction. In addition to the need to adopt special construction techniques (including avoidance) for specific wetland types and field conditions, the types of wetlands encountered has significant implications from a permitting and compensatory mitigation perspective.
Based on the desktop review, wetlands and waterbodies appear to be crossed by the Project. This can impact Project permitting and construction. An on-site delineation would be required to determine the actual location and extent of wetlands and waterbodies present and to assess permitting implications for jurisdictional features.

Threatened and Endangered (TE) Species and Protected Habitats

Threatened and endangered species and protected habitats can impact permitting, construction schedules, and construction techniques.

Given the results of the desktop review of publicly available data, it is anticipated that the Project is within the range of both federally- and state-listed species, and that coordination with state and federal agencies will be required. Construction restrictions, timeframe, or mitigation may be necessary to comply with avoidance of sensitive species, however, the extent of which cannot be known until after coordination with the NJDEP takes place.

Cultural Resources

The NJ Historic Preservation Office's data sets for historic districts, historic properties, and archaeological site grids were used to determine the presence of known cultural resources in the Study Area. The review showed that the Project crosses through several historic districts including, Camden and Amboy Railroad Main Line, New York and Long Branch Railroad, Old Bridge, G.W Helme Snuff Mill, Raritan River Railroad, Metuchen to Burlington Transmission Line, and the Garden State Parkway Historic Districts. Additionally, the Primary Route runs in close proximity to numerous historic properties located within these historic districts.

While not pinpointing the exact location, the archaeological site grid identifies the presence of an archaeological resource within a half-mile by half-mile area. The Primary Route crosses through five grids with eligible resources and four grids with identified resources.

Coordination with NJ Historic Preservation Office will need to be conducted to required surveys (if any) to assess the extent of impact to the cultural resource. However, given that the Primary Route will be located underground in existing disturbed ROW, impacts to cultural resources are likely to be minimal.

Federal, State, and Local Environmental Permits

Appendix A -Table 10 lists the environmental permits, authorizations, clearances, and consultations that could be required for the Project's on-shore components. For each authorization, the table identifies the administrating agency/authority, anticipated agency review timeframe, and additional information to be considered. The table represents a list of typically required permits for similar projects in the same area and is not specific to the Project. Although the Project-specific details included in this report can assist in the planning stages of the Project, additional reviews should be conducted as the Project is further developed and the extent of environmental impacts is known.

Federal Permits and Authorizations

Depending on the outcome of the environmental survey and Division of Land Resource Protection (DLRP) inspection and the final design of Project facilities, the Project could require several federal permits, authorizations, and consultations prior to construction. In addition, USFWS consultations and authorizations under Section 7 of the Endangered Species Act (ESA) could also be required to be obtained prior to receiving federal permits. These consultation and concurrences are discussed below in greater detail.

USACE Section 404

In NJ, the NJDEP is the agency delegated responsibility to implement Section 404 of the Clean Water Act (33 U.S.C. 13574), which regulates the discharge of dredged or fill material into waters (including wetlands) of the United States. The exception being an activity proposed in a tidal water or water designated under Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 403), for which the USACE has regulatory authority. The Project is located within the jurisdictional boundary of the New York District of the USACE. The New York District Office would need to be contacted to confirm if a Section 10 designated water is crossed by the Project.

USFWS Endangered Species Consultation and Clearance

For federally funded or permitted projects, consultation with the USFWS is necessary to ensure that impacts to federally-listed threatened or endangered species and critical habitats are appropriately addressed under Section 7 of the ESA. The Project falls within the jurisdictional boundary of the USFWS NJ Ecological Services Field Office. Initial screening for many projects in NJ may be conducted online utilizing the IPaC online tool and county data compiled by the NJDEP. A "preliminary" screening for the Project has been completed, with results discussed in detail in the previous TE Species section of this report.

Typically, early consultation with USFWS will be of paramount importance. Coordination with the USFWS NJ Ecological Services Field Office will be required to determine the extent of survey and/or mitigation needed for each species.

USFWS authorizations are generally valid for two years. If construction is not completed after two years or new species are added to the list before construction begins, the protected species assessment must be revalidated through renewed consultation and, potentially, new or additional field surveys. Species-specific surveys and construction timeframes may be applicable.

State Permits
It is anticipated that the Project could require the following state environmental permits, consultations, clearances, and authorizations, including:

- State Protected Species Consultations
- State Historic Preservation Office (SHPO) Consultations and Clearances
- Freshwater Wetlands Permits
- Coastal Wetlands Permits
- Waterfront Development Permit
- Flood Hazard Area Permit
- Tidelands License
- Green Acres Program Diversion Permit
- NJ Pollutant Discharge Elimination System Permits (NJPDES) Basic Industrial Stormwater Permit
- Air Quality Permits

Local Permits and Approvals
It is anticipated that the Project could require the following county and municipal permits, consultations, clearances, and authorizations:

- Zoning Permits,
- Road Permits,
- Building Permits, and
- Erosion and Sediment Control Plan.

Environmental (Regulatory) Risks

Right-of-Way and Easement Risks

- Securing easements and using previously secured easements has been identified as a critical constraint. Easements can be held in perpetuity and may not allow for additional development, depending on the easement type and language. Each parcel crossed by the transmission line ROW could have an easement with the property owner, which need to be reviewed to identify the extent of the easement and the restrictions surrounding it. The easement agreement from Conrail to share approximately 13 miles of their railroad ROW is critical. Construction within the railroad ROW may require significant coordination depending on the activity level of the rail line. Work within the railroad ROW may need to be stopped whenever a train is passing the work area. Construction within the road ROW, particularly in congested areas, may require significant coordination regarding foreign underground utility avoidance. Additionally, supplemental ROW or easements may be needed around the Greenfield on-shore converter station.
- Several public lands are crossed by the Primary Route utilizing existing ROWs, and presumably can be covered under the existing easement for the ROW. Supplemental easements may be necessary to augment the existing ROW or for the development of access roads, and the requirements or availability of obtaining supplemental easements is unclear until coordination with the property owner or review of the easement language is conducted.

Permitting Risks

- Portions of the Project are proposed to be located within railroad ROW and will require permits. Railroads are privately owned, and each has its own requirements. While railroad permitting for the Project may be better received by the railroad due to it being underground, significant coordination regarding placement of the line and construction techniques may be required that prolong the permitting process.
- Components of this project run through Green Acres-encumbered properties and may require Green Acres Program Diversion Permits.
- The aboveground and underground components of the Project have the potential to impact environmental resources including streams and wetlands within coastal and freshwater ecosystems and impacts to these resources will require a number of permits from the state and county. If impacts to freshwater wetlands exceed a threshold of 0.5-acre for aboveground impacts, or one-acre of total wetland impact, general permits may not be applicable and an individual permit may need to be acquired, which will include a lengthier review time. Mitigation is also required if the Project permanently disturbs or impacts 0.1-acre or more of freshwater wetland. Consultation with the NJDEP earlier in the Project's development will help mitigate risks by addressing permitting concerns and allowing for a larger consultation and permitting timeline.

TE Species Risks

- Review of various sources that maintain TE species records indicated the potential for numerous species to be located within the Project Study Area of both the Primary Route and converter station components. The Project proponents should conduct an independent TE species review once the potential limits-of-disturbance and environmental impacts are better known to fully ascertain the requirements for mitigation associated with the sensitive

Transmission Line Risks

- Schedule risks based on outage windows required at Deans Substation.
- For the underground transmission lines, the room required in the existing railroad corridor for the new transmission line duct banks is a concern, based on the railroad company's required clearance to the rail. Although the proposed depth is four feet, that is a minimum, and with utility crossings, the depth could be much deeper, which affects the heat dissipation. If the railroad determines there is not enough room, the transmission line may need to parallel the railroad corridor, affecting cost.
- The three separate duct banks along the railroad may be an issue with two circuits on one side and one circuit on the other. One duct bank with all three circuits could be more beneficial for the railroad and transmission line construction costs. The conduits for circuits 2 and 3 could be left empty until needed. Installing a separate duct bank for each circuit could affect cost and schedule.
- Should the Alternative be chosen, extensive construction in road ROW should be anticipated which would require coordination and scheduling with municipal and department of transportation authorities as well as potentially extensive utility avoidance coordination.

Substation Risks

- Procurement of HVDC equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With HVDC equipment being relatively uncommon in the United States, unexpected delays in procurement, engineering, and construction may occur. Additionally, currency fluctuations for overseas equipment are likely to occur which will impact costs.

- The proposal provided states that Deans Substation has sufficient space, and all construction (Labor & Cost) will be incurred by the owning party. Also, extensive construction within the substation could require extending outages beyond those mentioned in the project proposal. Further contractual discussions should occur between the developer, and the owning party to verify these details if they have not yet occurred.

Construction Schedule

- The conceptual project schedule developed by the onshore consultant indicates that the on-shore aspects of each project will take approximately 84 months to complete, from Project initiation to energization. It is assumed that the engineering process can continue as siting permit is reviewed. There are four major activities on the critical path: Engineering; Siting and major permit acquisition; long lead equipment procurement; construction and commissioning. Delays in completing any of these activities would jeopardize completing the Project within the estimated schedule.
- Based on the conceptual estimate, no concerns identified with the overall APT project schedules as proposed.

Offshore Constructability Review

Proposals 210, 172 and 769

Environmental (Regulatory) Analysis

Routing

Atlantic Power Transmission (APT)'s three 1,200 MW proposals each represent an HVDC link from an offshore platform in the New York Bight offshore wind area to a POI at Deans 500 kV substation. The routing for the APT project beyond state waters is not specified beyond a conceptual sketch out to what APT terms a "cable convergence area". One cable corridor extends easterly to an area that would serve lease areas (or future lease areas) north of Hudson Canyon; the other corridor extends in a generally southerly direction to serve current or future lease areas south of Hudson Canyon.

The specific cable route beyond the convergence area and its associated offshore platform (Electric Service Platform or ESP) will be sited and permitted by the offshore wind generator holding the lease for development of a wind generating facility. APT would then install the submarine cable and offshore ESP to which the wind generator would connect its 66 kV cables from wind turbines.

APT's rationale and claim for this siting and permitting arrangement is that it eliminates project-on-project risk because both the transmission project and offshore wind development are responsible for obtaining their own permits, both permits are required for the transmission system to be installed, and the siting of the offshore ESP affords the wind developer flexibility in choosing its location based on what is best for the wind turbine array being constructed.

Since a significant part of the submarine cable route and the location of the offshore ESP will be sited by wind developers under APT's construct it is difficult to determine the risks associated with the developer-sited portions of the system.

Landfall

The proposed landfall for APT's HVDC cables is currently an unused former industrial pier on the south shore of Raritan Bay in South Amboy, NJ just east of the NJTransit railroad bridge. An alternative location has also been identified just inland of this pier. The land from which the pier extends, and approximately 25% of the pier area, is owned by the City of South Amboy; with the portion of the pier owned by a redevelopment company designated by

South Amboy to redevelop the pier and the adjacent surrounding area. APT has developed a conceptual plan to develop the pier as a public space including a boardwalk, park, and amphitheater. This plan has been discussed with the mayor of South Amboy and he and his staff have confirmed that APT's cable landing plans are, as stated in the proposal, "compatible with the overall redevelopment plans for the area, including those areas where redevelopment construction is already underway."

This pier is currently vacant and would provide the space for staging equipment and materials for the horizontal directional drilling (HDD) required to achieve the cable landfall. APT has provided a conceptual plan for the HDD operation and locations of the bores and transition cable vaults. All three APT projects would require a total of six HDD bores.

APT's plan for the landfall is reasonable but lacks specific details and designs which would need to be developed for permit filings and construction. It is also reasonable that these details have not been developed for this proposal; however it makes it difficult to assess the risks associated with the landfall. At a basic level, and as APT points out, this project does not require a beach crossing for its landfall. That may be viewed as a way to mitigate some permitting risk since a beach crossing may be seen as more disruptive to communities and recreation than a vacant formerly industrial area.

Note that the general area is adjacent to the South Amboy NJTransit train station and is being redeveloped with multi-story apartments in what would seem to be an effort to achieve transit-oriented development of a former industrial site which also sits next to a substation and former generating station (Werner). Note that the former industrial nature of the site (a railroad terminal used for transfer of freight and materials to marine vessels) may increase the risks of encountering hazardous materials as part of staging and excavation needed for the HDD operation.

Facility Conflicts

Potential conflicts with existing submarine facilities will be present with this proposal due to the submarine cable route which traverses through the approaches to New York Harbor and into Raritan Bay. This area has historically been active with marine traffic and industrial uses, including submarine crossings of cables and pipelines.

Once in open waters the majority of concerns will be avoiding dumping grounds, wrecks, hazards, or other submerged obstructions as well as a myriad of submarine communications cables which exist across the entire area from the wind energy areas to the shoreline. Many of these cables may be abandoned, but many others may be uncharted and could only be discovered during submarine cable installation.

Environmental Risk

The general environmental risks associated with the various offshore ESPs and submarine cables is similar to the risks posed by the offshore elements of other proposals. The environmental impacts from these proposals mainly come from the installation of the submarine cable and the seabed disturbances caused by this activity.

As mentioned above, the cable route into Raritan Bay and the use of a former industrial site for landfall may present risks for discovery of hazardous materials or other environmental concerns. Detailed survey and design work needed to support permits would help mitigate these risks.

Permits

APT has conducted a route study and analysis for the offshore portions of the project and has engaged consulting firms (Epsilon Associates, Geo SubSea LLC) in analyzing the permitting requirements and potential environmental impacts for the project. The cable route study was essentially a desktop study using publicly available data (see BPU Form Response Attachment #11, Offshore Cable Routing Feasibility).

APT has also developed with its consultants a Stakeholder Engagement Plan, Environmental Protection Plan, Fisheries Protection Plan, and Permitting Plan covering the various federal, state, and local permits that will be required. These plans are very detailed and provide a good view of the complexity and effort that will be required to apply for and obtain the necessary permits.

It appears that the nature and complexity of permits for APT's project will be similar to those of other projects, and present similar risks.

Technology and Supply Chain Risks

This section offers an assessment of risks that may be apparent in the overall system, the technology being proposed, specific risks that may be inherent in specific equipment, and risks posed by supply chain considerations.

Technology Risk

Overall System

The overall system described by this proposal will, for the most part, contain power system equipment and components that are proven and fully understood over many years of successful operation in similar circumstances. However, application of these components to installation on offshore platforms and exposure to the harsh environment that surrounds any salt water marine environment has not been commonly done using the voltage and scale being proposed. The primary risk associated with the overall system is that associated with the construction and operation the offshore portions of the system, and in particular the platform-based HVDC converters and associated transformers, switchgear, and other components.

HVDC System

The HVDC system proposed by APT is a modular multi-level (MMC) voltage source converter (VSC) based system rated at 1,200 MW and operating at +/- 320 kV. VSC HVDC systems using submarine cables have been operating for many years and in general represent minimal technology risk. Systems operating at 320 kV are relatively established, although the 1,200 MW level has only recently been achieved within the past few years. Power capability is mainly driven by cable ampacity which is typically limited to around 2,000 amperes – which is the approximate ampacity needed to achieve a 1,200 MW rating at ±320 kV DC.

Note that the overall conceptual HVDC design does not contemplate the need for offshore AC harmonic filters. The working assumption is that harmonic mitigation would be implemented in the connecting wind farm by modifications of turbine converter control systems and/or passive filters mounted in the turbines themselves. There is a risk that, despite the assumption given above, platform-based AC harmonic filters could be needed.

A risk consideration across all NJBPU SAA projects involving HVDC is application of this HVDC technology in an offshore platform environment. This has been done relatively recently in offshore wind installations in Europe at or near the power levels and voltages being considered for this project. Besides the technical risk, the primary risk is schedule related; namely can this design be qualified, designed, constructed, and commissioned within the schedules proposed.

Offshore Platform

The offshore platforms (jackets and topsides) proposed for housing the converter stations and associated switchgear will be a customized design drawn from experience in oil and gas exploration and production. The main risks associated with the offshore platforms is essentially the same for all proposals in the NJBPU SAA solicitations, and it relates mainly to available facilities to build the platforms, production capabilities of those facilities, and availability and pricing of materials such as steel. APT has engaged Aibel as an alliance partner for offshore platform design, fabrication, installation and commissioning, and has proposed a design based on Dogger Bank and DolWin 5 concepts and experience.

Further scheduling risk is introduced by the need for specialized equipment to install the platforms such as a semi-submersible crane vessel (SSCV), of which there are only a handful available globally. The availability of these SSCVs may be challenging due to global offshore wind construction activity expected at the time of installation. For this reason, vessels need to be booked early to ensure timely installation.

Submarine Cable

As discussed above ±320 kV HVDC submarine cable is available and established at the power level being contemplated. Schedule and supply chain risks associated with these types of specialized cables remains as the most significant risk. Only a handful of manufacturing facilities globally are capable of supplying this type of cable, and with the quantities contemplated for these projects production capability and availability of production slots can greatly impact any planned schedule. This may be magnified by the global demand for submarine power cables associated with robust offshore wind development.

Furthermore, installation vessels for these types of cables are also limited globally and can influence the construction schedule for these projects to a great degree depending on their availability. As stated above, this could be exacerbated by global offshore wind construction activity expected at the time of installation.

APT has engaged Nexans as an alliance partner to supply the high voltage power cables for this project. The cables are slated to be made at the Nexans factory in Charleston, South Carolina; however, depending on factory capacity, it may be required to make one or more of the cables at Nexans facility in Norway as a backup.

Project Complexity

The relative complexity of the APT project is on par with most of the other proposals involving HVDC links between offshore platforms and landfalls using submarine cables. Most of the offshore complexity resides in the construction and installation of offshore platform jackets and topsides as well as installation and commissioning of HVDC converters, converter transformers, AC switchgear, and auxiliary power and control equipment on the topside. Although construction of this technology is well established on land, installation in an offshore environment is relatively new. Most existing experience in this area lies in recent offshore wind projects in Europe.

Incremental risks related for the APT project associated with project complexity can be found in its routing in Raritan Bay and landfall at South Amboy, NJ. This is mainly an installation and schedule risk due to the issues of marine traffic, underwater obstructions, and conflicting submarine facilities inherent in a busier and historically active waterway. These issues may require alternations in proposed schedules to accommodate seasonal or commercial issues that may arise. Further risk may be present in dealing with any environmental issues that arise during construction due to use of a former industrial site for landfall.

Supply Chain Risk

The risks in the supply chain for these projects predominantly resides in the HVDC converters, offshore platforms, and submarine cables. The relative risks between the APT proposal and other proposals in the SAA solicitation is about the same when considering HVDC systems of the same MW size and operating voltage.

Long Lead Time Items

Long lead time items of highest concern are the submarine cables, HVDC converters, and offshore platforms. The vast majority of this risk resides in the limited number of suppliers for these items which is discussed in more detail below.

Supplier Scarcity

Submarine cables, HVDC converters, and offshore platforms of the designs needed for these projects are capable of being supplied and constructed by limited number of globally based companies. Combine this with the relative scarcity of specialized equipment needed to transport and install these facilities in a marine environment, significant risk can develop should many similar projects be planned for construction in the same period of time.

Of particular concern are the vessels for transporting and laying submarine transmission cables and the heavy-lift SSCVs needed for offshore platform installation. Note that the potential competition for these resources will come from not only other offshore transmission projects, but also offshore wind generator projects which will need the same vessels for their own platform installations and submarine cables for their collector systems. As stated above this risk is associated with all similar SAA projects and not just for the APT projects.

APT has engaged Hitachi ABB Power Grids (HAPG) as an alliance partner with a work scope that includes HVDC system design, electrical equipment, and converter station and system commissioning. The Dogger Bank project is very similar to the APT project and the HAPG proposal to APT is largely based on this concept.

Construction Schedule Risk

The overall schedule duration is approximately 9.5 years culminating in a Commercial Operation Date (COD) of March 2031. This schedule utilizes a COD of March 2030 for Phase 1 (Proposal 210 - First 1200MW) and March 2031 for Phase 2 (Proposal 172 - Second 1200MW) and Phase 3 (Proposal 769 – Third 1200MW).

Permitting

The total duration for permitting activity is approximately 3.5 years. Based on the detail provided in the proposals a good level of understanding exists for the permits and processes involved. However, no specific permit plan has been developed other than on a conceptual level based on studies and research of publicly available information. Also, permitting activity for all of the other similar Option 2 proposals is assumed to be similar, hence the relative risks between SAA projects is essentially the same.

Construction

The construction schedule duration for the APT proposal is approximately 6 years on an Engineer-Procure-Construct (EPC) basis. The schedule presented in the proposal does not provide detail into the various design, procurement, and installation parts of the EPC schedule so it is difficult to evaluate the reasonableness of the overall duration. However, 6 years does seem to be a realistic duration from an overall duration from NTP to completion for this type and scale of project. Note that APT's schedule does contemplate construction of all three HVDC systems somewhat simultaneously which could be impacted by availability of specialized equipment and seasonal cable installation windows.

Outage Planning

Outage planning schedule risk will relate mainly to construction for onshore facilities, and in particular those facilities being integrated into the existing POI substation at Deans. These outages will drive the ability to connect and energize the offshore system and perform commissioning activities. APT did an analysis based on aerial imagery to study potential construction sequencing needed to make the Deans POI connection. Note that APT anticipates the station owner, in consultation with PJM, will make the final determination for modifications of their station and the related sequencing.

Other Overall Schedule Risk

Perhaps the largest overall schedule risk is related to supply chain constraints for HVDC converters and submarine cables, and the need for specialized equipment for installation of submarine cables and offshore platforms. This will be especially impactful should multiple projects be chosen for installation during the same time period. Further exacerbating this risk will be construction of offshore generating facilities which will place similar demands on the same universe of manufacturers and constructors. Given the permitting strategy for this project, it is anticipated that both wind generation and related transmission projects will be occurring at about the same time.

O&M Risk

Once installed and upon operation the various systems and components of APT's transmission system will be subject to risk of failure. Some of this risk is determined by the configuration of each system and its exposure to failure, while other types of operational risk is determined by the ability of the various facilities to be brought back to service quickly.

Route Diversity

The APT project seeks to follow a concept where three transmission lines share a common corridor for a significant portion of the overall submarine route. Each cable would have a ROW width of 200 feet. Use of common ROWs to co-locate facilities whether on land or underwater have advantages in limiting impacts to the surrounding area by confining these impacts to the corridors themselves.

However, one disadvantage is that having multiple lines in a common corridor can expose those lines to the possibility of a simultaneous event which can outage those facilities. This exposure may be even more acute in the

situation of an underwater corridor where events like anchor drags can occur for hundreds of feet and potentially impact multiple circuits. That said, the risk of such an event can be mitigated by regularly verifying cable burial depth as well as other operational measures such as monitoring shipping traffic along cable routes.
The three APT proposals have multiple transmission link corridors proposed, and if multiple proposals are accepted the routing of the transmission links can potentially be optimized to minimize this risk.
It should also be noted that the landfalls may, depending on the number of APT projects selected, result in multiple circuits making landfall at the same location. Although the landfalls will retain separation of circuits by using multiple HDD routes, the cables approaching the landfalls will converge until they enter the HDD bores. This can add risk for multiple submarine cable outages in this area from an event like an anchor drag.

Redundancy & Operational Flexibility

Each individual HVDC system as a symmetrical monopole system will essentially be a radial transmission link with the N-1 outage of the total system capability being the ruling contingency. Within each system is contained redundancy that can mitigate the risk of a long-term equipment failure. For example, the offshore HVDC converters contain two three-phase converter transformers which would allow operation of the system at reduced capability for loss of one of those transformers, typically slightly more than half of the total capability of the system pre-outage. Onshore converter transformers are single phase units which, when coupled with a spare, can restore full system capability for loss of one of the single-phase units. Note that this spare single-phase unit may provide for spare service to multiple HVDC converters if they are installed together.

The redundancy of the APT project is comparable to other similarly configured HVDC-based projects in the NJBPU SAA solicitation.

Maintenance and Spare Equipment Strategy:

Typically, spares are provided for long lead time equipment in transmission systems similar to those described in the APT proposal. In particular, spares are usually carried for the following components:

- Converter transformers – onshore (single-phase)
- Converter transformers – offshore (three-phase)
- Submarine cables – lengths sufficient for use in a splice
- Submarine cable accessories – terminations, splices, etc.
- Critical HVDC converter components – valves, insulators, bushings
- AC switchgear circuit breakers

The APT proposals do not provide a detailed listing of spare parts to be provided. The proposal technical description states that "the detailed spare parts engineering, and the definition of the spare parts list, is done during the project detail design phase." Because no listing of spare parts is provided it is difficult to assign a risk level to this aspect of the proposal.

Cost Review

Proposal 210

Proposal Cost Estimates

APT characterizes their cost estimates in their proposal to range in the AACE higher-Class levels, mostly Class 3 (-20% to +30%) and Class 4 (-30% to +50%). No further definition was given.
With offshore wind generators connecting their turbine array cables at 66 kV on APT's offshore platform, the system described in APT's proposal provides a complete path for delivering offshore wind generation to an onshore POI on the existing PJM transmission system. Note that no AC harmonic filters are included on the offshore platform, but filters are included in the onshore converter.

The total proposal cost for APT's First 1200 MW proposal is given below.

Category	Full Project
	$
Engineering & Design	$131,869,117
Permitting/ Routing/Siting	$16,666,667
ROW/Land Acquisition	$107,425,000
Materials and Equipment	$779,773,111
Construction & Commissioning	$383,227,514
Construction Management	$126,025,541
Overheads & Misc.	$229,485,990
Component Total	$1,774,472,939
Contingency	$250,000,000
Total Component Cost (Current Year)	$2,024,472,939

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's Offshore consultant assembled independent cost estimates for the proposed offshore facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the Offshore portion of APT's proposal 210:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$700,000,000	$700,000,000
±320 kV Submarine Cable	105	$5,000,000	$525,000,000
Total Offshore			**$1,225,000,000**

PJM's Offshore consultant's review of the Offshore related costs is summarized in this section. A description of the values in each column is as follows:

- Independent Estimate values are costs developed by consultant based on cost data from comparable projects and prior estimates, information from equipment suppliers, and engineering judgement
- Average of Proposals Reviewed values are averages for all the proposals consultant was assigned to review.

The basic characteristics for the APT project are as follows:

- One 1,200 MW ±320 kV HVDC system
- Submarine Cable Mileage: 105 (note: a mileage range of 62-105 was given)

	Independent Estimate	Average of Proposals Reviewed
Offshore Converter	$700,000,000	$712,425,600
Offshore Converter $/MW	$583,333	$593,668
Submarine Cable Total	$525,000,000	
Submarine Cable $/mi	$5,000,000	$4,367,629
Total Offshore Portion $/MW	$1,020,833	

Onshore Component Independent Cost Estimates

As part of this study, PJM's Onshore consultant performed a high-level conceptual cost estimate for the on-shore components of the Project.

The consultant's estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with substation engineering, transmission line engineering, and construction. The total does include a contingency of 30 percent as it is a concept level estimate.

The following is the independent cost estimate for the Onshore portion of APT's proposal 210.

	Total
Materials and Equipment	$255,507,891
Engineering and Design	$23,071,395
Construction and Commissioning	$108,502,672
Permitting/Routing/Siting	$7,234,538
ROW/Land Acquisition	$45,147,000
Construction Management	$20,476,885
Overheads/Misc./Contingency Cost (30%)	$137,574,900
Total Cost	$597,515,281

Assumptions for Onshore Cost Estimates

Component 3: On-shore Section of 1200MW HVDC Transmission Line #1:

- The submarine cable segment will make landfall via HDDs at an unused pier in the City of South Amboy.
- Install approximately 17 miles of HVDC underground cable between the pier and the new converter station.
- The proposed conductor is 2500 mm2 copper cable. The ±320kV HVDC circuit will comprise of two cables.
- A 2.13-foot-wide concrete duct bank, at a minimum of four feet below ground, will be installed along the edge of railroad ROW for 13 miles, then along the edge of a 500kV overhead transmission line ROW for the remaining four miles. The installation process will typically involve trench excavation, with a vault approximately every 2,000 feet. When trenching is not possible, Jack & Bore or Horizontal Directional Drilling methods will be utilized.
- Land survey and ROW labor is required. A ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- Extensive construction in road ROW will be required if one of the alternative routes is chosen.
- Minimal tree clearing will be required. The route is primarily along developed land, railroad ROW, road ROW, or existing transmission line ROW.

Component 4: On-shore 1200MW Converter Station:

- The new substation will encompass 40 acres. The land for the new converter station is already owned by the proposing entity and land acquisition costs are not included. The estimate assumes a converter station with a capacity of 1200MW. To facilitate an increase in power transfer from the off-shore wind generation area to 2400MW or 3600MW, additional paired projects would be required.
- The new substation will contain the following equipment:
  - Two underground risers for incoming ±320kV DC transmission lines
  - One ±320kV HVDC Valve Hall with converter valves
  - Two ±320kV HVDC Disconnect Switches
  - Four ±320kV HVDC Grounding Switches
  - Six ±320kV HVDC Reactors
  - Four 500kV AC Power Transformers
  - One 500kV Circuit Breaker
  - Two 500kV Disconnect Switches
  - Three sets 500kV AC filtering equipment
  - Three 500kV Surge Arresters
  - One underground riser for outgoing AC transmission line
  - One Control Building
- The contractor will be performing the testing of major material, relays, and construction labor.

Component 5: 500kV AC Underground Transmission Line:

- Install approximately one mile of 500kV AC single circuit underground transmission line between the new converter station and the existing Deans Substation.
- The proposed conductor is 2500 mm2 copper cable. The 500kV AC circuit will comprise of three cables.
- A 2.13-foot-wide concrete duct bank, at a minimum of four feet below ground, will be installed along the edge of a 500kV overhead transmission line ROW. The installation process will typically involve trench excavation, with a vault approximately every 2,000 feet. When trenching is not possible, Jack & Bore or Horizontal Directional Drilling methods will be utilized.
- Land survey and ROW labor is not required. The entirety of the route will be either on land owned and controlled by APT or by PSE&G, the Deans substation owner.
- Minimal clearing will be required.

Component 6: Expansion of 500 kV Switching Area at Deans Substation:

- The work is located inside the existing Deans Substation.
- The estimate includes one underground circuit entry at Deans SS and is considered part of the 1200MW injection, where APT's first project proposal is selected.
- The following equipment will be added at this substation:
  - Two 500 kV circuit breakers
  - Four 500 kV disconnect switches
  - Three 500 kV surge arresters
  - Three 500 kV CCVTs
  - One 500 kV underground riser structure
  - One Line Relay Panel
  - Two Breaker Control Panels
- Buswork consisting of four- inch rigid bus was used for the buswork in this proposal
- All relay panels will be placed inside the existing Control Building.
- The contractor will be performing the testing of major material, relays and construction labor.

Total Independent Cost Estimates

The following is the total independent cost estimate for APT's Proposal 210,

Independent Cost Estimate

Proposal 210	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$1,822,515,281	$1,225,000,000	$597,515,281

For comparison, the total proposal cost estimate for APT's Proposal 210 is shown below.

Proposal Cost Estimate

Proposal 210	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$2,024,472,939	$1,364,331,711	$660,141,228

Proposal 172

Proposal Cost Estimates

APT characterizes their cost estimates in their proposal to range in the AACE higher-Class levels, mostly Class 3 (-20% to +30%) and Class 4 (-30% to +50%). No further definition was given.

With offshore wind generators connecting their turbine array cables at 66 kV on APT's offshore platform, the system described in APT's proposal provides a complete path for delivering offshore wind generation to an onshore POI on the existing PJM transmission system. Note that no AC harmonic filters are included on the offshore platform, but filters are included in the onshore converter.

The total proposal cost for APT's Second 1200 MW proposal is given below.

Category	Full Project
	$
Engineering & Design	$94,187,847
Permitting/ Routing/Siting	$6,666,667
ROW/Land Acquisition	$25,000,000
Materials and Equipment	$694,803,110
Construction & Commissioning	$369,443,177
Construction Management	$77,154,253
Overheads & Misc.	$184,115,605
Component Total	$1,451,370,659
Contingency	150,000,000
Total Component Cost (Current Year)	$1,601,370,659

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's Offshore consultant assembled independent cost estimates for the proposed offshore facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the Offshore portion of APT's proposal 172:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$700,000,000	$700,000,000
±320 kV Submarine Cable	105	$5,000,000	$525,000,000
Total Offshore			**$1,225,000,000**

PJM's Offshore consultant's review of the Offshore related costs is summarized in this section. A description of the values in each column is as follows:

- Independent Estimate values are costs developed by consultant based on cost data from comparable projects and prior estimates, information from equipment suppliers, and engineering judgement
- Average of Proposals Reviewed values are averages for all the proposals consultant was assigned to review.

The basic characteristics for the APT project are as follows:

- One 1,200 MW ±320 kV HVDC system
- Submarine Cable Mileage: 105 (note: a mileage range of 62-105 was given)

Note that individual component costs for offshore converter and submarine cable were provided in the proposal.

	Independent Estimate	Average of Proposals Reviewed
Offshore Converter	$700,000,000	$712,425,600
Offshore Converter $/MW	$583,333	$593,668
Submarine Cable Total	$525,000,000	
Submarine Cable $/mi	$5,000,000	$4,367,629
Total Offshore Portion $/MW	$1,020,833	

Onshore Component Independent Cost Estimates

As part of this study, PJM's Onshore consultant performed a high-level conceptual cost estimate for the on-shore components of the Project.

The consultant's estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with substation engineering, transmission line engineering, and construction. The total does include a contingency of 30 percent as it is a concept level estimate.

The following is the independent cost estimate for the Onshore portion of APT's proposal 172.

	Total
Materials and Equipment	$243,703,485
Engineering and Design	$22,465,253
Construction and Commissioning	$108,131,239
Permitting/Routing/Siting	$3,128,936

ROW/Land Acquisition	$17,595,000
Construction Management	$20,756,101
Overheads/Misc./Contingency Cost (30%)	$119,530,666
Total Cost	$535,310,681

Assumptions for Onshore Cost Estimates

Component 3: On-shore Section of 1200MW HVDC Transmission Line #2:

- The submarine cable segment will make landfall via HDDs at an unused pier in the City of South Amboy.
- Install approximately 17 miles of HVDC underground cable between the pier and the new converter station.
- The proposed conductor is 2500 mm^2 copper cable. The ±320kV HVDC circuit will comprise of two cables.
- A 2.13-foot-wide concrete duct bank, at a minimum of four feet below ground, will be installed along the edge of railroad ROW for 13 miles, then along the edge of a 500kV overhead transmission line ROW for the remaining four miles. The installation process will typically involve trench excavation, with a vault approximately every 2,000 feet. When trenching is not possible, Jack & Bore or Horizontal Directional Drilling methods will be utilized.
- Land survey and ROW labor is required. A ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- Extensive construction in road ROW will be required if one of the alternative routes is chosen.
- Minimal tree clearing will be required. The route is primarily along developed land, railroad ROW, road ROW, or existing transmission line ROW.

Component 4: On-shore 1200MW Converter Station:

- The new substation will encompass 40 acres. The land for the new converter station is already owned by the proposing entity and land acquisition costs are not included. The estimate assumes a converter station with a capacity of 1200MW. To facilitate an increase in power transfer from the off-shore wind generation area to 2400MW or 3600MW, additional paired projects would be required.
- The new substation will contain the following equipment:
  - Two underground risers for incoming ±320kV DC transmission lines
  - One ±320kV HVDC Valve Hall with converter valves
  - Two ±320kV HVDC Disconnect Switches
  - Four ±320kV HVDC Grounding Switches
  - Six ±320kV HVDC Reactors
  - Four 500kV AC Power Transformers
  - One 500kV Circuit Breaker
  - Two 500kV Disconnect Switches
  - Three sets 500kV AC filtering equipment
  - Three 500kV Surge Arresters
  - One underground riser for outgoing AC transmission line
  - One Control Building
- The contractor will be performing the testing of major material, relays, and construction labor.

Component 5: 500kV AC Underground Transmission Line:

- Install approximately one mile of 500kV AC single circuit underground transmission line between the new converter station and the existing Deans Substation.
- The proposed conductor is 2500 mm^2 copper cable. The 500kV AC circuit will comprise of three cables.
- A 2.13-foot-wide concrete duct bank, at a minimum of four feet belowground, will be installed along the edge of a 500kV overhead transmission line ROW. The installation process will typically involve trench

excavation, with a vault approximately every 2,000 feet. When trenching is not possible, Jack & Bore or Horizontal Directional Drilling methods will be utilized.
- Land survey and ROW labor is not required. The entirety of the route will be either on land owned and controlled by APT or by PSE&G, the Deans substation owner.
- Minimal clearing will be required.

Component 6: Expansion of 500 kV Switching Area at Deans Substation:

- The work is located inside the existing Deans Substation.
- The estimate includes three underground circuit entries at Deans SS and is considered part of the 3600MW injection, where APT's first, second, and third project proposals are selected.
- The following equipment will be added at this substation:
  - Five 500 kV circuit breakers
  - Ten 500 kV disconnect switches
  - Nine 500 kV surge arresters
  - Nine 500 kV CCVTs
  - Three 500 kV underground riser structures
  - Three Line Relay Panels
  - Five Breaker Control Panels
- Buswork consisting of four-inch rigid bus was used for the buswork in this proposal
- All relay panels will be placed inside the existing Control Building
- The contractor will be performing the testing of major material, relays and construction labor

Total Independent Cost Estimates

The following is the total independent cost estimate for APT's Proposal 172.

Independent Cost Estimate

Proposal 172	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$1,760,310,681	$1,225,000,000	$535,310,681

For comparison, the total proposal cost estimate for APT's Proposal 172 is shown below.

Proposal Cost Estimate

Proposal 172	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$1,601,370,659	$1,115,435,892	$485,934,767

Proposal 769

Proposal Cost Estimates

APT characterizes their cost estimates in their proposal to range in the AACE higher-Class levels, mostly Class 3 (-20% to +30%) and Class 4 (-30% to +50%). No further definition was given.

With offshore wind generators connecting their turbine array cables at 66 kV on APT's offshore platform, the system described in APT's proposal provides a complete path for delivering offshore wind generation to an onshore POI on the existing PJM transmission system. Note that no AC harmonic filters are included on the offshore platform, but filters are included in the onshore converter.

The total proposal cost for APT's third 1200 MW proposal is given below.

Category	Full Project
	$
Engineering & Design	75,184,188
Permitting/ Routing/Siting	6,966,667
ROW/Land Acquisition	25,000,000
Materials and Equipment	659,717,313
Construction & Commissioning	411,753,588
Construction Management	61,643,158
Overheads & Misc.	138,194,562
Component Total	1,378,459,476
Contingency	100,000,000
Total Component Cost (Current Year)	1,478,459,476

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's Offshore consultant assembled independent cost estimates for the proposed offshore facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.
The following is an independent cost estimate for the Offshore portion of APT's proposal 769:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$700,000,000	$700,000,000
±320 kV Submarine Cable	105	$5,000,000	$525,000,000
Total Offshore			**$1,225,000,000**

PJM's Offshore consultant's review of the Offshore related costs is summarized in this section. A description of the values in each column is as follows:

- Independent Estimate values are costs developed by consultant based on cost data from comparable projects and prior estimates, information from equipment suppliers, and engineering judgement
- Average of Proposals Reviewed values are averages for all the proposals consultant was assigned to review.

The basic characteristics for the APT project are as follows:

- One 1,200 MW ±320 kV HVDC system
- Submarine Cable Mileage: 105 (note: a mileage range of 62-105 was given)

Note that individual component costs for offshore converter and submarine cable were provided in the proposal.

	Independent Estimate	Average of Proposals Reviewed
Offshore Converter	$700,000,000	$712,425,600
Offshore Converter $/MW	$583,333	$593,668
Submarine Cable Total	$525,000,000	
Submarine Cable $/mi	$5,000,000	$4,367,629
Total Offshore Portion $/MW	$1,020,833	

Onshore Component Independent Cost Estimates

As part of this study, PJM's Onshore consultant performed a high-level conceptual cost estimate for the on-shore components of the Project.

The consultant's estimate of probable construction cost for Project 769 is $542,912,670. This figure is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with substation engineering, transmission line engineering, and construction. The total does include a contingency of 30 percent as it is a concept level estimate.

The following is the independent cost estimate for the Onshore portion of APT's proposal 769.

	Total
Materials and Equipment	$246,407,928
Engineering and Design	$22,730,992
Construction and Commissioning	$110,162,366
Permitting/Routing/Siting	$3,128,936
ROW/Land Acquisition	$17,595,000
Construction Management	$1,856,389
Overheads/Misc./Contingency Cost (30%)	$121,031,059
Total Cost	$542,912,670

Assumptions for Onshore Cost Estimates

Component 3: On-shore Section of 1200MW HVDC Transmission Line #3:

- The submarine cable segment will make landfall via HDDs at an unused pier in the City of South Amboy.
- Install approximately 17 miles of HVDC underground cable between the pier and the new converter station.
- The proposed conductor is 2500 mm^2 copper cable. The ±320kV HVDC circuit will comprise of two cables.
- A 2.13-foot-wide concrete duct bank, at a minimum of four feet below ground, will be installed along the edge of railroad ROW for 13 miles, then along the edge of a 500kV overhead transmission line ROW for the remaining four miles. The installation process will typically involve trench excavation, with a vault approximately every 2,000 feet. When trenching is not possible, Jack & Bore or Horizontal Directional Drilling methods will be utilized.
- Land survey and ROW labor is required. A ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- Extensive construction in road ROW will be required if one of the alternative routes is chosen.
- Minimal tree clearing will be required. The route is primarily along developed land, railroad ROW, road ROW, or existing transmission line ROW.

Component 4: On-shore 1200MW Converter Station:

- The new substation will encompass 40 acres. The land for the new converter station is already owned by the proposing entity and land acquisition costs are not included. The estimate assumes a converter station with a capacity of 1200MW. To facilitate an increase in power transfer from the off-shore wind generation area to 2400MW or 3600MW, additional paired projects would be required.
- The new substation will contain the following equipment:
  - Two underground risers for incoming ±320kV DC transmission lines
  - One ±320kV HVDC Valve Hall with converter valves
  - Two ±320kV HVDC Disconnect Switches
  - Four ±320kV HVDC Grounding Switches
  - Six ±320kV HVDC Reactors
  - Four 500kV AC Power Transformers
  - One 500kV Circuit Breaker
  - Two 500kV Disconnect Switches
  - Three sets 500kV AC filtering equipment
  - Three 500kV Surge Arresters
  - One underground riser for outgoing AC transmission line
  - One Control Building
- The contractor will be performing the testing of major material, relays, and construction labor.

Component 5: 500kV AC Underground Transmission Line:

- Install approximately one mile of 500kV AC single circuit underground transmission line between the new converter station and the existing Deans Substation.
- The proposed conductor is 2500 mm^2 copper cable. The 500kV AC circuit will comprise of three cables.
- A 2.13-foot-wide concrete duct bank, at a minimum of four feet belowground, will be installed along the edge of a 500kV overhead transmission line ROW. The installation process will typically involve trench excavation, with a vault approximately every 2,000 feet. When trenching is not possible, Jack & Bore or Horizontal Directional Drilling methods will be utilized.
- Land survey and ROW labor is not required. The entirety of the route will be either on land owned and controlled by APT or by PSE&G, the Deans substation owner.
- Minimal clearing will be required.

Component 6: Expansion of 500 kV Switching Area at Deans Substation:

- The work is located inside the existing Deans Substation.
- The estimate includes three underground circuit entries at Deans SS and is considered part of the 3600MW injection, where APT's first, second, and third project proposals are selected.
- The following equipment will be added at this substation:
  - Five 500 kV circuit breakers
  - Ten 500 kV disconnect switches
  - Nine 500 kV surge arresters
  - Nine 500 kV CCVTs
  - Three 500 kV underground riser structures
  - Three Line Relay Panels
  - Five Breaker Control Panels
- Buswork consisting of four-inch rigid bus was used for the buswork in this proposal
- All relay panels will be placed inside the existing Control Building
- The contractor will be performing the testing of major material, relays and construction labor

Total Independent Cost Estimates

The following is the total independent cost estimate for APT's Proposal 769,

Independent Cost Estimate

Proposal 769	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$1,767,912,670	$1,225,000,000	$542,912,670

For comparison, the total proposal cost estimate for APT's Proposal 769 is shown below.

Proposal Cost Estimate

Proposal 769	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$1,478,459,476	$1,013,473,895	$464,985,581

Mid-Atlantic Offshore Development (MAOD) Proposals

Mid-Atlantic Offshore Development (MAOD or Developer) is a joint venture of Shell Renewables and EDF Suez. The Developer presented proposals 431, 551 and 321 describing three stages of development for a system designed to connect offshore wind generation into the PJM control area in New Jersey. The 431 proposal is for connecting 2,400 MW by October 2029, proposal 551 is for connecting 3,600 MW by December 2030 and proposal 321 is for connecting 4,800 MW by December 2032.

Integration of Mid-Atlantic's SAA Option 2 solution has been coordinated with the local NJ utility JCP&L. The combination of JCP&L system upgrades (SAA option 1a) and onshore connection facilities (SAA option 1b) with Mid-Atlantic offshore transmission connection facilities (SAA option 2) are intended to provide an end-to-end solution for the NJ OSW SAA problem statement.

Table 2. **MAOD Proposals 431, 551 and 321**

Proposal ID(s)	Description(s)	Capability (MW)
431 551 321	Option 2, MAOD Proposals 1 Option 2, MAOD Proposals 2 Option 2, MAOD Proposals 3	2 x 1200 HVDC 3 x 1200 HVDC 4 x 1200 HVDC

Project Overview

The proposed ±320 kV HVDC circuits share a common power corridor and make landfall at the National Guard training center in Sea Girt, NJ. This area is also used as landfall for many charted communication cables, many of which are said to be out of service but may somewhat complicate the installation of equipment at the landfall to avoid conflicts.

Each 1,200 MW increment is delivered by connecting an offshore collector / converter substation to the single onshore interconnection / converter substation that is be located adjacent to the Jersey Central Power & Light (JCP&L) Larrabee Substation, off Randolph Road in Howell NJ.

The main risks associated with these proposals are similar to those for many of the other NJ State Agreement Approach (SAA) proposals, including those associated with permitting, HVDC converter and cable procurement and installation, and offshore platform procurement and installation. Proposal 431 indicates a Commercial Operation Date (COD) in 2030 which may present some additional schedule risk given the nature of this project and supplier scarcities associated with supply of HVDC converters, submarine cables, and offshore platforms.

The budgets presented in each proposal are inclusive of all the facilities required to deliver wind generation starting at a 66 kV collector switchgear located within the offshore platforms and ending at the onshore interconnection / converter substation as follows:

1. Proposal 431
    a. Two offshore platforms, each housing:
        i. Two 66 kV gas insulated collector switchgear accommodating 10 collector circuits each.
        ii. Two 800 MVA – 66/66/275 kV generator step up transformers.
        iii. One 1,200 MW - ±320 kV HVDC converter.
    b. Cable systems:
        i. One ±320 kV HVDC circuit consisting of 53.4 miles of submarine cable and 12.4 miles of land cable from platform 1 to onshore substation.

   - ii. One ±320 kV HVDC circuit consisting of 40.5 miles of submarine cable and 12.4 miles of land cable from platform 2 to the onshore substation.
   - iii. One ±320 kV HVDC intertie link circuit consisting of approx. 13 miles of submarine cable between platforms 1 and 2.
- c. One onshore substation consisting of:
   - i. Two 1,200 MW - ±320 kV HVDC converters.
   - ii. Two banks of three 450 MVA – 320/230 kV transformers.
   - iii. Two bays of breaker-and-a half 230 kV open air switchgear.
   - iv. One bank of three 450 MVA – 230/500 kV transformers plus a spare.
   - vi. One half bay of 500 kV open air switchgear.

2. Proposal 551
   - a. Three offshore platforms, each housing the same equipment as described under Proposal 431.
   - b. Cable systems:
      - i. The same cable systems as described in Proposal 431 plus one additional ±320 kV HVDC circuit consisting of 52.5 miles of submarine cable and 12.4 miles of land cable from platform 3 to the onshore substation.
   - c. One onshore substation as described in Proposal 431 but also including:
      - i. One additional 1,200 MW - ±320 kV HVDC converter.
      - ii. One bank of three 450 MVA – 320/230 kV transformers.
      - iii. One additional bay of breaker-and-a half 230 kV open air switchgear.
3. Proposal 321
   - a. Four offshore platforms, each housing the same equipment as described under Proposal 431.
   - b. Cable systems:
      - i. The same cable systems as described in Proposal 551 plus one additional ±320 kV HVDC circuit consisting of 67.6 miles of submarine cable and 12.4 miles of land cable from platform 4 to the onshore substation and one ±320 kV HVDC intertie link consisting of approx. 13 miles of submarine cable between platforms 3 and 4.
   - c. One onshore substation as described in Proposal 551 but also including:
      - i. One additional 1,200 MW - ±320 kV HVDC converter.
      - ii. One additional bank of three 450 MVA – 320/230 kV transformers.
      - iii. One additional bay of breaker-and-a half 230 kV open air switchgear.
      - iv. One bank of three 450 MVA – 230/500 kV transformers.
      - vi. One half bay of 500 kV open air switchgear.

Constructability Review

Proposals 431, 551 and 321

Environmental (Regulatory) Analysis

Overview

The Mid-Atlantic Offshore Development (MAOD or the Developer) presented proposals 431, 551 and 321 that describe three stages of development for a proposed collector and transmission system designed to connect offshore wind generation into the PJM control area in New Jersey. Proposal 431 calls for connecting 2,400 MW and increases in 1,200 MW increments to 3,600 MW (Proposal 551) and finally to 4,800 MW (Proposal 321) by 2032. Each 1,200 MW increment is delivered by connecting an offshore collector / converter substation of that output to a single onshore interconnection / converter substation that is be located adjacent to the Jersey Central Power & Light (JCP&L) Larrabee Substation, off Randolph Road in Howell NJ.

Routing

The Part 1 Project Technical Description Proposal 1 document included with proposals 431, 551 and 321 under Supplemental Files describes:

1. One single cable corridor from the offshore collector / converter substations to the shore where four sets of ±320 kV HVDC (two sets to be installed under proposal 431, one set each under 551 and 321) cables make landfall.
    a. The proposals indicate that the Developer contracted specialized consultants to perform cable route studies for the offshore cables. The work product from those studies is not included in the supplemental files accompanying the proposals. A very high-level description of the route is provided so it is not possible to determine if there are flaws with the proposed route.
2. At the offshore substations the cable corridor is indicted as being 3,300 ft – 4,200 ft wide with 492 ft. spacing between cable sets.
3. The four sets of cables are proposed to transition to a 240 ft. wide corridor with 60 ft. spacing between sets as they approach landfall.
    a. The narrow transmission corridor near the landfall exposes the 4,800 MWs of offshore generation to the risk of common mode failure for damage from fishing or navigational activities.
4. Part 1 Project Technical Description Proposal 1 document and associated One Line Diagrams describe sets of ±320 kV HVDC cable systems interconnecting offshore converter substations in pairs to provide operational flexibility if one of the converter substations is out of service. The same applies to the onshore converters located at the site adjacent to JCP&L's Larrabee Substation.
    a. While the unavailability of a converter or cable limits export capability, the converter interconnecting cable systems proposed do provide for improving delivery of wind energy up to the capability of the system remaining in service.
5. Page 16 of the document states that the Developer has spent 'two years and considerable resources' surveying the proposed cable corridors as part of the Atlantic Shores Offshore Wind (ASOW) projects which are assigned PJM Queue Position No. AE2-022 and 021. The document further clarifies that a cable burial risk assessment for the proposals will be completed in October of 2021 and that a desktop study of 'hard and soft' constraints for the cable routes has been conducted.
    a. No supporting documentation for either the assessment or study were supplied as part of the supplemental files provided with the proposals.
6. The proposals also show intertie cable systems to the offshore collector / converter substations for the ASOW and Ocean Wind LLC (PJM Queue Position No. AE2-251) and state that the proposed HVDC system can operate in a multiterminal configuration with the ASOW projects which have POI at Cardiff Substation.
    a. Operation flexibility is gained by having access to the Cardiff POI but it is limited to the capability of the onshore converter station.

b. No detailed information for this second transmission corridor from the offshore substations for the ASOW project to the Cardiff POI was provided.

Landfall

The Part 1 Project Technical Description Proposal 1 document included with proposals 431, 551 and 321 under Supplemental Files describes:

- One single landfall location is presented for all three options. The four sets of ±320 kV HVDC cables make landfall at a property located in Sea Girt. Research of property records identified the property as 500 Sea Girt Avenue, Sea Girt NJ.
  - No documentation is provided related to negotiation of property rights or property acquisition to support the landfall facilities despite the statement on Page 15 that '...the beach landing was negotiated with the New Jersey Department of Military and Veterans Affairs'.
  - The proposed landfall location also serves as landfall for a multitude of other offshore facilities. Limited and incomplete information on the location of these other facilities in relation to the proposed cable systems was provided.
- A single 8 ft. by 4 ft. concrete encased duct bank housing four pairs of ducts for the proposed onshore portion of the HVDC tie cables. The duct bank runs from the above described landfall location, under public ways, to a site located off Randolph Rd., Howell NJ.
  - A set of plan and profile drawings for the ~12-mile onshore duct bank is included in the supporting documentation. However, the plans do not show any existing underground utilities making it impossible to evaluate the viability of the plan.
- The parcel of land for the onshore interconnection / converter substation is indicated as being in the process of being acquired.

Facility Conflicts

The review of the Part 1 Project Technical Description Proposal 1 document included with proposals 431, 551 and 321 under Supplemental Files yielded the following conflicts:

- The statement that the cable route does not conflict with 'existing subsea cables, pipelines, waste disposal, nuclear plants, oil and gas platforms, wrecks, fishing activities, unexploded ordnance (UXO) and military areas' is made on page 18 but no backup information is provided. Research of public records indicates the presence of all such facilities in the area.
- The Sea Girt landfall location chosen by the Developer currently houses a number of other in-service and retired in place facilities. The proposed landfall plans provide limited and incomplete information to verify that the plan does conflict with those facilities.
- The information provided for the proposed underground cable corridor from the landfall location to POI Larrabee does not identify existing underground utilities. Research of public records indicate the existence of underground water, sewer, phone, electric and communication facilities along the route.

Environmental Risk

Part 1 Project Technical Description Proposal 1 document, page 22, states that the project's components have been sited to avoid sensitive environmental and fisheries resources project impacts by utilizing construction technologies that mitigate potential impacts to fish, wildlife and their habitats, as well as residents and businesses. However, no supporting documentation was provided.

The Developer has included a letter summarizing confirmation of a Pre-Submission Meeting with the New Jersey Department of Environmental Protection held on August 30, 2021.

Part 1 Project Technical Description Proposal 1 document, page 82, Table 11 provides a high- level summary of risks and mitigation strategies. On the environmental side the following are identified:

- The location selected for housing the onshore converter / interconnection substation is near mapped NJ threatened species breeding habitat (barred owl) and may contain breeding habitat. Site also contains mapped stream and associated wetlands and may require 50' or 150' buffer from delineated resource.
    - Mitigation proposed: The Developer obtained permit history of the property (i.e., trash processing plan) to determine NJDEP rulings and interpretation of environmental constraints. The Developer adjusted the design to avoid wetlands and buffer based on DTS work, field surveys and permitting review.
- Protected species concerns (North Atlantic right whales), commercial fisheries activities, sensitive habitats, or other environmental constraints interrupting installation or operations schedules.
    - Mitigation proposed: Data analysis and data sharing with ASOW project provides baseline validation of seasonal presence of protected species. Additional G&G surveys will identify sensitive habitats. Contracting of a Fisheries Liaison support will help to identify key fishing areas and time of year for fishing activity in the project's footprint. Underwater noise and behavior modeling to support implementation of most appropriate mitigation and monitoring techniques (i.e., seasonal or nighttime piling restrictions, noise attenuation devises, vessel speed restrictions, protected species observers [PSOs]; passive acoustic monitoring [PAM]). Early and often coordination with federal government to provide data and modeling to support installation and operation schedules.

Permits

Components of this project run through Green Acres-encumbered properties and may require Green Acres Program Diversion Permits.

Part 1 Project Technical Description, page 21 states 'Mid-Atlantic performed a comprehensive analysis on the siting and permit requirements.' However, no supporting documentation was provided.

Part 1 Project Technical Description Proposal 1 document, page 82, Table 11 provides a high- level summary of risks and mitigation strategies. On the permitting side the following are identified:

1. Local planning and zoning setbacks compliance for onshore substation. Observe local bulk regulations for parcel development.
    a. Mitigation proposed: The design for the onshore substation incorporated local planning and zoning lot development requirements (setbacks, bulk requirements).
    b. Comment: Proposal is silent on zoning regulations for applicable to proposed site.
2. Site control for onshore offshore cable route, including concrete duct banks, cable joint pits and cable crossings.
    a. Mitigation proposed: Advance design work was done on cable routes to account for environmental constraints, including green acres restrictions, and other technical challenges. Multiple site surveys were done with environmental consultants, EPC contractors and designer to optimize the route. Geotech survey will be performed early 2021.
3. Site control for offshore cable landing
    a. Mitigation proposed: The cable landing solution is aligned with landowner expectations and requirements. Current process with ASOW federal government public hearings in October 2021 will identify stakeholder concerns with site control for the landing.
    b. Comment: No documentation to substantiate the claim above is provided. The Developer expects to learn from the ASOW process and incorporate lessons learned into plans.
4. Strict interpretation of BOEM OCS Lands Act regulations (CFR 585.300) would result in possible competitive interest in RUE (easement-substation) Grant areas identified by Mid-Atlantic. A competitive interest determination by BOEM for offshore transmission is unprecedented but could result in an auction for the ROW Grant and significant (2 years) schedule delay.
    a. Mitigation proposed: Defensible argument that the proposal does not represent competitive interest as new ROW grant but qualifies for amendment to existing OCS Lease Area development because

of the State and ISO program. State program to advance OCS Renewable Energy Generation. Early federal qualification (of MAOD as OCS entity) and early submission of federal grant application to initiate the process prior to NJBPU award. Consider installation of offshore substations within an existing OCS offshore wind lease area (partner with lease holder on connected action assignment of authority).

5. Strict interpretation of BOEM OCS Lands Act regulations (CFR 585.300) would result in possible competitive interest in ROW (rights-of-way, cable corridors) Grant areas identified by Mid-Atlantic. A competitive interest determination by BOEM for offshore transmission is unprecedented but could result in an auction for the ROW Grant and significant (2 years) schedule delay.
    a. Mitigation proposed: Defensible argument that MAOD proposal does not represent competitive interest as new ROW grant but qualifies for amendment to existing OCS Lease Area development because of the State and ISO program. State program to advance OCS Renewable Energy Generation. Early federal qualification (of MAOD as OCS entity) and early submission of federal grant application to initiate the process prior to NJBPU award. Consider installation of cables within an existing OCS offshore wind lease area and ROW (partner with lease holder on connected action assignment of authority)
6. GAP approval delay due to BOEM load, agency delays, etc.
    a. Mitigation proposed: Early, continuous, and proactive BOEM and cooperating agencies engagement. Assumed a reasonable 37-month BOEM review and approval schedule vs the 24-month statutory timeframe to account for BOEM's acknowledged backlog of offshore wind projects.
7. Challenges from stakeholders under NEPA process (GAP review).
    a. Early and proactive Federal and State engagement. Early coordination and shared engagements with lease holders. Local community and stakeholder liaison support for early project engagement. Proactive schedule contingency request (accounting for additional federal permitting timeline).

Technology and Supply Chain Risks

The Developer's proposals are based on offshore collector / converter substations and a single onshore converter / AC substation. The substations consist of:

1. Each offshore substation includes: Two main-tie-main configured 66 kV gas insulated switchgears (GIS). Each GIS interconnects to 10 submarine cables bringing power from the wind resource areas. The 66 kV GIS is connected to two 66/66/275 kV three winding transformers which, in turn, feed two 1,200 MW converters operating at ± 320 kV. The converters supply cables exporting the power to the onshore converter / AC substation.
2. The onshore converter / AC substation consists of: 1,200 MW converters operating at ± 320 kV. The converter supplies both 230 kV and 500 kV air insulated switchyards.
3. The proposals are modular:
    a. Under proposal 431 two offshore substations (and corresponding pairs of HVDC interconnection cables) will be constructed and two converters will be installed at the onshore substation for a total capacity of 2,400 MW. At the onshore substation two bays of 230 kV switch-and-a-half breakers, one bank of 230/500 kV step-up transformers, one 500 kV half bay, one 230 kV line to Larrabee Substation and one 500 kV line to Smithburg substation will be built.
    b. Under proposal 551 a third offshore substation (and corresponding pair of HVDC interconnection cables) will be built and a third converter will be added to the onshore substation bringing the total capacity to 3,600 MW. At the onshore substation a third converter, a second bay of 230 kV switch-and-a-half breakers and one 230 kV line to Atlantic Substation will be built.
    c. Under proposal 321 a fourth offshore substation (and corresponding pair of HVDC interconnection cables) will be constructed and a forth converter installed at the onshore substation for a total capacity of 4,800 MW. At the onshore substation a fourth converter, a second bay of 230 kV

switch-and-a-half breakers, a second bank of 230/500 kV step-up transformers, a second 500 kV half bay, and one 500 kV line to Smithburg substation will be built.

4. The proposals state that preliminary studies indicate that the maximum capacity of the proposed HVDC design can be expanded to at least 1,300 and 1,400 MWs.

Technology Risk

Technology risk associated with the plans presented by the Developer is mitigated by proposing to use technology that is currently commercially available. The main components are:

1. 1,200 MW ±320 kV converters. A letter of support from ABB Hitachi provides evidence that the converter technology as proposed is available today.
2. The GIS proposed for the offshore collector / converter and onshore coveter / interconnection substations operating at 66, 230, 275 and 320 kV is available today.
3. Three phase, 800 MVA – 66/66/275 kV, step-up transformers proposed of the offshore substation have been built for other applications and are available from a number of North American and overseas suppliers.
4. Single phase, 450 MVA – 500/230 kV step-up transformers proposed of the onshore substation have been built for other applications and are available from both North American and overseas suppliers.
5. 320 kV XLPE DC cables with 3,000 to 1,600 mm^2 Cu conductors have been in service at several locations across the globe.
6. Air insulated 230 and 500 kV switchyards are in use by utilities across the country.

Part 1 Project Technical Description Proposal 1 document, page 82, Table 11 provides a high- level summary of risks and mitigation strategies. On the technology side the following are identified:

1. HVDC links from different suppliers operating in parallel.
    a. Mitigation proposed: MAOD plan to use same supplier for all HVDC links.
2. Unavailability of HVDC cables from main suppliers for first phase
    a. Mitigation proposed: Early and proactive negotiations with potential suppliers; consider LOI and advanced negotiations; supplier relationships.
3. Unknown/insufficient data regarding soil conditions for onshore and offshore Converter stations sites - possible increased cost for foundations and/or site preparation
    a. Mitigation proposed: Geotechnical survey already performed with ASOW and new surveys to be performed during Front End Engineering & Design (FEED) will provide sufficient level of details to EPC contractor - remaining soil risk to be managed through EPC contract.
4. Design modifications or overly conservative design hypothesis due to unavailable or changing HVDC system input design data from Mid-Atlantic or third party.
    a. Mitigation proposed: Start detailed engineering early. Clear list of design inputs and sufficient tolerance to be defined during FEED.
5. Offshore HVDC converters and cables technology maturity.
    a. Mitigation proposed: The technology proposed is currently in service providing a high level of feasibility and constructability. ABB Hitachi and Aibel are currently providing a 1,200 MW ±320 kV offshore solutions for projects in Europe. Multiple ±320 kV XLPE cables have been supplied in previous projects.
6. Export cable route.
    a. Onshore cable routes development is advanced and a FEED level design has been performed. Schedule has been created to account for restriction windows. Offshore cable routes survey have been completed for Monmouth cable corridor and desktop studies have been completed for NY Bight Transit corridor area where additional offshore surveys will be performed.

Overall System

The review did not identify any overall system technology risks. The proposed system uses technology that is currently commercially available and has examples in service at several other locations.

HVDC System

The Developer proposes to use the ABB Hitachi HVDC Light system which is currently in service at various locations across the globe therefore there does not appear to be any technological risk associated with the proposed system. The proposed plan provides cable interties between converter terminals which provide the flexibility of operating the HVDC system in a multiterminal configuration if a converter or cable is out of service. Note that changing the configuration of the HVDC circuits would require an outage of the HVDC systems involved; also, since DC circuit breakers (which are still in development and not commonly available) are not part of the HVDC circuits, the entire HVDC cable system as it may be tied together could be subject to a single point of failure. Operational flexibility is dependent on manual reconfiguration of the system in a de-energized state.

As an option for future development the Developer proposes intertie cables for connection to the ASOW offshore substation (PJM Queue Position No. AE2-022 and 021). These intertie cables would provide for the MAOD project to have a second POI but would be limited to the capability of the converter station at the ASOW onshore substation. Note that multi-terminal operation of an HVDC system is generally confined to converter terminals from the same manufacturer, so the ability to operate with other HVDC systems may be limited.

Offshore Platform

The proposals describe a topside platform consisting of four decks and measuring 70m W x 40m L x 40 m H. The proposals states that a platform of those dimensions can accommodate the equipment required but there is no supporting documentation to verify the claim.

A statement of support of the project from Aibel and ABB Hitachi is provided. Aibel and ABB Hitachi have partnered to build similar platforms for offshore wind projects since 2002.

Risks associated with the offshore platforms are similar to those for other NJ SAA proposals.

Submarine Cable

The Developer issued an RFI to five cable vendors for the supply of the offshore and onshore HVDC XPLE cables required. Letters of support from two of the cable vendors are included in the supplemental files.

The cable voltage classes, cable sizes and cable types being considered for the project are commercially available today and have been in service for years at various locations around the globe, therefore there is no technological risk associated with the cable systems.

Project Complexity

A project of the size and scope covered by the proposals is, inherently, complex. However, within this context, the project does not include any complexities that are unique or unsurmountable. Schedule delays attributable to permitting, property/property rights acquisition and transmission system outages present the biggest risk.

Supply Chain Risk

The universe of firms capable of supplying the equipment required for the project is limited and there are multiple offshore wind projects entering the planning and construction stage on similar schedules across the country. The Developer has been in contact with selected suppliers as evidenced by the letters of support included in the supplemental files. The Developer acknowledges this risk and is considering entering into Letters of Intent (LOI) with selected suppliers.

Long Lead Time Items

Major components with long lead times are:

1. Offshore platforms,
2. Converters,
3. Power transformers,
4. HVDC cables,
5. and GIS.

In addition, the following specialized equipment needed for the construction of the facilities require significant lead in coordination:

1. Heavy lift DP vessel for installation of offshore platform foundations,
2. Jack-up vessel for installation of platform,
3. And, cable laying vessels.

The Developer intends to place orders for the long lead time items starting 2Q24 and with the same vendors being used for the ASOW projects.

Supplier Scarcity
The suppliers for long lead items indicated above are, for the most part, located overseas. This supply chain risk is mitigated by the Developer's choice of technology which is currently commercially available.
The Developer intends to use the same suppliers being used for the ASOW projects and that relationship will also help mitigate supplier chain risk.
The Developer proposes to have Liquidated Damages clauses to mitigate supply chain risks.

Construction Schedule Risk

The schedules are predicated on a contract award date of 10/3/2022 and yield expected commercial operation dates (CODs) to deliver the first 2,400 MW of offshore wind power by 10/1/2029, the next 1,200 MW by 12/31/2030 and the final 1,200 MW by 12/31/2032.

Part 1 Project Technical Description Proposal 1 document, page 82, Table 11 provides a high- level summary of risks and mitigation strategies. On the construction side the following are identified:

1. Weather conditions impact on installation
    a. Mitigation proposed: Schedules include margins in the planning of offshore works to allow for delays in installation due to inadequate weather conditions.
    b. Comment: The detailed schedule provided in Appendix 1-14 do not indicate the time allocated to weather delays.

Permitting

The schedules indicate the following milestones:

1. Securing Federal permits and Final Investment Decision (FID) by 4/1/2025
2. Release for construction of the converters and HVDC cables to follow for a construction start date of 4/1/2026.
3. COD for the first two offshore collector / converter substations, two associated HVDC cable systems to shore and interlinks between offshore substations, and the onshore converter / AC switchyard substation required to deliver first 2,400 MW by 10/1/2029.
4. COD for the third offshore collector / converter substation, associated HVDC cable system and the onshore converter / AC switchyard substation required to deliver the next 1,200 MW by 12/31/2030.
5. COD for the fourth offshore collector / converter substation, associated HVDC cable system to shore and interlinks between this offshore substation and the one described above, and the onshore converter / AC switchyard substation required to deliver the next 1,200 MW by 12/31/2032.

The schedule allows for NJ State and local permits to be completed by 7/1/2026 to support the landing and onshore work being completed by 10/1/2029. This schedule seems reasonable and will be subject to risks similar to the other NJ SAA proposals.

Construction

The Developer has incorporated the following expected delays into the schedule:

1. Receiving orders of conditions limiting construction for the sections starting at the Landfall Site, west of the Garden State Parkway, to where the route exits the bike path near Allaire State Park at Hospital Road during the Summer months (generally considered to start Memorial Day and end Labor Day).
2. Seasonal restrictions for the piling of the offshore foundations.

Proposal 431 (2,400 MW) indicates a COD in 2030 which may be a bit optimistic given the need to procure and install HVDC equipment and offshore platforms. There is a risk of not meeting this date that rises above the other proposals (321 and 551) which have CODs in 2032.

Outage Planning

The proposals do not describe or include in the schedule the outages to the JCP&L substations or transmission lines required to support the connection of the project.
No plans or schedule for the substation and transmission line work on the JCP&L facilities system are included in the proposals.

Other Overall Schedule Risk

The construction of substation facilities at the JCP&L Larrabee, Atlantic and Smithburg substations, as well as the construction of new 230 and 500 kV and the rebuilding of 230 kV lines required for the project are not reflected on the schedules presented.

O&M Risk

Part 1 Project Technical Description Proposal 1 document, page 87, Table 12 provides a high- level summary of risks and mitigation strategies for operation risks.

Route Diversity

The following risks are identified:

1. Cable exposure.
    a. Mitigation proposed: Cable depth will be constantly monitored to avoid insufficient depth resulting from seabed movements: Should the cable be exposed; the Project will then rebury the cable to the designed burial depth.
    b. Comment: No description of the process for cable reburial is provided.
2. Cable strike due to anchor placement.
    a. Mitigation proposed: Same as above
3. Cable strike due to jack up vessel legs.
    a. Mitigation proposed: Cable layout will be designed to offer maximum maneuverability for the jack up vessel

Redundancy & Operational Flexibility

The following redundancy and operational flexibility risks are identified:

1. Potential cable damage from crossings, exposed cable, and anchor strikes, including damage to existing cables.
    a. Mitigation proposed: Interlinks included in the design are providing additional reliability in case of a cable failure. MAOD performed strategic route planning and stakeholder communications. MAOD will contract insurance to account for repairs or interruptions and declare as laid information publicly.
    b. Comment: The proposed mitigation provides for operation flexibility but not for redundancy. The capacity of the system at N-1 condition is limited by the converter remaining in service.
2. Hurricanes.
    a. Mitigation proposed: All components are designed to withstand hurricane conditions based on site-specific extreme event hindcasting and analysis

   b. Comment: The proposed system does not provide for redundancy for loss of an entire offshore substation.
3. Lightning strikes.
   a. Mitigation proposed: All installed equipment include lightning protection systems that direct the current to ground, shield electronic equipment, and protect personnel
4. Corrosion.
   a. Mitigation proposed: All components will be protected against the marine environment. Coating systems are designed for the lifetime of the Project. Cathodic protection systems will be used in foundations to protect the underwater structures against corrosion.
5. Vessel collision.
   a. Mitigation proposed: Navigation aids, fog horns, protocols with USCG and local fishermen will be established to avoid incidents.
   b. Comment: The proposed system does not provide for redundancy for loss of an entire offshore substation.
6. Rogue waves.
   a. Mitigation proposed: All components will be designed to withstand rogue waves on site-specific extreme event hindcasting and analysis.
   b. Comment: The proposed system does not provide for redundancy for loss of an entire offshore substation.

Overall, operational risks are similar to other NJ SAA proposals. Note that platform interlinks can provide some additional operational flexibility, but they also can create operational issues and additional outage exposure depending on how the system is configured.

Maintenance and Spare Equipment Strategy:
The Developer proposes to build an O&M base in Atlantic City NJ that will provide 24/7 remote operation, monitoring and control of the assets, and overall O&M oversight and logistics.

The Developer proposes to enter into long term support agreements with ABB Hitachi for the converters. This support will cover:
1. Remote technical support to the Mid-Atlantic team
2. Software updates and upgrades through the life time of the project.
3. Cybersecurity support and services to ensure highest level of protection of the asset.

Part 1 Project Technical Description Proposal 1 document also indicates that the Developer proposes to conduct foundation inspection, scour protection campaigns, cable surveys and scheduled substation inspections. MAOD will adopt a strategy to minimize cost and maximize the assets availability based on the following activities:
1. Preventive maintenance: Subcontract specific activities to specialized contractors based on the maintenance schedule, e.g. cable surveys, electrical High Voltage infrastructure onshore and offshore, and underwater inspections.
   a. Comment: The parent companies of MAOD currently operate and maintains similar offshore facilities.
2. Critical failures: Keep a large stock of critical spare parts that have long lead times (e.g., spare length of cables, joints, switchgears) and enter into a "prepare to repair" contract with the qualified subcontractors to ensure that repair of the faults can be done quickly to minimize production losses.
   a. Comment: The level of detail on spare equipment to be purchased is not sufficient to determine the effectiveness of the program. Repairs to failures affecting transformers, gas insulated switchgear and converters are measured in months.
3. Emergency Protocols: Each element of the offshore equipment is designed to prevent, mitigate consequences, and facilitate response to fault conditions. Substations, and other equipment are equipped with control and safety systems which monitor the operational parameters and initiate a shut-down if operational limits are exceeded.

4. Technical Expertise: The parent companies of MAOD have decades of experience operating offshore wind generation projects. For example: the 108 MW NordZee Wind offshore windfarm and will soon take over O&M of the 731.5 MW Borssele 3&4 offshore wind farm once it reaches commercial operation in 2021. Both are located in the North Sea, off Holland.

Cost Review

Proposals 431, 551 and 321

Proposal Cost Estimates

The following main assumptions were considered for the Project cost estimate as proposed:

1. All prices are in U.S. Dollars.
2. The cost calculations reflect 2021 prices for materials and labor.
3. To capture possible cost increases in 2022 – 2027, Mid-Atlantic is proposing to use the Handy-Whitman index.
4. No indexation or inflation have been applied to the project's CAPEX.
5. Capital cost estimates are based upon current foreign exchange.
6. The bid cost proposal is calculated using beta-distribution technique, referred to as Program Evaluation and Review technique (PERT).
7. The project cost estimate for FEED and EPC is based on RFIs and RFQs from prospective suppliers, EDF and Shell procurement and costing practices, and Atlantic Shore contract rates.
8. The project cost estimate for OPEX is based on EDF practices and Atlantic Shores contact prices.
9. Acquiring all U.S. federal permits for Mid-Atlantic is the minimum regulatory requirement for Final Investment Decision (FID) approvals of the project.

To provide the required transmission capability to realize the offshore development schedule specified by PJM schedule it was decided to accelerate the start of the phase 1 of EPC and initiate Detailed Engineering Design and Contracting for HVDC converters 15 months before FID.

The total proposal costs for MAOD's Proposals 431, 551 and 321 are given below.

Category	Proposal 431	Proposal 551	Proposal 321
	$	$	$
Engineering & Design	316,819,000	474,763,000	618,807,000
Permitting/ Routing/Siting	9,733,000	14,848,000	17,903,000
ROW/Land Acquisition	13,650,000	13,650,000	13,650,000
Materials and Equipment	1,357,082,000	2,052,159,000	2,685,612,000
Construction & Commissioning	905,363,000	1,368,779,000	1,791,110,000
Construction Management	83,781,000	115,836,000	132,496,000
Overheads & Misc.	79,731,000	86,120,000	162,714,000
Contingency	190,656,000	284,833,000	287,350,000
Total Component Cost (Current Year)	2,956,815,000	4,410,988,000	5,709,642,000

In addition to the MAOD costs captured above, the Developer has also disclosed estimates from JCP&L for the direct connect facilities required for the projects as follows:

1. $109,100,000 for proposal 431 which includes:
    a. A 230 kV line from the onshore converter/interconnection substation to Larrabee and a 230 line position at Larrabee,
    b. facilities required to rebuild a 230 kV line to double circuit 230/500 kV from Larrabee to Smithburg and a 500 kV line position at Smithburg,
    c. 230/500 kV transformer upgrade at Smithburg.
2. $402,200,000 for proposal 551which includes:
    a. The above plus,
    b. a new 230 kV line from the onshore converter/to Atlantic Substation,
    c. and upgrades at Atlantic to accommodate a line position.
3. $988,800,000 for proposal 321:
    a. The above plus,
    b. facilities required to rebuild a second 230 kV line to double circuit 230/500 kV from Larrabee to Smithburg and a second 500 kV line position at Smithburg.

Independent Cost Estimates

Independent Cost Estimates

PJM's consultant assembled independent cost estimates for the proposed facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The Independent estimates for the three proposals are:

Proposal 431 (2400 MW):

Item	Qty:	Unit Cost ($)	Subtotal
Offshore collector/converter substation	2	$700,000,000	$1,400,000,000
Offshore intertie cable links - 13 miles	13	$5,000,000	$65,000,000
Offshore cable systems to landfall - 94 miles	94	$5,000,000	$470,000,000
Onshore cable systems - 24.8 miles	24.8	$8,500,000	$210,800,000
Onshore converter	2	$260,000,000	$520,000,000
Onshore 230 kV switchyard - Six breaker positions	6	$3,000,000	$18,000,000
230/500 kV single phase transformers	4	$3,000,000	$12,000,000
Onshore 500 kV switchyard - One breaker position	1	$6,000,000	$6,000,000

TOTAL			**$2,701,800,000**

Proposal 551 (3,600 MW):

Item	Qty:	Unit Cost ($)	Subtotal
Offshore collector/converter substation	3	$700,000,000	$2,100,000,000
Offshore intertie cable links - 13 miles	13	$5,000,000	$65,000,000
Offshore cable systems to landfall - 146 miles	146	$5,000,000	$730,000,000
Onshore cable systems - 37.2 miles	37.2	$8,500,000	$316,200,000
Onshore converter	3	$260,000,000	$780,000,000
Onshore 230 kV switchyard - Nine breaker positions	9	$3,000,000	$27,000,000
230/500 kV single phase transformers	4	$3,000,000	$12,000,000
Onshore 500 kV switchyard - One breaker position	1	$6,000,000	$6,000,000
TOTAL			**$4,036,200,000**

Proposal 321 (4,800 MW):

Item	Qty:	Unit Cost ($)	Subtotal
Offshore collector/converter substation	4	$700,000,000	$2,800,000,000
Offshore intertie cable links - 26 miles	26	$5,000,000	$130,000,000
Offshore cable systems to landfall - 214 miles	214	$5,000,000	$1,070,000,000
Onshore cable systems - 50 miles	50	$8,500,000	$425,000,000
Onshore converter	4	$260,000,000	$1,040,000,000
Onshore 230 kV switchyard - 12 breaker positions	12	$3,000,000	$36,000,000
230/500 kV single phase transformers	7	$3,000,000	$21,000,000
Onshore 500 kV switchyard - One breaker position	2	$6,000,000	$12,000,000
TOTAL			**$5,534,000,000**

Total Independent Cost Estimates for the Three Projects

Independent Cost Estimate

Projects	Proposal 431	Proposal 551	Proposal 321
Total Component Cost (Current Year)	$2,701,800,000	$4,036,200,000	$5,534,000,000

For comparison, the total proposal cost estimates for MAOD's Proposals are shown below.

Proposal Cost Estimate

Projects	Proposal 431	Proposal 551	Proposal 321
Total Component Cost (Current Year)	$2,956,815,000	$4,410,988,000	$5,709,642,000

NextEra Energy Transmission MidAtlantic Holdings (NEETMH) Proposals

NextEra Energy Transmission MidAtlantic Holdings, LLC (referred to as both NEETMA and NEETMH throughout various proposal documentation) has provided seven independent Option 2 proposals and one Option 3 proposal. These independent Option 2 proposals include 3 varying levels of MW injections (3000, 4500 and 6000 MW) into the Deans POI, 3 varying levels of MW injections (1500, 2400 and 3000 MW) into the Oceanview POI, and one injection of 2700 MW into Cardiff POI. The Option 3 proposal provides AC submarine cable links to provide a networking solution for the offshore platforms.

Table 3. **NEETMH Option 2 and 3 Proposals**

Proposal ID(s)	Description(s)	Capability (MW)
461	Deans 3,000 MW DC Injection	2 x 1500 HVDC
860	Deans 4,500 MW DC Injection	3 x 1500 HVDC
250	**Deans 6,000 MW DC Injection**	**4 x 1500 HVDC**
27	Oceanview 1,500 MW DC Injection	2 x 1500 HVDC
298	Oceanview 2,400 MW DC Injection	2 x 1200 HVDC
15	**Oceanview 3,000 MW DC Injection**	**2 x 1500 HVDC**
604	**Cardiff 2,700 MW DC Injection**	**1 x 1200 + 1 x 1500 HVDC**
359	**Platform Connections**	**230 kV AC Links (800 MVA)**

Due to expected similarities in constructability results between the three Deans injection Proposals (Proposals 461, 860, and 250), only the maximum Deans injection Proposal 250 for 6,000 MW is addressed in this report. Similarly, for the Oceanview injections (Proposals 27, 298, and 15), only the maximum Oceanview injection Proposal 15 for 3,000 MW is addressed in this report.

For the three NEETMH Option 2 proposals 15, 250, and 604, several HVDC-based transmission systems connecting to the 3 different POIs (Oceanview, Deans, and Cardiff) are proposed to achieve various levels of offshore wind generation connectivity. These systems use several identified submarine cable corridors which could require ROW widths of up to 800-1,000 feet depending on the number of systems included. Several offshore wind energy areas can be connected using these systems which are proposed at discrete platform locations. All the Option 2 offshore wind platforms include comprehensive HVDC facilities on the platforms, provisional space and equipment for reactive compensation, GIS switchgear, and a 66kV collection system switchgear to receive the offshore wind collection feeders directly.

Project Overview

The proposals are inclusive of all the facilities required to deliver wind generation starting at a 66 kV collector switchgear located within the offshore platforms and ending at the onshore interconnection / converter substation as follows:

- Proposal 015 (2-O30) – Oceanview 230kV 3,000MW
  - Landing at City of Asbury Park Beach
  - a. Two offshore platforms, each housing:
    - i. 66 kV gas insulated collector switchgear - 22 collector circuits each
    - ii. Two 900 MVA – 66/66/400 kV generator step up transformers.
    - iii. One 1,500 MW - ±400 kV HVDC converter.
  - b. Cable systems:

i. Two ±400 kV HVDC circuit consisting of 115 miles of submarine cable
ii. Two ±400 kV HVDC circuits consisting of 3 miles of terrestrial cable to the converter site.
ii. 230kV transformer, cable termination and reactive compensation for cable connectors between platforms (see proposal 359).

c. One onshore substation (Neptune) consisting of:
   i. Two 1,500 MW - ±400 kV HVDC converters.
   ii. Two banks of 900 MVA – 400/230 kV converter transformers.
   iii. Four bays of breaker-and-a half 230 kV GIS switchgear.

- Proposal 250 (2-D60) – Deans 500kV 6,000MW
  - Landing at Raritan Bay Waterfront Park in Middlesex County

  a. Two offshore platforms, each housing:
     i. 66 kV gas insulated switchgear - 22 collector circuits each
     ii. Two 900 MVA – 66/66/400 kV generator step up transformers.
     iii. One 1,500 MW - ±400 kV HVDC converter.
  b. Cable systems:
     i. Four sets of ±400 kV HVDC circuit consisting of 1372 miles of submarine cable
     ii. Four sets of ±400 kV HVDC circuit consisting of 60 miles of terrestrial cable to the converter site.
     iii. 230kV transformer, cable termination and reactive compensation for cable connectors between platforms (see proposal 359).
  c. One onshore substation (Fresh Ponds) consisting of:
     i. Four 1,500 MW - ±400 kV HVDC converters.
     ii. Four sets of two banks of 900 MVA – 400/500kV converter transformers
     iii. Four bays of breaker-and-a half 500 kV Air insulated bus.

- Proposal 604 (2-C27) – Cardiff 230kV 2,700MW
  - Landing near former motel site (744 E Absecon Blvd, Absecon) at Southeast Absecon Bay

  a. Two offshore platforms, each housing:
     i. 66 kV Gas insulated switchgear – 22 / 18 collector circuits each
     ii. Two 900 MVA – 66/66/400 kV generator step up transformers.
     iii. One 1,500 MW / 1,200 MW - ±400 kV HVDC converter
  b. Cable systems:
     i. Two ±400 kV HVDC circuit consisting of 50 miles of submarine cable
     ii. Two ±400 kV HVDC circuit consisting of 10.35 miles of terrestrial cable to the converter site.
     iii. 230kV transformer, cable termination and reactive compensation for cable connectors between platforms (see proposal 359).
  c. One onshore substation (Reega) consisting of:
     i. Two 1,500 MW / 1,200 MW - ±400 kV HVDC converters.
     ii. Two banks of 900 MVA – 400/230 kV converter transformers.
     iii. Three bays of breaker-and-a half 230 kV air insulated bus.

Since the individual Option 2 proposals share many common documented characteristics provided by the NEETMH's which also includes some common risks associated with submarine facility technology, locations, routing, as well as landfall locations, the following review has been performed by grouping the proposals for certain characteristics while also reviewing some characteristics separately by POIs and landfall locations.

NEETMH has also proposed HVAC cable links between these offshore platforms in a separate Option 3 proposal which is referred throughout this report as:

- Proposal 359 (3-PC) – Platform Connections

Component	Length (Mi.)
Platform A – Platform B	10.2
Platform A – Platform C	28.8
Platform C – Platform D	0.01
Platform E – Platform F	18.0

  - The proposed cable is 2,000 mm^2 AC 230 kV AC

For the Option 2 proposals, the HVDC systems proposed by NEETMH will be VSC based and have power ratings in the 1,200 and 1,500 MW range and will operate at ± 400 kV. Offshore and submarine cable VSC HVDC systems operating at these power and voltage levels are relatively new, and although some are in operation, the total operating experience with systems using this voltage is limited when compared to 320 kV or below. Also, 400 kV systems in operation are limited to systems in the 1,000 MW range. Commercial offerings for the 1,200 and 1,500 MW systems being proposed for the NEETMH projects are still in the development stage. Therefore, there is some added development and schedule risk associated with these larger sized systems, and additional risk consideration should be given to application of this technology in an offshore platform environment. The primary risk is schedule related; it is uncertain if these new designs can be qualified, designed, constructed, and commissioned within the schedules proposed.

Notwithstanding these potential schedule impacts, NEETMH's overall schedules indicate commercial operation dates of June 2028 for the Oceanview and Cardiff Option 2 projects that were reviewed which each include two offshore converter platforms and between 50 and 115 miles of HVDC cable, and June 2029 for the Deans location which includes four offshore converter platforms and over 370 miles of submarine cable. The schedule for these Option 2 proposals appears optimistic considering the overall complexity of the projects, the availability and experience of the technology being used, and the magnitude of offshore construction involved in the Deans proposal for 6,000MW.

In particular for the Deans proposal for 6,000MW, NEETMH's did not account for any supply chain issues procuring equipment to install four 1500 MW offshore platforms and over 370 miles of submarine cable which are assumed to be constructed mostly in parallel. There would be a high risk of constraints procuring all the specialized equipment and cable necessary to meet the proposed in service date. Additional projects utilizing HVDC technology being awarded in either New Jersey or the broader global market would likely extend the overall schedule due to risks associated with limited HVDC supplier options and availability of specialized equipment for transport and installation of platforms and submarined cables.

An additional risk for the Deans proposal for 6,000MW include the lack of route diversity. The four proposed sets of offshore submarine cables which deliver power from the four offshore platforms will be located mostly in common submarine corridors and in a common landing location within a common transition vault on land before traversing urban streets in a single duct bank to the POI. While this provides the benefit of less impact from construction activities when compared to multiple projects at different locations, it creates common risk factors and single points of failure for the collective output of the four delivery systems. In the event that the submarine corridor, transition vault, or any land-based vaults or duct banks in the ROW are required to be serviced or have experienced a failure, there is a high probability of over 6000MW of wind energy being unavailable at some point due to an event occurring on the common facility ROW. This adds significant operational risk.

For Option 2 proposal Oceanview 3000MW (015) and Deans 6000MW (250) There is also a moderate environmental risk of mitigations or minimizations required with the fisheries, and marine archeology for the chosen offshore cable corridor route which may require potential avoidance, minimization, and/or mitigation measures. Further detailed survey work is required to determine the necessary measures.

For its Option 3 proposal (359), NEETMH proposed numerous 230kV connectors between its own platform locations for the various Option 2 proposals. NEETMH chose to only include the cable costs in its Option 3 proposal and included the platform connector transformation, termination, and reactive power equipment requirements on the platforms in its Option 2 proposals.

The risk factors associated with the platform connectors is primarily in their compatibility, limitations, and materialized benefit. The 230kV HVAC voltage may or may not be expandable to connect platforms of other projects to create an interconnected offshore system since there are numerous other voltages and technologies proposed for other projects offshore platforms. Likewise, there is limited operational experience of a hybrid HVDC and HVAC offshore system as well as vendor technology interoperability limitations to overcome. While these issues are not unique to NEETMH's Option 3 proposal, NEETMH plans to lower the uncertainty and risk by only connecting the offshore platforms of its own Option 2 projects and only using it when there is an outage of an HVDC delivery cable/system. In this configuration, NEETMH's Option 3 proposal assumes the cable is on "standby" without normal power flow and is only used with an operational procedure for backup purposes during an outage and operates at 53% of the HVDC delivery cable capability. This is suggested until the state of the technology could potentially allow for an interconnected network assuming other aforementioned risks are potentially addressed at some indeterminate point in time. Considering these limitations, the Option 3 proposal risk includes not having enough materialized benefits to outweigh the costs.

Onshore Constructability Review

Proposals 15

Environmental (Regulatory) Analysis

Desktop Review for Proposal 15

The on-shore portion of the Project is comprised of four components. The construction of a new Neptune Converter Station near the existing Oceanview Substation is proposed on a parcel adjacent to Neptune Boulevard. A HVDC underground cable route starting at the land fall in Asbury Park and extending 2.4 miles through public road ROW to the new converter station is proposed. The reconductoring of the Atlantic – Oceanview and Larrabee-Oceanview 230kV lines within approximately 16.6 miles of the existing ROW is also proposed. The final proposed component is looping the reconductored lines into the new converter station utilizing new ROW.

Study Area

An analysis of the HVDC component, new converter station, reconductored transmission lines, and new loop lines connecting the Project facilities was performed to assist in the identification of major environmental and socioeconomic features and to provide a base for the extrapolation and derivation of future construction, permitting, mitigation, and land costs studies for the overall Project. A summary of the environmental and socioeconomic features are presented in Appendix A -Tables 11 and 12. Those features that have a particularly significant direct or indirect bearing on the Project's development are discussed further below. As the on-shore components are proposed to be constructed within existing ROWs, it is not anticipated that their alignments will deviate significantly from the proposed locations. Therefore, the Study Area is a 100-foot buffer centered on the HVDC underground cable between the landfall location in Asbury Park and the new converter station, the parcel for the planned converter station, and a 500-foot buffer centered on the lines to be reconductored and loop lines.

Land Use

Aerial imagery was used to develop a high-level review of land use and cover in the Project Study Area. The reconductoring components utilize land established as existing transmission line ROWs and the HVDC component utilizes land established as a public road ROW. However, these ROWs are adjacent to various types of commercial, residential, forested, and agricultural land use. From the on-shore landing in Asbury Park, the HVDC component crosses through a mixture of high density commercial and residential areas which transition into a mixture of mostly residential and forested land where it enters the new Neptune Converter Station. The reconductor component traverses a mixture of predominantly forested land with smaller patches of residential, agricultural, and commercial land to its ultimate termination point at the Larrabee Substation. The proposed location of the Neptune Converter Station and associated loop lines are located in forested areas and adjacent to transmission line ROW.

The Project is compatible with the land uses crossed. As the reconductor components are expected to be constructed largely in existing transmission line ROW, conflicts with land use are expected to be minimal. However, coordination will be needed for the crossings of various roads. For the HVDC component, coordination with the state and local authorities holding the existing road ROW easements would need to be conducted to negotiate use of their ROW. These negotiations can be unpredictable regarding a willingness to collocate facilities and the requirements of the existing easement language. For the new converter station and loop line components, easements will need to be negotiated from adjacent landowners.

Public and Protected Lands

The desktop review showed that the Project crosses seven public lands. Asbury Park City Boardwalk and Beach in Asbury Park is crossed by the HVDC component. Sunnyfield Municipal Park in Neptune Township and Shark River County Park in Wall Township as well as Allaire State Park, Bear Swamp Municipal Natural Area, Turkey Swamp County Park, and a Municipal Open Space in Howell Township are crossed by the Larrabee-Oceanview reconductor component. In addition to these public lands, a review of the NJ Public Access Locations Search Tool showed that one waterway along the HVDC component, access to the Atlantic Ocean, is subject to public trust rights.
The review of NJCMP's list of Excluded Federal Lands showed that no excluded federal lands are crossed by the Project. Review of NJ Farmland Preservation Program's preserved farmland database shows that Tullo Vaccaro Farm farmland conservation easement is crossed by the Larrabee-Oceanview reconductor component.

Public and/or protected land easements can restrict land use in perpetuity while retaining private ownership and typically have strict guidelines on future development. In general, easements can contain language precluding certain activities from occurring within the easement area. Except for Asbury Park City Boardwalk and Beach, utilizing existing ROWs to cross these areas should mitigate some risk associated with easement language, however, the details of the easements cannot be fully known until the easement is reviewed. Therefore, attempting to identify all impacted parcels that contain restrictive easements early in the planning stages of the Project should be of high priority so that the constraints associated with each easement can be properly assessed. Obtaining an easement to placing a high voltage cable under the public Asbury Park City Boardwalk and Beach may be difficult and may generate public opposition.

Special Regulation Regions

Certain urban areas within NJ are deemed as "Special Areas" due to their importance for human use or stringent planning requirements. According to the Division of Land Resource Protection, these areas include Atlantic City, the Hudson River Waterfront Area, and "Special Urban Areas" which are areas the NJ Department of Community Affairs (DCA) defines as municipalities in urban aid legislation qualified to receive state aid to enable them to maintain and upgrade municipal services and offset local property taxes. The Project is not located within the boundaries of either Atlantic City or the Hudson River Waterfront Area. However, the Project crosses two municipalities, Asbury Park and Neptune Township, which qualify as Special Urban Areas (DCA 2022). The HVDC component crosses both Asbury Park and Neptune Township while the Larrabee-Oceanview reconductor component, loop lines, and Neptune Converter Station components are located within Neptune Township. NJ Admin Code 7:7-9.41 states that any development that would adversely affect the economic wellbeing of these areas is discouraged when an alternative which is more beneficial to the Special Urban Area is feasible.

The portions of the Project that runs through Asbury Park and Neptune Township are predominantly confined to existing public road and existing electric transmission ROW. Impacts to the economic wellbeing of these areas are likely minimal in nature for components located within existing electric line ROW, however, the installation of the underground HVDC component is likely to cause significant temporary impacts to traffic patterns in both Asbury Park and Neptune Townships as well as beach use in Asbury Park, which could be viewed as negative impacts to the area's economic wellbeing. The Neptune Converter Station component is proposed to be located between existing residential and commercial use areas. This component will likely introduce novel visual impacts to the residential areas and prevent future commercial or residential use of the property, which could also be viewed as negative impacts to the area's economic wellbeing.

Certain ecological regions have special protections and regulations administered by the state of NJ. The Pinelands Protection Area is designated for state regulation by the Pinelands Protection Act and the Hackensack Meadowlands District is designated for state regulation by the Hackensack Meadowlands Reclamation and Development Act. The Project is not located within either of these regions.

Based on the desktop review, it is not anticipated that the Project will have adverse effects on Special Regulations Regions.

Special Landscape or Hazard Areas

Special hazard areas are areas that the NJDEP deems as having a known actual or potential hazard to public health, safety, and welfare, or to public or private property (NJDEP 2021). These areas include the navigable airspace around airports and seaplane landing areas, potential evacuation zones, hazardous material disposal sites, and areas of hazardous material contamination. Review of special hazard areas within the Study Area showed that no seaplane landing areas or airports were in the vicinity of the Project. The Project crosses seven hurricane evacuation routes. The HVDC component crosses NJ-71 and CR-16. The Larrabee-Oceanview reconductor component crosses I-195, NJ-33, NJ-66, NJ-18, and the Garden State Parkway.

Additionally, the review found that the Larrabee-Oceanview reconductor component crosses four hazardous material disposal sites. Monmouth County Reclamation Transfer Station is in Tinton Falls Borough. Three Class B Solid Waste Recycling Facilities, Rosano Howell Land, LLC, John Blewett, Inc., and Resource Engineering, LLC, are in Howell Township.

Aerial imagery of the Project was reviewed for special landscape features that include coastal bluffs, wet and dry borrow pits, dunes, erosional hazard areas, lagoon edges, and overwash area. Based on the review, it was determined that these special landscape features are not likely impacted by the Project. Furthermore, the Study Area was reviewed for mapped beaches. One beach, Asbury Park City Beach, is crossed by the HVDC component. Installation of the HVDC component will likely cause temporary disruptions to the public's use of the beach. Dredged Material Management Areas and filled water's edge areas are also regulated by the NJDEP as special areas. A review of the NJDEP's Bureau of GIS' Historic Fill in NJ Data set and USACE data was used to determine the presence of these sites along the Project. Filled water's edge areas were also found by cross referencing NJ Geographic Information Network (NJGIN) Wetlands of NJ Data set, the NJDEP Surface Water Quality Classification of New Jersey Data, and Historic Fill in New Jersey Data sets, along with aerial photography to determine areas of filled water's edge. The review showed that there are 13 sites within the Study Area where historic fill sites overlap with mapped wetlands and/or streams and would constitute a filled water's edge. USACE data also showed that no Dredged Material Management Areas are crossed by the Project.

NJ Geodetic Controls are established as reference points used for mapping and charting activities. Review of the control locations showed that a total of one mark was located within the HVDC component's Study Area.
Federal Emergency Management Agency's Floodplains and Floodways data was reviewed for coastal high hazard areas and flood hazard areas. A coastal high hazard floodplain is crossed by the HVDC component at the on-shore landing site in Asbury Park adjacent to the Atlantic Ocean. Additional floodplains and floodways are crossed by the Larrabee-Oceanview reconductor component and Neptune Converter Station component of the Project.
Based on the desktop review, it is anticipated that the Project will cross Special Landscape or Hazard Areas. This may result in more rigorous permitting processes or special construction requirements.

Waterbodies and Wetlands

The presence of wetlands can impact Project permitting and construction. In addition to the need to adopt special construction techniques (including avoidance) for specific wetland types and field conditions, the types of wetlands encountered has significant implications from a permitting and compensatory mitigation perspective.

Based on the desktop review, wetlands and waterbodies appear to be crossed by the Project. Depending on the type of crossings, permitting and construction schedules can be impacted. An on-site delineation would be required to determine the actual location and extent of wetlands and waterbodies present and to assess permitting implications for jurisdictional features.

Threatened and Endangered (TE) Species and Protected Habitats

Threatened and endangered species and protected habitats can impact permitting, construction schedules, and construction techniques.

Given the results of the desktop review of publicly available data, it is anticipated that the Project is within the range of both federally- and state-listed species, and that coordination with state and federal agencies will be required. Construction restrictions, timeframe, or mitigation may be necessary to comply with avoidance of sensitive species, however, the extent of which cannot be known until after coordination with the NJDEP takes place.

Cultural Resources

The NJ SHPO data sets for historic districts, historic properties, and archaeological site grids were used to determine the presence of known cultural resources in the Study Area. The review showed that the HVDC component crosses through two historic districts including Library Square and the New York (NY) and Long Branch Railroad Historic Districts. The Larrabee-Oceanview reconductor component crosses through two historic districts including the Garden State Parkway and NJ Southern Railroad Historic Districts. Additionally, the Larrabee-Oceanview reconductor component crosses three historic properties: 154 Squankum Road, Schneider Building and Collingwood South Flea Market Building, and Anthony Ventura Studio.

While not pinpointing the exact location, the archaeological site grid identifies the presence of an archaeological resource within a half-mile by half-mile area. The Larrabee-Oceanview reconductor component passes through two grids with eligible resources and four grids with identified resources.

Impacts associated with cultural resources include both direct (physical) and indirect (viewshed) considerations. Utilization of existing ROWs for the Project should mitigate some potential concerns regarding both consideration types, however, changes in tower heights and other necessary construction elements, such as access roads or laydown yards, must also be considered when assessing impacts. Coordination with the NJ SHPO will need to be conducted to determine required surveys (if any) to assess the extent of impact to cultural resources in the Project vicinity.

Federal, State, and Local Environmental Permits

Appendix A -Table 13 lists the environmental permits, authorizations, clearances, and consultations that could be required for the Project's on-shore components. For each authorization, the table identifies the administrating agency/authority, anticipated agency review timeframe, and additional information to be considered. The table represents a list of typically required permits for similar projects in the same area and is not specific to the Project. Although the Project-specific details included in this report can assist in the planning stages of the Project, additional reviews should be conducted as the Project is further developed and the extent of environmental impacts is known.

Federal Permits and Authorizations

Depending on the outcome of the environmental survey and Division of Land Resource Protection (DLRP) inspection and the final design of Project facilities, the Project could require several federal permits, authorizations, and consultations prior to construction. In addition, USFWS consultations and authorizations under Section 7 of the Endangered Species Act (ESA) could also be required to be obtained prior to receiving federal permits. These consultation and concurrences are discussed below in greater detail.

USACE Section 404

In NJ, the NJDEP is the agency delegated responsibility to implement Section 404 of the Clean Water Act (33 U.S.C. 13574), which regulates the discharge of dredged or fill material into waters (including wetlands) of the US. The exception being an activity proposed in a tidal water or water designated under Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 403), for which the USACE has regulatory authority. A Section 10 authorization from the USACE may be required if the Project crosses a Section 10 designated water. The Project is located within the jurisdictional boundaries of the NY and Philadelphia Districts of the USACE. The majority of the Project, including the HDVC component and the converter station, are located within the NY District. The NY District Office would need to be contacted to confirm if a Section 10 designated water is crossed by the Project. No Section 10 waters are proposed to be crossed in the Philadelphia District portion of the Project.

USFWS Endangered Species Consultation and Clearance

For federally funded or permitted projects, consultation with the USFWS is necessary to ensure that impacts to federally-listed threatened or endangered species and critical habitats are appropriately addressed under Section 7 of the ESA. The Project falls within the jurisdictional boundary of the USFWS NJ Ecological Services Field Office. Initial screening for many projects in NJ may be conducted online utilizing the IPaC online tool and county data compiled by the NJDEP. A "preliminary" screening for the Project has been completed, with results discussed in detail in the previous TE Species section of this report.

Typically, early consultation with USFWS will be of paramount importance. Coordination with the USFWS NJ Ecological Services Field Office will be required to determine the extent of survey and/or mitigation needed for each species.

USFWS authorizations are generally valid for two years. If construction is not completed after two years or new species are added to the list before construction begins, the protected species assessment must be revalidated through renewed consultation and, potentially, new or additional field surveys. Species-specific surveys and construction timeframes may be applicable.

State Permits

It is anticipated that the Project could require the following state environmental permits, consultations, clearances, and authorizations, including:

- State Protected Species Consultations
- State Historic Preservation Office (SHPO) Consultations and Clearances
- Freshwater Wetlands Permits
- Coastal Wetlands Permits

- Waterfront Development Permit
- Flood Hazard Area Permit
- Tidelands License
- Green Acres Program Diversion Permit
- NJ Pollutant Discharge Elimination System Permits (NJPDES) Basic Industrial Stormwater Permit
- Air Quality Permits

Local Permits and Approvals

It is anticipated that the Project could require the following county and municipal permits, consultations, clearances, and authorizations:

- Zoning Permits,
- Road Permits,
- Building Permits, and
- Erosion and Sediment Control Plan.

Private Permits

Activities located within railroad ROWs require permits from the owner and operators of the rail lines. The Project is proposed to install the HVDC component under a NJ Transit Corporation railroad and reconductor transmission lines currently spanning a Consolidated Rail Corporation (Conrail) line. Agreements may be in place for the reconductored transmission line components but likely not for the HVDC component. Railroad permits carry an average review time of six to 12 months.

Roadway Permits

Activities located within public road ROWs require permits from local and state departments of transportation. This could include the placement of the HVDC component within road ROWs and temporary construction access points. The HVDC component is proposed predominantly within public road ROWs. Additionally, major highways are crossed by various components of the Project, including Interstate 195 and the Garden State Parkway. The Garden State Parkway is managed by the NJ Turnpike Authority (NJTA) and requires a license to cross for utility lines and construction easements when NJTA property is impacted. Roadway permits carry an average review time of six months.

Environmental (Regulatory) Risks

Right-of-Way and Easement Risks

- Securing easements and using previously-secured easements with private landowners has been identified as a critical constraint. Easements can be held in perpetuity and may not allow for additional development, depending on the easement type and language. Each parcel crossed by the reconductored transmission line components would likely contain an easement with the property owner, which needs to be reviewed to identify the extent of the easement and the restrictions surrounding it. The majority of the reconductored transmission line components are in existing ROWs and it is possible that there are existing agreements in place that would accommodate the Project. Supplemental ROW easements may be needed around the Neptune Converter Station and looping transmission lines, and other agreements or easements may be required for the development of access roads.

- Securing easements along the HDVC component, which falls within public road ROW, is critical for the feasibility of the Project and will need to be coordinated with the easement holders. Other underground utilities may also be present within the road ROW proposed to be used by the HDVC component, which may complicate obtaining an easement and require significant coordination regarding underground utility avoidance.

- Several public lands are crossed by the HVDC component and reconductored transmission line components. Presumably, the reconductored transmission line components can be covered under the existing easements for the ROW. Supplemental easements may be necessary to augment the existing ROW or for the development of access roads. The HVDC component, while utilizing the existing ROW of public roadways, may require additional easement negotiations with the public lands since it will be a new facility within the ROW. The difficulty in obtaining supplemental easements from public lands for the reconductored transmission line components and new easements for the HVDC component is unclear until coordination with the property owner or easement holder takes place, or review of the easement language is conducted.

- Installation of the underground HVDC component is likely to cause significant temporary impacts to traffic patterns in both Asbury Park and Neptune Townships as well as beach use in Asbury Park, which could be viewed as negative impacts to the area's economic wellbeing. The Neptune Converter Station will likely introduce novel visual impacts to the residential areas and prevent future commercial or residential use of the property, which could also be viewed as negative impacts to the area's economic wellbeing.

Permitting Risks

- The HVDC and reconductored transmission line component are proposed to be located within road and railroad ROW, and will require permits. Placement within public road ROW will require permits from state and local agencies, and railroads are privately owned with each having its own requirements. Significant coordination regarding placement of the line and construction techniques may be required that prolong the permitting process.
- The Project has the potential to impact environmental resources, including streams and wetlands within coastal and freshwater ecosystems, and impacts to these resources may require a number of permits from the state and county. If impacts to freshwater wetlands exceed a threshold of 0.5-acre for aboveground impacts or one-acre of total wetland impact, general permits may not be applicable and an individual permit may need to be acquired, which will include a lengthier review time. Mitigation is also required if the Project permanently disturbs or impacts 0.1-acre or more of freshwater wetland. Consultation with the NJDEP early in the Project's development will help mitigate risks by addressing permitting concerns and allowing for a longer consultation and permitting timeline.

TE Species Risks

- Review of various sources that maintain TE species records indicated the potential for numerous species to be located within the vicinity of the Project. The Project's proponents should conduct an independent TE species review once the potential limits of disturbance and environmental impacts are better known to fully ascertain the requirements for mitigation associated with the sensitive species. Additionally, it is possible that new TE species location information may be added to the state and federal agency databases, and that the Project will be located within the new occurrence area. This could result in the need to conduct further consultation, and possibly the need to conduct surveys for the TE species. Depending on the results of the consultation and surveys, agencies could impose time-of-year restrictions on Project activities, require mitigation, or require another form of impact avoidance.

Transmission Line Risks

- Schedule risks based on outage windows required at Oceanview, Atlantic, and Larrabee Substations to reconductor the transmission lines and loop the lines into the new Neptune Substation.
- Construction within the road ROW may require significant traffic control and coordination with key stakeholders.
- Due to the densely populated area along the underground transmission route, numerous utility crossings are anticipated and the duct bank depth will vary based on each crossing. Proper protection of the crossings will be put in place during construction. Significant crossing impacts may require additional horizontal directional drilling, rerouting, or changes to the scope.
- Splice vaults will be needed approximately every 2,000 feet. Vaults will require additional real estate, compared to the standard duct bank.
- Potential increase for material cost or lead times, especially with the underground cable.

Substation Risks

- Procurement of HVDC equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With HVDC equipment being relatively uncommon in the US, unexpected delays in procurement, engineering, and construction may occur. Additionally, currency fluctuations for overseas equipment are likely to occur which will impact costs.

Construction Schedule

- The conceptual project schedule developed by the onshore consultant indicates that the on-shore aspects of the project will take approximately 84 months to complete, from Project initiation to energization. It is assumed that the engineering process can continue as siting permit is reviewed. There are four major activities on the critical path: Engineering; Siting and major permit acquisition; long lead equipment procurement; construction and commissioning. Delays in completing any of these activities would jeopardize completing the Project within the estimated schedule.
- Schedule risks identified due to impacts to traffic patterns and land use in special urban areas of Ashbury Park and Neptune township, which have potential for public opposition and delays or denials of permits

Proposal 250

Environmental (Regulatory) Analysis

Desktop Review for Proposal 250

The on-shore portion of the Project consists of three components:

- Construction of the new Fresh Pond Converter Station (converter station) near Deans Substation
- A HVDC underground cable route (HVDC component) starting at the land fall in Raritan Bay Waterfront Park and extending to the Fresh Pond Converter Station

- Reconductoring (reconductor component) two existing aerial electric transmission lines (Deans-Smithburg 500 kV and Dean-East Windsor 500 kV) between the new Fresh Pond Converter Station and existing Deans Substation and looping them in and out of the converter station

The HVDC component initially follows public road rights-of-way (ROW) for approximately 14 miles and then turns onto an existing transmission line ROW which it follows to the new converter station (1.1 miles). The reconductor component follows existing aerial electric transmission ROW from the new converter station to the existing Deans Substation (two miles). The new converter station is located on an approximately 37-acre parcel consisting of agricultural land adjacent to Deans Rhode Hall Road and I-95.

Study Area

An analysis of the Project was performed to assist in the identification of major environmental and socioeconomic features and to provide a base for the extrapolation and derivation of future construction, permitting, mitigation, and land costs studies for the overall Project. A summary of the environmental and socioeconomic features are presented in Appendix A -Tables 14 and 15. Those features that have a particularly significant direct or indirect bearing on the Project's development are discussed further below. As the HVDC component and reconductor component are proposed to be constructed within existing ROWs, it is not anticipated that their alignments will deviate significantly from the proposed locations. Therefore, the Study Area is a 100-foot buffer centered on the HVDC component and a 300-foot buffer centered on the reconductor component. The study area for the converter station included its entire parcel.

Land Use

Aerial imagery was used to develop a high-level review of land use and cover in the Project Study Area. The HVDC and reconductor components utilize existing ROWs for their alignments. Therefore, the land use impacted by the HVDC component is largely public road and the land use impacted by the reconductor component is transmission line ROW. These ROWs cross various types of commercial, residential, forested, and agricultural land. From the on-shore landing in the Raritan Bay Waterfront Park in the City of South Amboy, the HVDC component follows an existing public road ROW through a mixture of commercial and residential areas which transitions into a mixture of mostly residential and forested land. It leaves public road ROW for approximately 0.5-mile where it crosses the I-95 NJ Turnpike. The HVDC component then intersects an existing transmission line ROW that traverses a mixture of forested and agricultural land and utilizes this ROW before entering the new converter station. The land use adjacent to the reconductor component is largely forested. The converter station is located on agricultural land.

The Project is compatible with the land uses crossed. As the reconductor components are expected to be constructed largely in existing transmission line ROW, conflicts with land use are expected to be minimal. However, coordination will be needed for the crossings of various roads. For the HVDC component, coordination with the state and local authorities holding the existing road ROW easements would need to be conducted to negotiate use of their ROW. These negotiations can be unpredictable regarding a willingness to collocate facilities and the requirements of the existing easement language. For the new converter station and loop line components, easements will need to be negotiated from adjacent landowners.

Public and Protected Lands

The desktop review showed that the HVDC component crosses six public lands including the Raritan Bay Waterfront County Park in Sayreville Borough, Causeway Municipal Park in South River Borough, Ireland Brook County Conservation Area in East Brunswick Township, and Tamarack Hollow County greenspace and Pigeon Swamp State Park in South Brunswick Township. The reconductor component crosses Pigeon Swamp State Park and Davidson Mill Municipal Park in South Brunswick Township. The new converter station is located in Pigeon Swamp State Park. In addition to these public lands, a review of the NJ Public Access Locations Search Tool showed that two waterways along the HVDC component are subject to public trust rights including Raritan Bay, and South River.

Public and/or protected land easements can restrict land use in perpetuity while retaining private ownership and typically have strict guidelines on future development. In general, easements can contain language precluding certain activities from occurring within the easement area. Utilizing existing ROWs to cross these areas should mitigate some risk associated with easement language, however, the details of the easements cannot be fully known until the easement is reviewed. Proposed work within Raritan Bay Waterfront Park is not within existing ROW. Therefore, attempting to identify all impacted parcels that contain restrictive easements early in the planning stages of the Project should be of high priority so that the constraints associated with each easement can be properly assessed. Since the new converter station is located in Pigeon Swamp State Park easements from the NJDEP may be difficult to obtain.

Special Regulation Regions

Certain urban areas within NJ are deemed as "Special Areas" due to their importance for human use or stringent planning requirements. According to the Division of Land Resource Protection, these areas include Atlantic City, The Hudson River Waterfront Area, and "Special Urban Areas" which are areas the NJ Department of Community Affairs (DCA) defines as municipalities in urban aid legislation qualified to receive state aid to enable them to maintain and upgrade municipal services and offset local property taxes. The Project is not located within the boundaries of either Atlantic City or the Hudson River Waterfront Area. However, the Project crosses one municipality, Old Bridge Township, which qualifies as a Special Urban Area (DCA 2022). NJ Admin Code 7:7-9.41 states that any development that would adversely affect the economic wellbeing of these areas is discouraged, when an alternative which is more beneficial to the Special Urban Area is feasible. With the portion of the Project that runs through Old Bridge Township being the HVDC component, within an existing public road ROW, with the exception of temporary traffic disruptions during construction, impacts to the economic wellbeing of the township are likely minimal in nature.

Certain ecological regions have special protections and regulations administered by the State of NJ. The Pinelands Protection Area is designated for state regulation by the Pinelands Protection Act and the Hackensack Meadowlands District is designated for state regulation by the Hackensack Meadowlands Reclamation and Development Act. The Project is not located within either of these regions.

Based on the desktop review it is not anticipate that the Project will have adverse effects on Special Regulations Regions.

Special Landscape or Hazard Areas

Special hazard areas are areas that the NJDEP deems as having a known actual or potential hazard to public health, safety, and welfare, or to public or private property (NJDEP 2021). These areas include the navigable airspace around airports and seaplane landing areas, potential evacuation zones, hazardous material disposal sites, and areas of hazardous material contamination. Review of special hazard areas within the Study Area showed that no seaplane landing areas, airports, or hazardous material disposal sites were in the vicinity of the Project. The HVDC component does cross a portion of the Garden State Parkway which is a hurricane evacuation route.

Aerial imagery of the Project was reviewed for special landscape features that include: coastal bluffs, wet and dry borrow pits, dunes, lagoon edges, and overwash areas. Based on the review it was determined that these special landscape features are not likely impacted by the Project. Additionally, the Study Area was reviewed for mapped beaches and erosion hazard areas. One beach which is part of Raritan Bay Waterfront Park, is located in the Project's Study Area. Based on the physical characteristics of South Amboy Beach, the review found that it would qualify as a narrow beach according to the NJDEP which would classify it as an erosional hazard area (NJDEP, 2021).

Dredged Material Management Areas and filled water's edge areas are also regulated by the NJDEP as special areas. A review of NJDEP's Bureau of GIS' Historic Fill in NJ Data set and United States Army Corps of Engineers (USACE) data was used to determine the presence of these sites along the Project. Filled water's edge areas were also found by cross referencing NJ Geographic Information Network (NJGIN) Wetlands of NJ Data set, the NJDEP Surface Water Quality Classification of NJ Data and Historic Fill in NJ Data sets, along with aerial photography to determine areas of filled water's edge. The review showed that there are two sites along the HVDC component where historic fill sites overlap with mapped wetlands and or streams and would constitute a filled water's edge. USACE data showed that no Dredged Material Management Areas are crossed by the Project.

NJ Geodetic Controls are established as reference points used for mapping and charting activities. Review of the control locations showed that no marks were located within the Project's Study Area.

Federal Emergency Management Agency's Floodplains and Floodways data was reviewed for coastal high hazard areas and flood hazard areas. A coastal high hazard floodplain is crossed by the HVDC component adjacent to Raritan Bay. Additional floodplains and floodways are crossed by the HVDC and reconductor components of the Project.
Based on the desktop review it is anticipated that the Project will cross Special Landscape or Hazard Areas. This may result in more rigorous permitting processes or special construction requirements.

Waterbodies and Wetlands

The presence of wetlands can impact Project permitting and construction. In addition to the need to adopt special construction techniques (including avoidance) for specific wetland types and field conditions, the types of wetlands encountered has significant implications from a permitting and compensatory mitigation perspective.

Based on the desktop review, wetlands and waterbodies appear to be crossed by the Project. Depending on the type of crossings, permitting and construction schedules can be impacted. An on-site delineation would be required to determine the actual location and extent of wetlands and waterbodies present and to assess permitting implications for jurisdictional features.

Threatened and Endangered (TE) Species and Protected Habitats

Threatened and endangered species and protected habitats can impact permitting, construction schedules, and construction techniques.

Given the results of the desktop review of publicly available data, it is anticipated that the Project is within the range of both federally- and state-listed species, and that coordination with state and federal agencies will be required. Construction restrictions, timeframe, or mitigation may be necessary to comply with avoidance of sensitive species, however, the extent of which cannot be known until after coordination with the NJDEP takes place.

Cultural Resources

The NJ State Historic Preservation Office's (SHPO) data sets for historic districts, historic properties, and archaeological site grids were used to determine the presence of known cultural resources in the Study Area. The review showed that the HVDC component crosses through several historic districts including, Metuchen to Burlington Transmission Line, Raritan River Railroad, Camden and Amboy Railroad Main Line, Garden State Parkway, and New York and Long Branch Railroad Historic Districts. The reconductor component crosses the Metuchen to Burlington Transmission Line Historic District. The HVDC component also crosses the Camden and Amboy Railroad Bridge historic property and the reconductor component crosses the Electrical Substation in South Brunswick Township historic property.

While not pinpointing the exact location, the archaeological site grid identifies the presence of an archaeological resource within a half-mile by half-mile area. The HVDC component crosses through two grids with eligible resources and one grid with identified resources.

Impacts associated with cultural resources include both direct (physical) and indirect (viewshed) considerations. Utilization of existing ROWs for the Project should mitigate some potential concerns regarding both consideration types, however, changes in tower heights and other necessary construction elements, such as access roads or laydown yards, must also be considered when assessing impacts. Coordination with the NJ SHPO will need to be conducted to determine required surveys (if any) to assess the extent of impact to cultural resources in the Project vicinity.

Federal, State, and Local Environmental Permits

Appendix A -Table 16 lists the environmental permits, authorizations, clearances, and consultations that could be required for the Project's on-shore components. For each authorization, the table identifies the administrating agency/authority, anticipated agency review timeframe, and additional information to be considered. The table represents a list of typically required permits for similar projects in the same area and is not specific to the Project. Although the Project-specific details included in this report can assist in the planning stages of the Project, additional reviews should be conducted as the Project is further developed and the extent of environmental impacts is known.

Federal Permits and Authorizations

Depending on the outcome of the environmental survey, NJDEP's Division of Land Resources (DLRP) inspection, and the final design of Project facilities, the Project could require several federal permits, authorizations, and consultations prior to construction. In addition, USFWS consultations and authorizations under Section 7 of the Endangered Species Act (ESA) could also be required to be obtained prior to receiving federal permits. These consultations and concurrences are discussed below in greater detail.

USACE Section 404

In NJ, the NJDEP is the agency delegated responsibility to implement Section 404 of the Clean Water Act (33 U.S.C. 13574), which regulates the discharge of dredged or fill material into waters (including wetlands) of the United States. The exception being an activity proposed in a tidal water or water designated under Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 403), for which the USACE has regulatory authority. A Section 10 authorization from the USACE may be required if the Project crosses a Section 10 designated water. The Project is located within the jurisdictional boundary of the New York District of the USACE. The New York District Office would need to be contacted to confirm if a Section 10 designated water is crossed by the Project.

USFWS Endangered Species Consultation and Clearance

For federally funded or permitted projects, consultation with the USFWS is necessary to ensure that impacts to federally-listed threatened or endangered species and critical habitats are appropriately addressed under Section 7 of the ESA. The Project falls within the jurisdictional boundary of the USFWS NJ Ecological Services Field Office. Initial screening for many projects in NJ may be conducted online utilizing the IPaC online tool and county data compiled by the NJDEP. A "preliminary" screening for the Project has been completed, with results discussed in detail in the previous TE Species section of this report.

Typically, early consultation with the USFWS will be of paramount importance. Coordination with the USFWS NJ Ecological Services Field Office will be required to determine the extent of survey and/or mitigation needed for each species.

USFWS authorizations are generally valid for two years. If construction is not completed after two years or new species are added to the list before construction begins, the protected species assessment must be revalidated through renewed consultation and, potentially, new or additional field surveys. Species-specific surveys and construction timeframes may be applicable.

State Permits

It is anticipated that the Project could require the following state environmental permits, consultations, clearances, and authorizations, including:

- State Protected Species Consultations
- State Historic Preservation Office (SHPO) Consultations and Clearances
- Freshwater Wetlands Permits
- Coastal Wetlands Permits
- Waterfront Development Permit
- Flood Hazard Area Permit
- Tidelands License
- Green Acres Program Diversion Permit
- NJ Pollutant Discharge Elimination System Permits (NJPDES) Basic Industrial Stormwater Permit
- Air Quality Permits

Local Permits and Approvals
It is anticipated that the Project could require the following county and municipal permits, consultations, clearances, and authorizations:

- Zoning Permits,
- Road Permits,
- Building Permits, and
- Erosion and Sediment Control Plan.

Private Permits
Activities located within railroad ROWs require permits from the owner and operators of the rail lines. The Project crosses multiple rail lines operated by Consolidated Rail Corporation (Conrail) and NJ Transit Authority. The rail lines are proposed to be crossed underground, limiting impacts to rail operations, but construction activities may require further permits and consultations. Railroad permits carry an average review time of six to 12 months.

Roadway Permits
Activities located within public road ROWs require permits from local and state departments of transportation. This could include the placement of the underground transmission lines within road ROWs and temporary construction access points. The underground crossing of the I-95 NJ Turnpike may take additional coordination and it is anticipated the Turnpike authority will require the installation to take place via HDD techniques.

Environmental (Regulatory) Risks

Right-of-Way and Easement Risks

- Securing easements and using previously-secured easements with private landowners has been identified as a critical constraint. Easements can be held in perpetuity and may not allow for additional development, depending on the easement type and language. Each parcel crossed by the reconductor component would likely contain an easement with the property owner, which needs to be reviewed to identify the extent of the easement and the restrictions surrounding it. The majority of the reconductor component is in existing ROWs and it is possible that there are existing agreements in place that would accommodate the Project. Supplemental ROW easements may be needed around the converter station and looping transmission lines, and other agreements or easements may be required for the development of access roads. The property where the converter station is proposed to be located is also currently encumbered by the Green Acres program which could pose significant risks to placing the station on the property.

- Securing easements along the HVDC component, which falls within public road ROW, is critical for the feasibility of the Project and will need to be coordinated with the easement holders. Other underground utilities may also be present within the road ROW proposed to be used by the HVDC component, which may complicate obtaining an easement and also require significant coordination regarding avoidance. The underground crossing of the I-95 NJ Turnpike will be a new crossing and will require a new easement which may take additional time and engineering coordination regarding the methods used to install the crossing.

- Several public lands are crossed by the HVDC component and reconductor component. Presumably, the reconductor component can be covered under the existing easements for the ROW. Supplemental easements may be necessary to augment the existing ROW, or for the development of access roads. The HVDC component, while utilizing the existing ROW of public roadways for most of its length, may require additional easement negotiations with the public lands since it will be a new facility within the ROW. Sections of the HVDC component not within public road ROW will require easement negotiations with the landowners. The difficulty in obtaining supplemental easements from public lands for the reconductor component and new easements for the HVDC component is unclear until coordination with the property owner or easement holder takes place, or review of the easement language is conducted.

Permitting Risks

- Portions of the Project are proposed to be located within railroad ROW and will require permits. Railroads are privately owned, and each has its own requirements. While railroad permitting for the Project may be better received by the railroad as all of the railroad crossings occurring along the underground HVDC component, significant coordination regarding placement of the line and construction techniques may be required that prolong the permitting process.

- The Project has the potential to impact environmental resources, including streams and wetlands within coastal and freshwater ecosystems, and impacts to these resources may require a number of permits from the state and county. If impacts to freshwater wetlands exceed a threshold of 0.5-acre for aboveground impacts, or one-acre of total wetland impact, general permits may not be applicable and an individual permit may need to be acquired, which will include a lengthier review time. Mitigation is also required if the Project permanently disturbs or impacts 0.1-acre or more of freshwater wetland. Consultation with the NJDEP early in the Project's development will help mitigate risks by addressing permitting concerns and allowing for a longer consultation and permitting timeline.

TE Species Risks

Review of various sources that maintain TE species records indicated the potential for numerous species to be located within vicinity of the Project. The Project's proponents should conduct an independent TE species review once the potential limits of disturbance and environmental impacts are better known to fully ascertain the requirements for mitigation associated with the sensitive species. Additionally, it is possible that new TE species location information may be added to the state and federal agency databases, and that the Project will be located within the new occurrence area. This could result in the need to conduct further consultation, and possibly the need to conduct surveys, for the TE species. Depending on the results of the consultation and surveys, agencies could impose time-of-year restrictions on Project activities, require mitigation, or require another form of impact avoidance.

Transmission Line Risks

- Schedule risks based on outage windows required at Deans, East Windsor, and Smithburg substations to loop in and reconductor the existing transmission lines to the new Fresh Ponds converter station.
- Construction within the road ROW may require significant traffic control and coordination with key stakeholders.
- Due to the densely populated area along the underground transmission route, numerous utility crossings are anticipated, and the duct bank depth will vary based on each crossing. Proper protection of the crossings will be put in place during construction. Significant crossing impacts may require additional horizontal directional drilling, rerouting, or changes to the scope.
- Splice vaults will be needed approximately every 2,000 feet. Vaults will require additional real estate, compared to the standard duct bank.
- Potential increase for material cost or lead times, especially with the underground cable.

Substation Risks

- Procurement of HVDC equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With HVDC equipment being relatively uncommon in the US, unexpected delays in procurement, engineering, and construction may occur. Additionally, currency fluctuations for overseas equipment are likely to occur which will impact costs.

Construction Schedule

- The conceptual project schedule developed by the onshore consultant indicates that the on-shore aspects of the project will take approximately 84 months to complete, from Project initiation to energization. It is assumed that the engineering process can continue as siting permit is reviewed. There are four major activities on the critical path: Engineering; Siting and major permit acquisition; long lead equipment procurement; construction and commissioning. Delays in completing any of these activities would jeopardize completing the Project within the estimated schedule.
- Schedule risks due to significant delay and approval risks in obtaining a Green Acres easement for the Fresh Ponds converter station parcel.

Proposal 604

Environmental (Regulatory) Analysis

Desktop Review for Proposal 604

The project is located within Egg Harbor, Pleasantville, Atlantic City, Brigantine, and Absecon Townships in Atlantic County, New Jersey and includes one 1,200 MW HVDC symmetrical monopole system and one 1,510 MW HVDC symmetrical monopole system connecting offshore platforms to deliver the offshore power to a new Reega 230 kV switchyard.

The existing New Freedom to Cardiff 230 kV line will be looped into Reega 230kV and a new 230 kV line from Reega to Cardiff and a new 230 kV line from Reega to New Freedom will both be constructed. The proposed Reega to New Freedom line will traverse 30.9 miles, the new 230 kV OH Line from Reega to Cardiff will traverse 1.87 miles, and the

UG HVDC Line, OSW Landing to Reega Substation will traverse 10.23 miles underground all in Atlantic County, New Jersey

Study Area

The environmental review consisted of mapping and assessing the water/wetlands resources, biological resources, public lands, cultural resources, existing infrastructure, soils and farmland resources within a ¼ mile of the proposed Project centerline (henceforth known as the Study Area).

Land Use

According to the USGS National Land Cover Database (NLCD, 2019), the 4,117.4-acre Project Area is mainly comprised of Woody Wetlands and Open Water.

Land Cover Type	Area (Acres)	Percent of Total
Woody Wetlands	1,122.04	27.25
Open Water	909.22	22.08
Developed, Low Intensity	477.07	11.59
Developed, Medium Intensity	363.47	8.83
Mixed Forest	295.90	7.19
Deciduous Forest	244.88	5.95
Developed, Open Space	168.77	4.10
Cultivated Crops	148.82	3.61
Developed, High Intensity	97.13	2.36
Emergent Herbaceous Wetlands	91.79	2.23
Evergreen Forest	78.34	1.90
Shrub/Scrub	49.67	1.21
Pasture/Hay	29.58	0.72
Grassland/Herbaceous	23.58	0.57
Barren Land	17.14	0.42
Total	**4,117.40**	**100**

*Values rounded to the nearest hundredth.

Public and Protected Lands

A total of 29 parcels of public and conservation lands lies within a 0.25-mile buffer of the Project Area. These public and conservation lands include six township or county parks, Atlantic City and Brigantine Public Beaches, Leeds Avenue School, Strawberry Field Aviation Facility, four New Jersey State Wildlife Management Areas (Great Egg Harbor, Absecon, Makepeace Lake, and Winslow), three Conservation Focal Areas (CFAs): Great Egg Harbor CFA, Greater Bay Region CFA, Greater Atlantic City Coastal Bays, and 11 conservation or agricultural easements. The Project crosses the Mid-Atlantic Coastal Waters Area managed by the National Oceanic and Atmospheric Administration (NOAA). No other federal public lands are located within one mile of the Project Area (PADUS 2019).

Special Landscape or Hazard Areas

A search for known environmental contaminants within ¼-mile of the Project Area was completed using the New Jersey Department of Environmental Protection: NJ-GeoWeb and the U.S. Environmental Protection Agency: MyEnvironment online application. Several environmental hazards, such as underground storage tanks, four superfund sites, active remediation sites, groundwater contamination areas, and underground storage tanks have been identified within the aforementioned buffer. These should not cause issues but will need to be avoided in design, construction, and access planning. Soil testing should be conducted to avoid construction within an area of contaminated groundwater or other contamination.

Floodplains, Waterbodies and Wetlands

According to FEMA Flood Insurance Rate Map (FIRM), there are 642.87 acres of mapped 100-year floodplain (Zones A, AE, and VE) and 10.02 acres of mapped 500-year floodplain (Zone X) within the Project Area. Zone VE in particular should be highlighted as it corresponds to areas with storm wave hazards, which occur to the northwest and southeast of Absecon Bay. There is 1 mapped floodway (Zone AE) totaling 18.5 acres within the Project Area, which occurs along the Great Egg Harbor River. Most of the 100-year and 500-year floodplains are associated with the Great Egg Harbor River and its tributaries. It should be noted that areas surrounding open water in Absecon Bay and the Atlantic Ocean were unmapped by FEMA and not included in this floodplain summary.

According to NWI data, 379 wetlands totaling 1,996.60 acres were identified within the Project Area. Wetlands are classified as Freshwater Emergent Wetland, Freshwater Forested/Shrub Wetland, Freshwater Pond, Lake, Non-Tidal Riverine Wetland, Freshwater Farmed Wetland, Estuarine and Marine Wetland, and Estuarine and Marine Deepwater. It should be noted that the NWI dataset does not extend more than 3.5 miles into the Atlantic Ocean, so, in reality, the acreage of Estuarine and Marine Deepwater habitat is higher than what is reflected in the following table. Below is a breakdown of NWI wetland types and their respective acreages within the Project Area.

Wetland Classification		Count	Acres within Project Area
Tidal Wetlands	Estuarine and Marine Deepwater	5	963.87
	Estuarine and Marine Wetland	12	72.55
	Total	***17***	***1,036.42***
Non-Tidal, Non-Forested Wetlands	Lake	2	8.6
	Freshwater Emergent Wetland	24	47.52
	Freshwater Farmed Wetland	1	0.53
	Freshwater Pond	7	11.34
	Non-Tidal Riverine Wetland	57	16.74
	Total	***91***	***84.73***
Non-Tidal, Forested Wetlands	Freshwater Forested/Shrub Wetland	271	875.44
	Total	***271***	***875.44***

Threatened and Endangered (TE) Species and Protected Habitats

Threatened and endangered species and protected habitats can impact permitting, construction schedules, and construction techniques.

Given the results of the desktop review of publicly available data, it is anticipated that the Project is within the range of both federally- and state-listed species, and that coordination with state and federal agencies will be required. Construction restrictions, timeframe, or mitigation may be necessary to comply with avoidance of sensitive species, however, the extent of which cannot be known until after coordination with the NJDEP takes place.

Cultural Resources

This preliminary investigation into cultural resources was limited to a desktop review of publicly available online data. The Study Area included a ¼-mile buffer around the Project Area and included a review of the Archaeological Site

Grid, Historic Properties, Historic Property Features, and Historic Districts geospatial datasets maintained by the NJ Historic Preservation Office (HPO). Initial research utilized LUCY, the New Jersey Cultural Resources GIS (NJCRGIS) Online Map Viewer. The four sets of data were also downloaded from the NJ Department of Environmental Protection's (NJDEP) Bureau of GIS to map the resources in relation to the Project.

The results of the review for previously recorded archaeological sites and historic resources within the Project Area and the ¼-mile buffer are summarized below.

Archaeological Sites
According to the Archaeological Site Grid, there is a possibility for thirty-seven archaeological sites located within ¼-mile of the Project Area (2 are NRHP eligible). Twenty-one sites may intersect the Project Area (1 is NRHP eligible). One site may be adjacent to the Project. Specific locational data is confidential; a file request with HPO and a formal cultural resources literature review would be required to acquire precise site locations.

Historic Resources
Ninety-four Historic Properties are within ¼-mile of the Project Area (5 are NRHP eligible). More than half of the properties are elements within one of the six historic districts in the vicinity. Six properties intersect the Project (2 were NRHP eligible district resources but are demolished). Twenty properties are adjacent to the Project Area, half of which are in the Pleasantville North Historic District (unevaluated).

Ninety-one Historic Property Features are within ¼-mile of the Project Area (4 are NRHP eligible). Three of the four properties that intersect the Project are demolished (2 were NRHP eligible). Eleven properties are adjacent to the Project, but five are demolished.

Federal, State, and Local Environmental Permits

Federal Permits

Depending on the outcome of wetland and stream delineations and the final design, Project #604 could require federal permits, authorizations, and consultations prior to construction. These include but are not limited to the US Army Corps of Engineers (USACE) Section 404 permits for dredge and fill activities in wetlands and other waters of the US and USACE Section 10 permits for structure construction along the banks of or within, over, or under navigable waters. In addition, USFWS consultations and authorizations under Section 7 of the ESA could also be required. To be in compliance with these federal permits, consultation and concurrence typically needs to be received from state agencies as well.

For federally funded or permitted projects, consultation with the USFWS is necessary to ensure that impacts to federally-listed threatened or endangered terrestrial species and critical habitats are appropriately addressed under Section 7 of the ESA. Early consultation with USFWS will be of paramount importance. Agency feedback, along with information acquired through preliminary field reconnaissance and detailed review of maps and aerial photographs, will be used to identify the scope of any subsequent species or habitat-specific field surveys that may be required. Given the limited seasonal timeframes that exist for many such surveys, early planning is vital. Likewise, construction schedules can be impacted by agency-stipulated seasonal restrictions reflecting nesting, breeding, and other behavioral patterns. In the absence of Project-specific agency consultation and a preliminary field assessment of habitat availability within the Study Area, any species-related impacts on construction schedules cannot be ascertained.

USFWS authorizations are generally valid for two years. If construction is not completed after two years or new species are added to the list before construction begins, the protected species assessment must be revalidated through renewed consultation and, potentially, additional field surveys. Species-specific surveys and construction timeframes may be applicable. Due to Project #604 being within the range of federally-listed species, it is possible that field surveys and potentially other timeframe restrictions may be needed for compliance.

The Federal Aviation Administration (FAA) requires an Obstruction Evaluation / Airport Airspace Analysis (OE/AAA) to be completed and with the submission of notice at least 45 days prior to construction for proposed structures entering the airspace based on a variety of factors including height, proximity to airports, location, and frequencies emitted from structures. More specifically, if the structure will exceed 200 feet above ground level, the FAA must be notified prior to construction. The FAA is notified through submittal of the Notice of Proposed Construction or Alteration, FAA Form 7460-1 (FAA, 2019). Early consultation with the FAA regarding the proposed Project tower heights and locations is highly encouraged to ensure the required approvals are met in a timely manner prior to the start of construction.

More information regarding the Federal regulatory review process can be found in the Permit Matrix prepared for Project #604 in Appendix -Table 17.

State Permits

Potential approvals required for Project development include the 5G3 - Construction Activity Stormwater General Permit; Freshwater Wetlands (FWW) Individual Permit and FWW General Permits; Flood Hazard Area (FHA) Individual Permit and Streams/Rivers & Flood Hazard General Permits and Permit-by-Rule (PBR) 33; Coastal Permitting General Permits, Waterfront Development (WFD) Individual Permit and Coastal Zone Management Federal Consistency, CAFRA Individual Permit, Coastal Wetlands Individual Permit; and the Tidelands License/Grants Approval. Other non-water resource approvals administered by the NJDEP include a New Jersey Natural Heritage Program) - State T&E Species Consultation. More information regarding the State NJDEP regulatory review process can be found in the Permit Matrix prepared for Project #604 in Table X.
A Cultural and Historic Resource Review from the New Jersey Historic Preservation Office (HPO) will be required for any State or Federal undertakings. Review may be triggered by a variety of NJDEP approvals for water resource impacts.

If any of the local permit issuing municipalities do not possess code enforcement licenses of the appropriate class, a review from the NJ Department of Community Affairs would be required in place of municipal review. A Departmental plan review (typically referred to as a Construction Permit) shall not be required except when the Department acts as the enforcing agency. An Application should be made to the local construction office, not the Department.
The Project is sited in the New Jersey Pinelands Area, subject to the Pinelands Comprehensive Management Plan. Project development will require an Application for Development in the Pinelands Area (Certificate of Filing) approval from the New Jersey Pinelands Commission. Commission approval is required in order to receive local permitting approvals for Pinelands Area developments.

New Jersey Department of Transportation (NJDOT) permits and approvals are required for oversize/overweight vehicles, driveway access roads, utility openings, and highway occupancies. Permit required for vehicles exceeding the weights adopted in N.J.A.C. 13:18, Subchapter 1: Permits for Over dimensional or Overweight Vehicles. Determine if construction of the Project will require travel on state roads with oversize/overweight vehicles. If so, determine the length, weight, and number of trips necessary to complete the Project. Typically, these types of permits will be sought out by the contractor responsible for transporting materials. An Application for Utility Opening (MT17A) will be required for installation of utility infrastructure via highway openings. Project #604 crosses numerous New Jersey Highways and a US Highway; therefore, it is likely that approval of MT17A will be required. In addition, it is likely that Highway Occupancy Permit (MT120A) will be required for utility infrastructure occupancies of State-managed roadways. The minimum clearances for overhead power and communication lines must be no less than the standards prescribed by the National Electrical Safety Code (NESC) under N.J. Admin Code 16:25-10.4.
More information regarding the State regulatory review process can be found in the Permit Matrix prepared for Project #604 in Appendix -Table 17.

Local Permits and Approvals

At the local level, Project #604 crosses eight (8) different Townships and Cities in the State of New Jersey. All identified Townships and Cities will be the local authority having jurisdiction of Project development in the applicable corporate boundaries. Consultant reviewed each Townships and City's Government Website regarding zoning, land use ordinances, and potential local-level permitting for transmission line projects. Common approvals amongst the local jurisdictions include Zoning Permit Approvals for construction of electric transmission infrastructure across a variety of agricultural, residential, industrial, conservation and other zoning districts present in the proposed route. Site Plan Reviews demonstrating compliance with all zoning and land use regulations are required in local jurisdictions. A Construction Permit in accordance with the New Jersey State Uniform Construction Code will also be necessary for most jurisdictions. Other identified approvals from local jurisdictions include Tree Removal Permits and Street Opening Applications.

Ultimately, consultation with each identified local jurisdiction is recommended to ensure Project designs adhere to local regulations and all permitting requirements are met.

At the County-level, the Project is sited in Atlantic and Camden Counties. Any proposed developments abutting a County road or County drainage structure will require a County Site Plan Review Approval in addition to all Townships and City permitting requirements. Consultant determined that the Project does abut County roadways and/or County drainage systems and therefore, it is likely that Site Plan Reviews from the aforementioned Counties would be required. In addition, right-of-way permitting will be necessary from each County for infrastructure placed in the ROW of County roadways.

Construction activities resulting in one or more acres of earth disturbance require Soil Erosion and Sediment Control (SESC) Plan Approval from the local soil conservation district. Any land disturbances of 5,000 square feet or more need to apply for certification.

More information regarding the local regulatory review process can be found in the Permit Matrix prepared for Project #604 in Appendix -Table 17.

Infrastructure

The Project crosses numerous major highways, including US Highways 40 and 332, and numerous state and county roadways.

A review of aerial photography indicates that numerous residences, commercial buildings, and other buildings are present in close proximity to the Project Area.

Three railroads are crossed by the proposed Project.

One water well is located adjacent to the Project Area. Numerous wellhead protection areas for public community and public non-community water supplies are present in the Project Area.

No oil or gas wells are mapped in or within the Project Area. One natural gas pipeline is crossed in the central portion of the proposed Project.

Six substations are crossed or located in close proximity to the Project Area. Eighteen existing transmission lines are crossed or run parallel to the proposed Project. Identified transmission lines range from 69 kV up to 500 kV.

Twenty-two airports are mapped within five miles of the Project Area. Two airports are located immediately adjacent to the Project Area. The proposed Project is unlikely to trigger Form 7460-1 Notice of Proposed Construction or Alteration (Determination of No Hazard) through the Federal Aviation Administration (FAA) for construction of any structure exceeding 200 feet in height.

Environmental (Regulatory) Risks

A summary of the environmental risks that may impact the Project are summarized in the table below.

Risk Analysis		
Category	**Items of Note**	**Significant Constraints/Hurdles**
Floodplain	The Project Area has FEMA mapped floodways, 100-year floodplains, and 500-year floodplains.	An NJDEP permit is required for any development within a floodway or 100-year floodplain. Local development permits may also be required for development within a special flood hazard area.
Water Resources	Potential wetlands and other regulated waters, transition areas, and tidelands are most likely present in the Project Area. There are EPA Priority Wetlands, Wild and Scenic Rivers, Navigable Waters, and Outstanding Natural Resource Waters within the Study Area.	There are many special features within the Study Area that will likely require significant avoidance or minimization requirements from any federal, state, and local entities.
Water resources regulations	If jurisdictional wetlands/waterways are present, project infrastructure should be sited to avoid water resources to the degree practicable. There are impaired waters within the Project Area. There are EPA Priority Wetlands, Wild and Scenic Rivers, Navigable Waters, and Outstanding Natural Resource Waters within the Study Area.	State and Federal permits will be required for impacts to jurisdictional waters. Additional stormwater BMPs are likely. There are likely significant constraints and permitting timelines due to the myriad of special features within the Study Area.
Sensitive Biological Resources	NJDEP information will be updated once New Jersey natural heritage data has been received. Nine species were identified by the IPaC: American chaffseed, northern long-eared bat (NLEB), Eastern Black Rail, Piping Plover, Rufa Red Knot, seabeach amaranth, swamp pink, Knieskern's beaked-rush, and monarch butterfly. Likelihood of occurrence within the Project Area are as follows: **High:** NLEB, Bald Eagle, swamp pink, monarch butterfly. Candidate species are not currently afforded any statutory protections. **Moderate to High:** Knieskern's beaked-rush **Moderate:** Piping Plover, Rufa Red Knot, Eastern Black Rail, seabeach amaranth.	Tree clearing should be avoided; if necessary, restrict to the northern long-eared bat inactive season (November 1 – March 31), or at a minimum outside of the pup-rearing season (June 1 – July 31). Bald Eagle nest surveys are recommended. If present, all in-use (active) eagle nests require at least a 660' no-construction buffer. Alternate (inactive) nests may also require a buffer Rare plant species surveys could be required.

	Low: American chaffseed	
Archaeological and Historic Resources	Twenty-one archaeological sites may intersect the Project Area (1 is NRHP eligible). One site may be adjacent to the Project. Five historic districts, of which 4 are NRHP eligible, intersect the Project. Most of the historic resources that intersect or are adjacent to the Project are elements in historic districts. Four resources intersect the Project, although the two NRHP eligible properties are demolished.	Consultant recommends avoiding archaeological sites and historic districts.
Public Lands	29 parcels of public and conservation lands lie within a 0.25-mile buffer of the Project Area. These include 6 township or county parks, Atlantic City and Brigantine Public Beaches, Leeds Avenue School, Strawberry Field Aviation Facility, four New Jersey State Wildlife Management Areas (Great Egg Harbor, Absecon, Makepeace Lake, and Winslow), three Conservation Focal Areas (CFAs), and 11 conservation or agricultural easements. The Project is located in the Mid-Atlantic Coastal Waters Area managed by NOAA.	Public lands and conservation areas may have specific permits and/or land use restrictions. Project will need to confirm any restrictions/setbacks during design process to avoid and/or implement controls/setbacks as necessary.
Land Cover	The Project Area is mainly comprised of woody wetlands and open water.	None identified.
Zoning and Land Use	The Project Area is located across eight different Townships and Cities in the State of New Jersey. A variety of local permits may be required including: Zoning, Land Use, Site Plan Reviews, Construction, Tree Removal, and roadway permits. An assortment of permits are administered by the State and Federal Government Agencies, see Appendix -Table 17 for further information and discussions.	Consultant recommends additional coordination with regulatory agencies and permitting authorities as the plans for this Project develop.
Infrastructure	The proposed Project crosses numerous major highways, two railroads, two pipelines, numerous substations, and abundant transmission lines.	Avoidance or setbacks from structures may be necessary. Crossing agreements with other utility operators may be required.
Soils	Farmland of unique importance, farmland of statewide importance, not prime farmland, all areas are prime farmland, farmland of statewide importance, if drained, and farmland of local importance all occur within the project area.	None identified.
Environmental Hazards	Several active remediation sites, underground storage tanks, areas of immediate environmental concern, four superfund sites, and groundwater contamination areas were	Avoidance or setbacks from environmental hazards may be necessary.

	found within the quarter-mile buffer of the Project Area.	

Transmission Line Risks

Conceptual Design Summary, Potential Transmission Line Component Constraints, and Risks

- NextEra relied solely upon desktop assessments and local contacts in order to produce the general transmission modification plans.

OSW Connection / Landfall Consideration

- NextEra Proposal #604 does not contain an in-depth discussion of the OSW injection plans or coordination efforts. They provide detailed descriptions of the typical type of effort required to install underground transmission lines, but do not provide details to the specific line being proposed in the Proposal #604 documentation.
- The proposal recommendation is to use HVDC systems at 400/320kV from the Absecon Bay OSW landing site to the proposed Reega converter / switching substation.

#1 – New 230kV OH Line from Reega to New Freedom

- The existing 230kV OH Line Cardiff to New Freedom will be removed and replaced with two (2) single circuit 230kV lines. The first section will be from the new proposed Reega substation to the existing New Freedom substation. The new lines will be built using engineered steel mono poles.

#2 – New 230kV OH Line from Reega to Cardiff

- The existing 230kV OH Line Cardiff to New Freedom will be removed and replaced with two (2) single circuit 230kV lines. The second section will be from the new proposed Reega substation to the existing Cardiff substation. The new line will be built using engineered steel mono poles.

#3 - UG HVDC Line, OSW Landing to Reega Substation

- NextEra has proposed an underground 320kV/400kV route to bring the OSW from the shore at Absecon Bay to the new proposed Reega converter / switching substation.

- The line will traverse approximately 10.23 miles along mostly urban developed land. All major crossings are to be HDD, witch significant open trench construction the remainder of the route. The design discussion was lacking in specifics with regard to the number of manholes, pulling procedure and permitting consideration.

Substation Risks

Reega Substation

- The proposed Reega Substation seems feasible as long as the station amperage is a maximum of 4000A or less. For any higher ratings, procurement of equipment could prove to be more complex and a truly custom design may be needed.

New Freedom 230 kV Substation Upgrades

- Several upgrades are proposed at the New Freedom 230kV Substation.
- Adding a line position should only pose minimal risk with proper construction techniques. A portion of existing bus will have to be removed, and new equipment – including an A frame structure - will have to be brought in carefully, as to not damage any existing equipment. Site and civil work will again have to be done as to not adversely affect existing equipment.
- A new phase shifting transformer is to be added to the yard. This may require a small portion of the yard to have to be expanded depending on the size of the transformer. If expansion is required, there may be an existing 230kV transmission tower that will have to be moved. This expansion would also affect the access road, which could have an impact on transporting materials and equipment to the site.

Cardiff Substation Upgrades

- Several upgrades are proposed at the Cardiff 230kV Substation.
- Adding a line position should only pose minimal risk with proper construction techniques as long as the station does not have to be expanded. There is a small portion of fence or sliding gate that comes close to the existing buswork. This portion of fence would most likely have to be reconfigured to accommodate the construction of new equipment. A portion of existing bus will have to be removed, and new equipment will have to be brought in carefully, as to not damage any existing equipment. Site and civil work will again have to be done as to not adversely affect existing equipment.
- Adding a phase shifting transformer in series with the 230kV line going to Cedar seems to be a difficult task at this station. The area where this would most likely be installed has a control building, cable trench, storage building and SVC equipment nearby. In order to facilitate construction in this area, careful planning would be needed in order to not impact any of this equipment. Installation in another location within the existing station would require the design of complex buswork. At this time, it is unable to be determined if a phase shifting transformer would be able to be placed in the yard, having only Google Earth as a reference.
- The replacement of two of the transformers with units of higher ratings may prove to be a difficult task, but it seems feasible as long as proper construction techniques are used. Civil work must be planned as to have a minimal impact on other existing equipment. In particular, accessing the affected area of the station with a delivery vehicle and having a proper plan for the crane operation will be paramount in this instance. However, if the proposed new transformers have a larger footprint than the ones currently in service, electrical clearances may be violated, and a more extensive redesign of the station may have to be done.

Construction Schedule

- The conceptual project schedule developed by the onshore consultant indicates that the on-shore aspects of the project will take approximately 36 months to complete, from Project initiation to energization. It is assumed that the engineering process can continue as siting permit is reviewed. There are four major activities on the critical path: Engineering; Siting and major permit acquisition; long lead equipment procurement; construction and commissioning. Delays in completing any of these activities would jeopardize completing the Project within the estimated schedule.
- Schedule risks due to significant delay and approval risks in obtaining Green Acres easements required for the landing parcel, as well as Pinelands Commission permits for the Converter Station Site and the Cardiff-New Freedom upgrade.

Offshore Constructability Review

Proposals 15, 250, 604, and 359

Environmental (Regulatory) Analysis

Overview

NEETMH has proposed several HVDC-based transmission systems connecting to three different POIs (Oceanview, Deans, Cardiff) to achieve various levels of offshore wind generation connectivity. These systems use several identified submarine cable corridors which could require ROW widths of 800-1,000 feet depending on the number of cable systems.

Having multiple circuits in the same ROW and using the same landfall, while providing benefits of having a single construction program and minimizing community impact for installation of multiple facilities, could have a tradeoff of increasing the risk of possible simultaneous outages of significant offshore wind generation, up to 6,000 MW. This is due to the proposed construction method of having a single trench for all HVDC cables. For the proposal targeting a point of interconnection at Deans, routing the numerous sets of submarine cables through the approaches to into Raritan Bay may subject the projects to greater routing and schedule risk due to higher concentrations of marine traffic and numerous subsurface facilities and obstructions.

Routing

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

Routing evaluation (Submarine Portion):

- Converter platforms are proposed at specific locations in the Hudson South lease area.
- Approximately 45.4 miles of common route using 2 sets of cables with seabed disturbance from landfall to divergence point.
- Additional 11.1 mi from divergence location to Platform A (56.5 total mi)
- Additional 16.7mi from divergence location to Platform C (62.1 total mi)
- 114.5 total HVDC cable miles (pair of 2000mm^2 ±400 kV cables)
- Construction assumes 165ft / 50m cable separation and Burial depth of 4 feet.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

Routing evaluation (Submarine Portion):

- Converter platforms are proposed at specific locations in the Hudson South lease area.
- Approximately 55.5 miles of common route using 4 sets of cables with seabed disturbance from landfall to divergence point.
- Additional 26.9mi from divergence location to Platform A (82.4 total mi) -15.75 mi common to B, and an additional 32.4mi from divergence location to Platform B (87.9 total mi)
- Additional 45.6mi from divergence location to Platform C (101.1 total mi) - also common to D, and an additional 45.6mi from divergence location to Platform D (101.1 total mi)
- There are 372.5 total HVDC submarine cable miles (set of ±400 kV cables)
- Construction assumes 165ft / 50m cable separation and Burial depth of 4 feet.

Proposal 604 (2-C27) – Cardiff 230kV 2700MW

Routing evaluation (Submarine Portion):

- The proposal's HVDC platforms are an alternate to the Atlantic Shores / Ocean Wind project and proposes converter platforms in the Atlantic Shores / Ocean Wind lease areas.
- Approximately 12.3 miles of cable ROW use a common route for (2) sets of cables with seabed disturbance from landfall to divergence point.
- Additional 11.4mi from divergence location to Platform E (23.6 total mi)
- Additional 13.4mi from divergence location to Platform F (25.7 total mi)
- 49.4 total HVDC submarine cable miles (set of ±400 kV cables)
- Construction assumes 165ft / 50m cable separation and Burial depth of 4 feet.

Proposal 359 (3-PC) – Platform Connections

Project Component	Length (Mi.)
Platform A – Platform B	10.2
Platform A – Platform C	28.8

Platform C – Platform D	0.01
Platform E – Platform F	18.0

- The proposed cable is 2,000 mm^2 AC 230 kV AC
- The cable termination is included in the platform designs and associated equipment is included in platform costs and not the bid cost for the platform connectors.
- Cable assumes the NEETMH (NEETMH) is awarded other Option 2 platform projects. The chosen voltage for the cable is unique compared to bids from other entities which could prevent compatibility with "other entity" platforms unless those entities modified their proposed designs.
- NEETMH states it has performed a detailed routing analysis to minimize the impacts. Conflicts that require mitigation were identified.

Landfall

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

- NEETMH provided generic elevation and plan views for typical design and construction (attachment 6 Cross Section)
- Only typical construction practices were mentioned in the proposal, actual landing construction will be determined after detailed surveying and design.
- No crossing or underground utility conflicts are mentioned at landing
- There is uncertainty on whether landfall will be made via HDD, bore, or open cut to bring the subsea cable to shore.
- The landing vaults plan to be on Asbury Ave at Ocean Ave at Asbury Park beach which will interrupt local traffic at Asbury Park beach and the local businesses.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

- NEETMH provided generic elevation and plan views for typical design and construction (attachment 6 Cross Section)
- Only typical construction practices were mentioned in the proposal, actual landing construction will be determined after detailed surveying and design.
- No crossing or underground utility conflicts are mentioned at the landing site.
- There is uncertainty on whether landfall will be made via HDD, bore, or open cut to bring the subsea cable to shore.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

- NEETMH provided generic elevation and plan views for typical design and construction (attachment 6 Cross Section).
- Only typical construction practices were mentioned in the proposal, actual landing construction will be determined after detailed surveying and design.
- No crossing or underground utility conflicts are mentioned at the landing site.
- Plan for HDD at crossing under US 30 Roadway at landing with transition vaults located further west from actual landing site.
- NEETMH has partial site control (see site control plan) for landing site of HDD, however some land is public which will require approval.

Facility Conflicts

- The proposals all include a project specific crossing plan.
- The crossings and facility conflicts were identified with a general approach to address or mitigate various conflicts and crossings as well as a risk matrix identifying potential impacts to the project schedule.
- The ocean based conflicts did not reference NOAA nautical charts or other overlays which may provide details on potential known conflicts, but the proposals did reference ocean traffic maps.

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

Submarine:

- Proposal includes a general description of crossing mitigation techniques in Section 1.2 of the crossing plan.
- NEETMH identified (21) cable matting locations for submarine cable conflicts from landfall to offshore platform.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

Submarine:

- General description of crossing mitigation techniques in Section 1.2 of crossing plan and all crossings / conflict locations were provided in the attached .kmz file.
- Provided (32) cable matting locations for submarine cable conflicts from landfall to offshore platform.
- (2) locations cross the Neptune Regional Transmission system
- (3) locations cross Transco Pipeline
- Proposed submarine route in Raritan Bay is generally congested and subject to high probability of unknown conflicts that may surface during detailed routing and/or installation.

Overall, the route for proposal 250 (2-D60) introduces high risk of conflicts, complexity, and requires a higher occurrence of mitigations resulting in a high probability of potential schedule slip.

Proposal 359 (3-PC) – Platform Connections

Submarine:

- General description of crossing mitigation techniques in Section 1.2 of crossing plan and all crossings / conflict locations were provided in the attached .kmz file.
- (3) matting locations for submarine cable crossing between Platform A-B
- (6) matting locations for submarine cable crossing between Platform A-C

Overall, the risk profile of the platform connectors is low due to the low potential subsea conflicts.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

Submarine:

- General description of crossing mitigation techniques in Section 1.2 of crossing plan and all crossings / conflict locations were provided in the attached .kmz file.
- Provided (4) cable matting locations for conflicts from landfall to offshore platform (includes 1 pipeline and other submarine cables)

Environmental Risk

Note: NEETMH provided a single plan document which is generally common across all proposals which includes specific factors representative of all projects or only certain projects.

- Comprehensive assessment of construction methods, routing, siting, electric and magnetic fields
- Comprehensive assessments of geological resources, biological resources, cultural resources, and socioeconomic resources
- Section 7 of BPU Supplemental provides Potential Environmental Impacts to Construction, Operations and Maintenance or Decommissioning of each project
  - Table 7.1-1 Matrix demonstrates project specific unmitigated impacts with risk definition
  - Table 7.1-2 Matrix for 604 (2-C27) demonstrates project specific unmitigated impacts to expanded New Freedom – Cardiff Route
  - Fisheries Protection Plan provided in Section 7.3 or Attachment 21

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

- NEETMH suggests Raritan Bay and the marine areas of northern New Jersey are constrained by deep draft navigation channels associated with New York/New Jersey harbors; navigation channels, danger zones, and anchorage areas in Raritan Bay; existing cables, pipelines and electrical transmission lines; commercial and recreational fisheries; shellfish; borrow areas; ocean disposal areas; and prime fishing areas. Navigation- more cables over time, repeated temporal impacts, more area with cable to be avoided. Not utilizing the constrained areas effectively risks limiting the opportunity to reach interconnection points efficiently, which potentially limits offshore wind development in New Jersey.
- The proposed Oceanview projects would allow multiple developers to utilize the transmission, which would reduce environmental impacts, risks associated with transmission development and would promote efficient offshore wind development.
- Moderate risk of offshore facilities with Fisheries which may require potential avoidance, minimization, and mitigation measures.
- Moderate risk of Landfall / Onshore cable land use and Zoning which may require potential avoidance, minimization, and mitigation measures.
- Moderate risk of Marine Archeology for offshore cable which may require potential avoidance, minimization, and mitigation measures.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

- NEETMH suggests Raritan Bay and the marine areas off northern New Jersey are constrained by deep draft navigation channels associated with New York/New Jersey harbors; navigation channels, danger zones, and anchorage areas in Raritan Bay; existing cables, pipelines and electrical transmission lines; commercial and recreational fisheries; shellfish; borrow areas; ocean disposal areas; and prime fishing areas. Navigation- more cables over time, repeated temporal impacts, more area with cable to be avoided. Not utilizing the constrained areas effectively risks limiting the opportunity to reach interconnection points efficiently, which potentially limits offshore wind development in New Jersey.
- The proposed Deans projects would allow multiple developers to utilize the transmission, which would reduce environmental impacts, risks associated with transmission development and would promote efficient offshore wind development.
- There is moderate risk resulting from offshore facilities with Fisheries which may require potential avoidance, minimization, and mitigation measures.
- There is moderate risk resulting from Landfall / Onshore cable land use and Zoning which may require potential avoidance, minimization, and mitigation measures.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

- NEETMH suggests the most recent award to Ocean Wind 2 and Atlantic Shores exemplifies the challenges offshore wind developers must deal with through the interconnection process. If the two developers were to connect to the same point, they may develop and permit two different routes to get to the same point. However, when permitting and routing of both lines resides with a single entity, a coordinated approach to installation means fewer beach landings are required, fewer marine impacts can be achieved, and community impacts are minimized by utilizing a common duct bank for the installation of multiple terrestrial cables constructed in a single campaign.
- NEETMH suggests fewer total cable miles and fewer construction events would reduce impacts to commercial and recreational fisheries, as well as potential impacts to sensitive resources such as wetlands, SAV, shellfish beds, and nesting beaches. Fewer cable miles would result in reduced impacts to the marine environment and potentially submarine cultural resources from cable burial.
- In southern New Jersey the Carl N Shuster Horseshoe Crab Reserve, federal and state sand borrow areas, back bays with sensitive wetlands and submerged aquatic vegetation, prime fishing areas, marine protected areas, and recreational vessel traffic and fishing constrain transmission siting near shore. NEETMH suggests the Cardiff projects would allow multiple developers to utilize fewer transmission lines and platforms, which would reduce environmental impacts, impacts to coastal communities, risks associated with transmission development and would promote efficient offshore wind development. This represents careful and responsible development as requested by New Jersey stakeholders.
- All risk factors appear to be low to moderate environmental risk.

Proposal 359 (3-PC) – Platform Connections

- NEETMH suggests NEETMH's proposal offers the optionality to add cables between platforms and to provide redundancy between platforms. This partial redundancy approach does not require additional lines to shore and optimizes what will already be installed by fully utilizing NEETMH's proposals and bypassing any need to increase the number of cables to shore, thereby minimizing environmental impacts.
- Proposal does not offer ways of reducing the total offshore wind target or ways of limiting cable landfalls to meet such target, but instead offers redundancy for outages across the portfolio of wind that may otherwise require additional redundant radial cables to meet the objective.
- No other risk matrix provided.

Permitting Plan

Note: NEETMH's 'Attachment 20: Permitting Plan' - common document across all proposals with separate Appendix I Matrix for each project.

All Proposals (015, 250, 604, 359)

- Permit matrix provided to identify risk and to develop the schedule for permits
- NEETMH appeared to identify all known permits and approvals in Appendix I of each proposal
- Appendix II provides the same permitting timeline for all projects. All permits are shown to demonstrate the timeline for individual permits.
- Attachment 11 Schedule for each project provides detail of the permitting timeline for each respective project
- NEETMH provided agency consultation details for each project in Section 1.5. Other local / municipal consultation details are provided in Attachment 12.
- NEETMH suggests Federal permits are targeted for end of 2025, near the same time the lease for use of state land would be received. All other permits expected to fall within 2025 or earlier.

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

- Land-based HVDC converter station requires use of 33 acre parcel (Neptune Station)
- Site is a regulated riparian zone associated with Hollow Brook which will require DEP approval.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

- Land-based HVDC converter station requires use of 110 acre Pigeon Swamp State Park.
- State Lands Acquisition required. Risk in receiving timely NJDEP Process and State House Approval.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

- Land-based HVDC converter station and Cardiff – New Freedom upgrades will require Pinelands Commission approval. There is risk in receiving timely approval from Pinelands commission. Selected parcels provided minimized clearing.
- USACE coordination is necessary since the route is within the buffer area of borrow area which will require deeper HDD burial which adds complexity/risk to the landing approach.

Outreach Plan

All proposals (15, 250, 359, 604)

Note: NEETMH's 'Attachment 12 – Outreach Plan' includes common community outreach plan along with listed groups and stakeholders for all proposals

- Developed Fact Sheet and FAQs for projects.
- Provided list of all consultations for each proposal of various agencies up to the date of submittal
  - Includes the 3 counties and some municipals involved in each of the proposals
- For Proposal 604, provided consultation with Pinelands Commission and identified timeline and process for approvals.
- Environmental and Fisheries Stakeholder Outreach Plan
  - NEETMH identified fisheries with history of operation in the Project area.
  - The identified contacts from those fisheries will serve as liaisons.
  - Established plan for stakeholder workshops and meetings to review all aspects of project (routing & siting)

Technology and Supply Chain Risks

This section offers an assessment of risks that may be apparent in the overall system, the technology being proposed, specific risks that may be inherent in specific equipment, and risks posed by supply chain considerations.

Technology Risk

The overall system proposed and described by NEETMH in these proposals, for the most part, contain power system concepts, equipment, and components as well as their general installation and construction methods that are fundamentally proven and fully understood over many years of successful operation in somewhat similar circumstances. However, application of these specific components to an installation on offshore platforms with exposure to the harsh environment that surrounds any salt water marine environment has not been commonly installed and operated using the voltage class and scale / magnitude being proposed. While there are similar examples in Europe that resemble the proposed installation design concepts, the primary risk associated with the overall system is associated with the construction and operation the offshore portions of the systems, and in particular, the platform-based HVDC voltage source converters (VSC) and associated transformers, switchgear, and other auxiliary components. NEETMH proposes to use Siemens as their OEM provider for the HVDC system which utilizes voltage source converter (VSC) technology with symmetrical monopole configuration of one +400 kV cable paired with one -400 kV in each set. For all intents and purposes, each voltage source converter may be called simply "converter" or "HVDC converter" throughout this report, whether they are installed at a substation on land or on a platform in the ocean. Likewise, each HVDC cable pair will include both positive and negative 400 kV cable which are always installed together in the same trench, duct, or manhole.

Overall System

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

- The interconnection system proposes upgrade of Atlantic 230 kV substation & Smithburg 230 kV substation, the greenfield installation of the Neptune 230kV GIS switchyard and HVDC VSC converter station, installation of ~120.5 total miles of +/- 400 kV HVDC cables and installation of (2) offshore HVDC converter platform stations which will receive Offshore wind power on feeders operating at 66 kV.

- 400 kV submarine cable system and offshore HVDC platforms are relatively new technology. HVDC converters operating up to 1500 MW at this voltage class will likely have a long lead time which is high risk to the general constructability and schedule.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

- The interconnection system proposes upgrade of Deans 500 kV substation the greenfield installation of Fresh Pond 500 kV AIS switchyard and HVDC VSC converter station, the installation of ~432.5 total miles of ±400 kV HVDC cables and the installation of (4) offshore HVDC converter platform stations which will receive Offshore wind power on feeders operating at 66 kV.

- ±400 kV submarine cable system and offshore HVDC platforms are relatively new technology. HVDC converters operating up to 1500 MW at this voltage class will likely have a long lead time which is high risk to the general constructability and schedule.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

- The interconnection system proposes upgrade of New Freedom 230 kV substation & Cardiff 230 kV AIS switchyard, the greenfield installation of Reega 230 kV AIS switchyard and HVDC voltage source converter (VSC) station, the installation of 80.5 total miles of +/- 400 kV HVDC cables and the installation of (2) offshore HVDC VSC converter platform stations which will receive Offshore wind power on feeders operating at 66 kV.

- ±400 kV submarine cable system and offshore HVDC platforms are relatively new technology. HVDC converters operating 1200 MW and up to 1500 MW at this voltage class will likely have a long lead time which is high risk to the general constructability and schedule.

Proposal 359 (3-PC) – Platform Connections

- The interconnection system proposes installing a total of 57 miles of 230 kV HVAC cable submarine platform connections with lengths as follows:

Project Component	Length (Mi.)
Platform A – Platform B	10.2
Platform A – Platform C	28.8
Platform C – Platform D	0.01
Platform E – Platform F	18.0

- Given the HVAC 230 kV system proposed for the interlinks, there are no technology risks associated with proposal 359.

HVDC System

The HVDC systems for the NEETMH Option 2 proposals are modular multi-level (MMC) voltage source converter (VSC) based systems operating at ±400 kV DC.

VSC HVDC systems using submarine cables have been operating for many years and in general represent minimal technology risk. However, systems operating at ±400 kV are relatively new, and although some are in operation, the total operating experience with systems using this voltage is limited when compared to 320 kV or below. The 400 kV risk is associated both with the submarine cables as well as the HVDC converters themselves.

Also, the representative ±400 kV systems in operation have only achieved the 1,000 MW range. Commercial offerings for the 1,200 and 1,500 MW systems being proposed for the NEETMH projects are still in the development stage. Therefore, the is some added development and schedule risk associated with these larger sized systems, and additional risk consideration should be given to application of this technology in an offshore platform environment. The primary risk is schedule related, namely can these new designs be qualified, designed, constructed, and commissioned within the schedules proposed.

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

Four (4) HVDC converters, two (2) on onshore station and two (2) offshore platform stations. Includes (2) 900 MVA converter transformers per platform (4 total).
Total of ~114.5 miles of 400 kV HVDC submarine cable.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

Eight (8) HVDC converters, four (4) on onshore station and four (4) on offshore station.
Includes (2) 900 MVA converter transformers per platform (4 total).
Total of ~372.5 miles of 400 kV HVDC submarine cable.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

Four (4) HVDC converter, two (2) on onshore station and two (2) on offshore station with no details of equipment
Total of ~49.4 miles of 400 kV HVDC submarine cable.

Offshore Platform

The main risks associated with the offshore platforms is essentially the same for all proposals in the SAA solicitations, and it relates mainly to available facilities to build the platforms, production capabilities of those facilities, and availability and pricing of materials such as steel.

Further scheduling risk is introduced by the need for specialized equipment to install the platforms such as a semi-submersible crane vessel (SSCV), of which there are only a handful available globally. The availability of these SSCVs may be challenging due to global offshore wind construction activity expected at the time of installation. For this reason, vessels need to be booked early to ensure timely installation.

Platform Equipment for Each Platform (Proposals 15, 250, and 604)

- 66kV switchgear with 18 feeder positions (1200 MW) and 22 feeder positions (1500 MW)
- 230kV interlink termination (50KA, 4000A Breaker)
- Converter GIS breakers (550kV AC, 4000A 63 kA)
- DC GIS 550kV DC 5000A 50 kA
- 3ph / 3winding 1500 MW or 1200 MW converter transformer
- 230kV transformer for platform connectors – 420 kV 800 MVA
- Shunt compensation – 245kV (MVar range from 62.2 – 175.6 depending on connector)
- Single line diagram indicates the equipment used and general concept of the offshore platform. However, description of equipment is representative.

Submarine Cable

Proposal 015 (2-O30) – Oceanview 230kV 3000MW

- 114.5 total HVDC cable miles (pair of 2000mm^2 ±400 kV cables)
- 165ft / 50m cable separation with 4ft seabed depth
- 400 kV DC cable systems to connect the HVDC converter terminals. 400 kV submarine cable system are relatively new technology.
    - 400 kV HVDC VSC systems utilizing 6,000kcmil and 2,000mm^2 ±400 kV cables and operating up to 1,500 MW at this voltage class will likely have a long lead time which is high risk to the general constructability and schedule.

Proposal 250 (2-D60) – Deans 500kV 6000MW

- 372.5 total HVDC cable miles (pair of 2000mm^2 ±400 kV cables) to platforms in the Hudson South lease space.
- 165ft / 50m cable separation with 4ft seabed depth
- Uses 400 kV DC cable systems to connect the HVDC converter terminals.
    - 400 kV submarine cable system are relatively new technology. 400 kV HVDC VSC systems utilizing 6,000kcmil and 2,000mm^2 ±400 kV cables and operating up to 1,500 MW at this voltage class will likely have a long lead time which is high risk to the general constructability and schedule.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

- 49.4 total HVDC submarine cable miles (pair of 2,000mm^2 ±400 kV cables) to the platforms in the Atlantic Shores / Ocean Wind lease areas.
- 165ft / 50m cable separation with 4ft seabed depth
- Uses 400 kV DC cable systems to connect the HVDC converter terminals. 400 kV submarine cable system are relatively new technology.
    - 400 kV HVDC VSC systems utilizing 6,000kcmil and 2,000mm^2 ±400 kV cables and operating up to 1,500 MW at this voltage class will likely have a long lead time which is high risk to the general constructability and schedule.

Proposal 359 (3-PC) – Platform Connections

Project Component	Length (Mi.)
Platform A – Platform B	10.2
Platform A – Platform C	28.8
Platform C – Platform D	0.01
Platform E – Platform F	18.0

- Cable is 2,000 mm^2 AC 230 kV AC
- 165ft / 50m cable separation with 4ft seabed depth
- Connector link cable terminations are included in the Option 2 platform costs.
- The proposal assumes own entity (NEETMH) project platform locations. The chosen voltage for the cable is unique compared to bids from other entities which could prevent compatibility with "other entity" platforms unless those entities modified their proposed designs.

Project Complexity

The relative complexity of the NEETMH Option 2 projects is similar to most of the other proposals involving HVDC links between offshore platforms and landfalls using submarine cables. Most of the offshore complexity resides in the construction and installation of offshore platform jackets and topsides as well as installation and commissioning of HVDC converters, converter transformers, AC switchgear, and auxiliary power and control equipment on the topside. Although construction of this technology is well established on land, design, installation, and maintenance in an offshore environment is relatively new. Most existing experience in this area lies in recent offshore wind projects in Europe.

Incremental risks among the NEETMH projects associated with project complexity can be found in the project with landfall in Raritan Bay (the Deans 6,000 MW project). This is mainly installation and schedule risks due to the issues of marine traffic, underwater obstructions, and conflicting submarine facilities inherent in a busier and historically active waterway. These issues may require alternations in proposed schedules to accommodate seasonal or commercial issues that may arise. Additionally, it is uncertain if a single trench method can accommodate the mutual heating that four pairs of HVDC cables will introduce in the terrestrial cable installations. It appears there was no alternative discussion or consideration given for potentially using 2 installed trenches with 2 cable pairs in separate manhole and ducts on opposite sides of the roadway to allow higher heat dissipation and greater flexibility in maintenance and operation while also preventing a single point of failure. This is a common best practice among utilities serving large magnitudes of loads through dense urban environments to prevent common modes of failure.

Further installation and operational complexity will be introduced should the Option 3 project be incorporated into these Option 2 projects. This is due to the operational switching that needs to occur on the platforms to allow the normally open cable to be used in the event of contingencies or maintenance.

Supply Chain Risk

There are only 2-3 major suppliers of HVDC equipment of the voltage and power ratings specified in these proposals. As such, the ability of a single supplier to build and install converter stations and test/commission the HVDC systems can quickly become a critical schedule issue. Contributing to this situation may be other HVDC projects that are active worldwide.

Offshore and submarine cable VSC HVDC systems operating at 1500MW and 400kV voltage levels are relatively new. Typically, 400 kV systems in operation are limited to systems in the 1,000 MW range and have not been used on an offshore platform. Commercial offerings for the 1,200 and 1,500 MW systems being proposed for the NEETMH projects are still in the development stage. Therefore, there is some added supply chain risk in scheduled procurement and consideration should be given to application of this technology in an offshore platform environment.

For the HVDC cable, Oceanview 3000MW (proposal 015) and Cardiff 2700MW (proposal 604) involve between 50 and 115 miles of HVDC cable, and 2 offshore converter platforms each to be installed in parallel. For Deans 6000 MW (proposal 250), over 370 miles of submarine cable and 4 1500MW converter platforms are proposed. In these proposals, NEETMH's did not account for any supply chain issues procuring equipment. It is predicted that NEETMH would encounter high risk of procuring all the specialized equipment and cable necessary to meet the proposed in service date. Additional projects utilizing HVDC technology being awarded in either New Jersey or the broader global market would likely extend the overall schedule due to risks associated with limited HVDC supplier options and availability of specialized equipment for transport and installation of platforms and submarined cables.

Long Lead Time Items

Proposing entity did not provide any details on long lead time equipment other than an expected procurement schedule.
Assumes HVDC converter equipment (including converter transformers) can be procured within 1 to 1.5 years in schedule. This timeline is not adjusted for procurement and installation of multiple converters from the same OEM Use of specialized vessel equipment is mentioned but not explicitly called out as a risk or a schedule adjustment to account for limited installation equipment necessary to install numerous converters.
HVDC cables are assumed to be available, although Proposal 250 (2-D60) – Deans 500kV 6,000 MW includes over 372 mi of 400kV HVDC cable.

Supplier Scarcity

The transmission-class voltages proposed for HVDC includes ±400 kV DC and 230 kV AC. There is a limited number of global suppliers of cables in the 400 kV class 6,000kcmil copper and 2,000mm^2 ±400 kV HVDC and 230 kV HVAC submarine cables. While proposals 015 (2-O30) and 604 (2-C27) include shorter distances and less quantify of overall HVDC cable given they have fewer total HVDC systems, Proposal 250 (2-D60) also includes a longer land and submarine ROW causing a total procurement of over 432 miles of cable sets, or 864 total miles of individual HVDC cable. Combine this with what may be a simultaneous need for other HVDC or HVAC cable installations using 275kV or 66 kV submarine cables for offshore wind collection systems and there may become supply chain challenges in obtaining the amount of cable available to support a host of projects which are slated to occur in the same general timeframe. Adding other global projects to the mix and the issue may become even more critical.

While a letter of support was provided by the chosen OEMs (Siemens) for HVDC VSC systems and Prysmian for the cable, those letters of support generalize the equipment and support and did not provide context or detailed availability of a design components to achieve 1,500 MW at ±400 kV and the fact that numerous systems could be procured and installed within the quoted schedule.

Construction Schedule Risk

The three NEETMH Option 2 proposals consisting of HVDC systems targeted to POIs at Oceanview and Cardiff having the same relative schedules with a total duration of approximately 5-6 years culminating in a Commercial Operation Date (COD) of June 2028 and June 2029 for the POI at Deans.

Permitting

The total duration for permitting activity is approximately 3 years which includes a 4-year process for offshore related federal permits including coordination. Based on the detail provided in the proposals, a good level of understanding exists for the permits and processes involved which is evident in the detailed project schedule with a section dedicated to a permitting breakdown. Permitting activity for all the Option 2 proposals is assumed to be similar in the permitting plan with the exception of any timelines for certain permits, hence the relative risks between projects is dependent on those differentiating factors.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

The total duration for the Pinelands Commission permitting activity is approximately 1 year. NEETMH did identity this as risk factor in their project risk matrix and allowable schedule slip to maintain overall schedule is captured.

Construction

The construction portion of the proposal schedules ranges between approximately 4 years for the HVDC offshore platforms, up to 2.5 years for onshore transmission, and 0.5 - 2 years for the offshore transmission cables depending on the project. It should be noted that the schedule durations will likely vary and be extended should multiple NEETMH proposals be chosen or Proposal 250 which includes 6,000 MW at Deans are chosen. This is due to the availability of specialized installation equipment and seasonal limitations often imposed on submarine cable installation time windows which would make numerous projects or those with longer cable installations a higher risk of schedule slip.

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

The construction portion of the proposal is approximately 4.5 years in total for the HVDC offshore platforms. Most of the construct activity cannot begin until permits are received while the offshore converter stations are driven also by the procurement of HVDC equipment. The proposal assumes the OEM can manufacture the HVDC equipment within a 1.5 year time (4 total converters). This is expected to be optimistic considering the lead time on transformers is over 2 years and additional engineering time is likely needed for a 400kV 1,500 MW HVDC System.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

The construction portion of the proposal is approximately 5.5 years in total for the HVDC offshore platforms. Most of the construct activity cannot begin until permits are received while the offshore converter stations are driven also by the procurement of HVDC equipment. The proposal assumes the OEM can manufacture the HVDC equipment within a 1.5 year time for all the necessary systems (8 total converters). This is expected to be optimistic considering the lead time on transformers is over 2 years and additional engineering time is likely needed for a ±400kV 1,500 MW HVDC System. In addition, there is no consideration for the additional time allotted for the added complexity and potential schedule conflicts that are likely to arise from availability of vessels and installation equipment to install the 4 HVDC offshore platforms which are assumed be constructed in parallel. For these reasons, the procurement and construction schedule risk of this project is substantially higher than other projects.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

The construction portion of the proposal is approximately 4.5 years in total for the HVDC offshore platforms. Most of the construct activity cannot begin until permits are received while the offshore converter stations are driven also by the procurement of HVDC equipment. The proposal assumes the OEM can manufacture the HVDC equipment within a 1.5 year time for all necessary equipment (4 total converters). This is expected to be optimistic considering the lead time on transformers is over 2 years and additional engineering time is likely needed for a ±400kV 1,500 MW HVDC System.

Proposal 359 (3-PC) – Platform Connections

The critical path of the platform connectors is the scheduled completion for the relative Option 2 projects since the cable cannot be terminated and tested until the platforms and all associated equipment is operational.

Outage Planning

Outage planning schedule risk will relate mainly to construction for onshore facilities, and in particular those facilities being integrated into existing POI substations. These outages will drive the ability to connect and energize the offshore systems and perform commissioning activities.

Other Overall Schedule Risk

As mentioned above, perhaps the largest overall schedule risk is related to the supply chain limits for HVDC converters and submarine cables, and the need for specialized equipment for installation of submarine cables and offshore platforms. This will be especially impactful should multiple projects be chosen for installation during the same time period. Further exacerbating this risk will be construction of offshore generating facilities which will place similar demands on the same universe of manufacturers and constructors.

O&M Risk

Once installed and upon operation the various systems and components of NEETMH's transmission systems will be subject to risk of failure. Some of this risk is determined by the configuration of each system and its exposure to failure, while other types of operational risk is determined by the ability of the various facilities to be brought back to service quickly.

Route Diversity

The NEETMH projects seek to follow a concept to route multiple transmission circuits along a single underwater ROW which can vary in width from 200-1,000 feet depending on the number of circuits. Use of common ROWs to co-locate facilities whether on land or underwater have advantages in limiting impacts to the surrounding area by confining these impacts to the corridors themselves.

However, one disadvantage is that having multiple lines in a common corridor can expose those lines to the possibility of a simultaneous event which can outage those facilities. This exposure may be even more acute in the situation of an underwater corridor where events like anchor drags can occur for hundreds of feet and potentially impact multiple circuits. That said, the risk of such an event can be mitigated by regularly verifying cable burial depth as well as other operational measures such as monitoring shipping traffic along cable routes.

The NEETMH proposals have multiple HVDC corridors proposed, and if multiple proposals are accepted the routing of the transmission links can potentially be optimized to minimize this risk.

Also, it should be noted that all landfalls may, depending on the number of projects selected, result in multiple circuits making landfall at the same location. This is particularly pronounced at the Deans landfall in Keyport, NJ, where up to 4 HVDC circuits (pairs) could pass through this landfall area. The cables approaching the landfalls will converge until they enter the HDD bores. This can add risk for multiple submarine cable outages in this area from an event like and anchor drag.

Proposal 015 (2-O30) – Oceanview 230kV 3,000MW

- Option 2 proposal suggests 2 parallel 1,500 MW HVDC systems in a common construction program in a single UG / Submarine ROW. While there are benefits and efficiencies to limiting the impact from the construction of such facilities, single point of failures exist for approximately 3 miles from the converter station to landfall as well as coastal ROW.
- In the ocean ROW, the NEETMH uses 165ft cable separation at an average 4 foot depth for ~43 miles of common ROW. Unintended equipment / anchor dragging from vessels on the ocean floor or unearthing of the cables which can cause damaging movement and eventual failure can potentially cause an impact to both cables.
- Common contingency of 3,000 MW may exceed PJM single contingency operational limit.

Proposal 250 (2-D60) – Deans 500kV 6,000MW

- Option 2 proposal suggests 4 parallel 1,500 MW HVDC systems in a common construction program in a single terrestrial UG / Submarine ROW. While there are benefits and efficiencies to limiting the impact from the construction of such facilities, single point of failures exist for over 15 miles from the converter station to landfall as well as coastal ROW in Raritan Bay.
- In the ocean ROW, the NEETMH uses 165ft cable separation at an average 4 foot depth for ~55.5 miles of common ROW. Unintended equipment / anchor dragging from vessels on the ocean floor or unearthing of the cables which can cause damaging movement and eventual failure can potentially cause an impact to both cables.
- Common contingency resulting in a loss of 6,000 MW is likely to result in a high risk of operational and/or reliability issues for a PJM single contingency unless proper mitigations or additional separation are considered.

Proposal 604 (2-C27) – Cardiff 230kV 2,700MW

- Option 2 proposal suggests 2 parallel 1,200/1,500 MW HVDC systems in a common construction program in a single terrestrial UG / Submarine ROW. While there are benefits and efficiencies to limiting the impact from the construction of such facilities, single point of failures exist for over 10.3 miles from the converter station to landfall as well as coastal ROW in Absecon Bay.
- In the ocean ROW, the NEETMH uses 165ft cable separation at an average 4 foot depth for ~12.3 miles of common ROW. Unintended equipment / anchor dragging from vessels on the ocean floor, or unearthing of the cables which can cause damaging movement and eventual failure can potentially cause an impact to both cables.
- Common contingency for 2700 MW may exceed PJM single contingency limit for system reliability.

Proposal 359 (3-PC) – Platform Connections

- The Option 3 proposal's 230 kV platform connector cables provide single routes between platforms to interconnect HVDC platforms. This approach can offer an alternative to mitigate some route diversity issues of other projects by rerouting up to 800 MW of capacity after switching.

Redundancy & Operational Flexibility

Each individual HVDC system as a symmetrical monopole system will essentially be a radial transmission link with the N-1 outage of the total system capability being the ruling contingency. Within each system is contained redundancy that can mitigate the risk of a long term equipment failure. For example, the offshore HVDC converters contain two three-phase converter transformers which would allow operation of the system at reduced capability for loss of one of those transformers, typically slightly more than half of the total capability of the system pre-outage. NEETMH proposed to maintain one spare transformer for its projects. Note that this spare unit may provide for spare service to multiple HVDC converters if they are installed together.

The redundancy of each NEETMH project is comparable to the other projects as well as other similarly configured HVDC-based projects in the SAA solicitation.

Proposals 015 (2-O30), 250 (2-D60), 604 (2-C27)

- Each of the Option 2 proposal suggests 2 or 4 parallel HVDC systems in a common construction program in a single terrestrial UG / Submarine ROW. Each HVDC system is a symmetrical monopole which contains numerous single points of failure that do not offer any level of redundancy.
- Each HVDC platform also utilizes 2 AC transformers from the 66kV collection feeders. There is no switching equipment provided that would allow partial HVDC operation with 1 transformer out of service.

Proposal 359 (3-PC) – Platform Connections

- Each of the Option 3 platform connectors (by network design) offers some level of redundancy up to a capacity of 800 MW, but this redundancy is after post contingent or planned switching. This provides partial redundancy for each platform up to 53% of each platform's output if all 4 platform connectors were constructed.

Maintenance and Spare Equipment Strategy

Typically, spares are provided for long lead time equipment in transmission systems similar to those described in the NEETMH proposals.

Proposals 015 (2-O30), 250 (2-D60), 604 (2-C27)

- Each of the Option 2 proposals has a prescribed maintenance plan per Section 1.5 Maintenance described within the Attachment 7 O&M plan. The proposals include up to eight maintenance staff members consisting of P&C engineers, Field operations leads, IT and HV technicians. The Oceanview 3000 MW and Cardiff 2700 MW projects both consist of up to 6 maintenance staff members.
- NEETMH plans to contract the HVDC maintenance, inspection and technical services to the OEM provider for 2 years. Other auxiliary equipment both at the land-based converter and the Offshore platforms will be maintained by the NEETMH staff.
- NEETMH provided a detailed maintenance schedule for both land-based facilities as well as offshore marine facilities which includes the use of a maintenance vessel. See Tables 3-8 of the O&M plan.
- Minor spare equipment for wear and tear parts (power modules, capacitors, filters, gaskets, seals, and lubrication) as recommended by the OEM will be held locally in storage containers. Due to the symmetrical design of the converters and use of the same converter OEM design, there will be a reduced need to maintain high inventory of spare equipment for each converter since it can be shared across converters.
- NEETMH states they will maintain recommended spare parts identified from the OEM's reliability study of its final design for the HVDC.
- NEETMH did not initially provide detail on spare transformers but subsequently stated that "NEETMH included a full dressed converter transformer spare" in their RFI response. Additionally, NEETMH plans to include DC cable spare and repair equipment which would include 3-4 cable sections depending on project.
- NEETMH has a submarine cable monitoring and maintenance plan described in Section 1.5.7 to maintain cable burial protection

Proposal 359 (3-PC) – Platform Connections

- Each of option 3 proposals includes only the 230 kV connector cables that intend to be installed between the Option 2 proposed platform locations proposed by NEETMH in proposals 015 (2-O30), 250 (2-D60), 604 (2-C27). NEETMH intends to maintain enough spare cable sections to make 5 total repairs (assumed to be 750 ft in length).
- NEETMH provided a cut sheet for the proposed cable.
- NEETMH affiliate company (Trans Bay Cable LLC) has experience managing the repair process of HVDC submarine cable monopole system for historical faults resulting from an anchor strike event.

Overall NEETMH's proposed O&M and Spare equipment strategy is sufficient and meets good utility practice.

Cost Review

Proposal 15

Proposal Cost Estimates

The total proposal cost for NEETMH proposal 15 is given below.

Category	Full Project
	$
Engineering & Design	287,313,000
Permitting/ Routing/Siting	22,780,303
ROW/Land Acquisition	9,035,874
Materials and Equipment	933,869,500
Construction & Commissioning	1,306,730,600
Construction Management	143,661,500
Overheads & Misc.	32,002,834
Contingency	287,323,000
Total Component Cost (Current Year)	3,022,726,611

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's Offshore consultant assembled independent cost estimates for the proposed offshore facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the Offshore portion of APT's proposal 210:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	2	$885,000,000	$1,770,000,000
±400 kV Submarine Cable	114	$5,600,000	$638,400,000
Total Offshore			**$2,408,400,000**

PJM's Offshore consultant's review of the Offshore related costs is summarized in this section. A description of the values in each column is as follows:

- Independent Estimate values are costs developed based on cost data from comparable projects and prior estimates, information from equipment suppliers, and engineering judgement
- Average of Proposals Reviewed values are averages for all the proposals consultant was assigned to review.

The basic characteristics for NextEra project 015 are as follows:

- Two 1,500 MW ±400 kV HVDC systems
- Submarine Cable Mileage: 114

	As Proposed	Independent Estimate	Average of Proposals Reviewed
Offshore Converter A	$784,424,269	$885,000,000	$887,319,000
Offshore Converter B	$784,419,409	$885,000,000	$887,319,000
Offshore Converter $/MW	$522,948	$590,000	$591,546
Submarine Cable Total	$578,679,116	$638,400,000	$515,977,680
Submarine Cable $/mi	$5,076,133	$5,600,000	$4,526,120
Total Offshore Portion $/MW	$715,841	$802,800	$763,538

Onshore Component Independent Cost Estimates

As part of this study, PJM's Onshore consultant performed a high-level conceptual cost estimate for the on-shore components of the Project.
The consultant's estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with substation engineering, transmission line engineering, and construction. The total does include a contingency of 30 percent as it is a concept level estimate.

The following is the independent cost estimate for the Onshore portion of NEETMH proposal 15.

Category	Total
Materials and Equipment	$272,685,775
Engineering and Design	$50,291,924

Construction and Commissioning	$258,160,279
Permitting/Routing/Siting	$23,974,228
ROW/Land Acquisition	$8,088,340
Construction Management	$44,674,526
Overheads/Misc./Contingency Cost (30%)	$197,362,522
Total Cost	$855,237,594

Assumptions for Onshore Cost Estimates

Component 3: On-shore Asbury Park Landing – Neptune Converter Station HVDC:

- The submarine cable segment will make landfall via HDDs at the Asbury Park Landing.
- Install approximately 2.3 miles of double circuit HVDC underground cable between the landing and the new Neptune Converter Station.
- The proposed conductor is 6,000 mm^2 copper cable. The two ±400kV HVDC circuits will comprise of two cables each, for a total of four cables.
- A 2.25-foot-wide concrete duct bank will be installed along public road ROW at a minimum of 5.4 feet belowground between the Asbury Park Landing and the new Neptune Converter Station. The installation process will be primarily trench excavation with a vault approximately every 2,000 feet to splice and pull cable. When trenching is not possible or a crossing is required, HDD methods will be utilized.
- Land survey and ROW labor is required. A ROW of up to 30 feet would be sufficient to accommodate the line installation and maintenance along the route.
- Minimal tree clearing will be required. The route is primarily along developed land and road ROW.
- Riser/transition structures included in substation components.

Component 6: Neptune Converter Station:

- The new substation will encompass 10 acres. The land for the new converter station is currently unutilized, assumed available, and land acquisition costs are included in the estimate.
- The new substation will contain the following equipment:
  - Two sets 1500MW HVDC converter halls and equipment
  - 11 230kV GIS Circuit Breakers
  - 22 230kV GIS Breaker Disconnect Switches
  - One Control Building
  - Relaying and metering equipment for five outgoing transmission lines
- The contractor will be performing the testing of major material, relaying installation, and construction labor.

Component 7: Atlantic - Oceanview 230kV line Circuit X:

- Reconductor 4.8 miles from Atlantic Substation to the second structure outside of Oceanview Substation, then build 0.25-mile of new 230kV line into new Neptune Station.
- New conductor will be double-bundle 795 ACSS 26/7.

- Existing shield wire will be utilized along the reconductored section. One new shield wire will be installed on the 0.25-mile of new line.
- The existing structures are in good condition and can be reused.
- No structure removals included in this component.
- New structures will be self-supporting steel monopoles with drilled shaft foundations. Structure costs are split between this component and component 8. Structures include:
  - Two new double circuit deadend (only one circuit on this component).
  - 12 existing double circuit deadend (new hardware and insulators for one circuit on this component).
  - 37 existing double circuit braced post (new hardware and insulators for one circuit on this component).
- The reconductored line will use the existing corridor. Some new ROW will be required to route the line into Neptune Station.
- Minimal clearing will be required.

Component 8: Atlantic - Oceanview 230kV line Circuit Y:

- Reconductor 4.8 miles from Atlantic Substation to the second structure outside of Oceanview Substation, then build 0.25-mile of new 230kV line into new Neptune Station.
- New conductor will be double-bundle 795 ACSS 26/7.
- Existing shield wire will be utilized along the reconductored section. One new shield wire will be installed on the 0.25-mile of new line.
- The existing structures are in good condition and can be reused.
- No structure removals included in this component.
- New structures will be self-supporting steel monopoles with drilled shaft foundations. Structure costs are split between this component and component 7. Structures include:
  - Two new double circuit deadend (only one circuit on this component).
  - 12 existing double circuit deadend (new hardware and insulators for one circuit on this component).
  - 37 existing double circuit braced post (new hardware and insulators for one circuit on this component).
- The reconductored line will use the existing corridor. Some new ROW will be required to route the line into Neptune Station.
- Minimal clearing will be required.

Component 9: Neptune - Oceanview 230kV line Circuit X:

- Build 0.3-mile of new 230kV transmission line from the new Neptune Substation to Oceanview Substation.
- New conductor will be 2156 ACSS/TW “Bluebird”.
- No structure removals included in this component.
- New structures will be self-supporting steel monopoles with drilled shaft foundations. Structure costs are split between this component and component 10. New structures include:
  - Two double circuit deadend
- The rebuilt line will utilize existing ROW.
- Minimal clearing will be required.

Component 10: Neptune - Oceanview 230kV line Circuit Y:

- Build 0.3-mile of new 230kV transmission line from the new Neptune Substation to Oceanview Substation.
- New conductor will be 2156 ACSS/TW “Bluebird”.
- No structure removals included in this component.

- New structures will be self-supporting steel monopoles with drilled shaft foundations. Structure costs are split between this component and component 9. New structures include:
- One double circuit deadend
- The rebuilt line will utilize existing ROW.
- Minimal clearing will be required.

Component 11: Larrabee – Oceanview 230kV line:

- Reconductor 16.6 miles of 230kV line from Larrabee Substation to Oceanview Substation. The circuit being reconductored is the southern/eastern position of the structures.
- The last three spans of the northern circuit outside of Oceanview Substation will be rebuilt into the new Neptune Substation. The southern circuit will continue into Oceanview Substation.
- New conductor will be double-bundle 795 ACSS 26/7.
- Existing shield wire will be utilized along the reconductored section. One new shield wire will be installed on the 0.3-mile of new line into Neptune Substation.
- The existing structures are in good condition and can be reused.
- No structure removals included in this component.
- New structures will be self-supporting steel monopoles with drilled shaft foundations. Structure costs are split between this component and component 8. Structures include:
    - Three new single circuit deadend
    - 24 existing double circuit deadend (new hardware and insulators for two circuits).
    - 105 existing double circuit braced post (new hardware and insulators for two circuits).
- The reconductored line will use the existing corridor.
- Minimal clearing will be required.

Total Independent Cost Estimates

The following is the total independent cost estimate for NEETMH Proposal 15,

Independent Cost Estimate

Proposal 15	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$3,263,637,594	$2,408,400,000	$855,237,594

For comparison, the total proposal cost estimate for NEETMH Proposal 15 is shown below.

Proposal Cost Estimate

Proposal 15	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$3,022,726,611	$2,147,522,794	$875,203,817

Proposal 250

Proposal Cost Estimates

The total proposal cost for NEETMH proposal 250 is given below.

Category	Full Project
	$
Engineering & Design	675,068,000
Permitting/ Routing/Siting	21,385,303
ROW/Land Acquisition	8,925,738
Materials and Equipment	2,070,307,000
Construction & Commissioning	3,205,524,880
Construction Management	337,534,000
Overheads & Misc.	34,722,098
Contingency	675,068,000
Total Component Cost (Current Year)	7,028,535,019

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's Offshore consultant assembled independent cost estimates for the proposed offshore facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the Offshore portion of APT's proposal 210:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	4	$885,000,000	$3,540,000,000
±400 kV Submarine Cable	375	$5,600,000	$2,100,000,000
Total Offshore			**$5,640,000,000**

PJM's Offshore consultant's review of the Offshore related costs is summarized in this section. A description of the values in each column is as follows:

- Independent Estimate values are costs developed based on cost data from comparable projects and prior estimates, information from equipment suppliers, and engineering judgement

- Average of Proposals Reviewed values are averages for all the proposals consultant was assigned to review.

The basic characteristics for NextEra project 250 are as follows:

- Four 1,500 MW ±400 kV HVDC systems
- Submarine Cable Mileage: 375

	As Proposed	Independent Estimate	Average of Proposals Reviewed
Offshore Converter A	$729,653,371	$885,000,000	$887,319,000
Offshore Converter B	$729,643,651	$885,000,000	$887,319,000
Offshore Converter C	$729,643,651	$885,000,000	$887,319,000
Offshore Converter D	$729,643,651	$885,000,000	$887,319,000
Offshore Converter $/MW	$486,430	$590,000	$591,546
Submarine Cable Total	$2,050,455,228	$2,100,000,000	$1,697,295,000
Submarine Cable $/mi	$5,467,880	$5,600,000	$4,526,120
Total Offshore Portion $/MW	$828,172	$940,000	$874,428

Onshore Component Independent Cost Estimates

As part of this study, PJM's Onshore consultant performed a high-level conceptual cost estimate for the on-shore components of the Project.

The consultant's estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with substation engineering, transmission line engineering, and construction. The total does include a contingency of 30 percent as it is a concept level estimate.

The following is the independent cost estimate for the Onshore portion of NEETMH proposal 250.

Category	Total
Materials and Equipment	$663,733,241
Engineering and Design	$83,459,065
Construction and Commissioning	$469,617,176
Permitting/Routing/Siting	$20,232,679
ROW/Land Acquisition	$20,904,250
Construction Management	$77,521,830
Overheads/Misc./Contingency Cost (30%)	$403,990,063

Total Cost	$1,739,458,305

Assumptions for Onshore Cost Estimates

Component 5: Fresh Ponds Converter Station:

- The new substation will encompass 40 acres. The land for the new converter station currently unutilized, assumed available, and land acquisition costs are included in the estimate.
- The new substation will contain the following equipment:
  - Four sets 1500MW converter halls and equipment
  - 12 500kV Circuit Breakers
  - Twenty-four 500kV Breaker Disconnect Switches
  - One Control Building
  - Relaying and metering equipment for four outgoing transmission lines
- The contractor will be performing the testing of major material, relaying installation, and construction labor.

Component 10: Raritan Bay Waterfront Park Landing – Fresh Ponds Converter Station HVDC:

- The submarine cable segment will make landfall via horizontal directional drills (HDDs) at Raritan Bay Waterfront Park Landing in the city of South Amboy.
- Install approximately 15.4 miles of HVDC underground cable between the landing and the new converter station. Four circuits will be installed in a single duct bank.
- The proposed conductor is 6,000 mm^2 copper cable. The four ±400kV HVDC circuits will comprise of two cables each, for a total of eight cables.
- A 4.25-foot-wide concrete duct bank will primarily be installed along public road ROW, at a minimum of 5.4 feet below ground, between the Raritan Bay Waterfront Park Landing and the new Fresh Ponds Converter Station. The installation process will be primarily trench excavation, with a vault approximately every 2,000 feet to splice and pull cable. When trenching is not possible, or a crossing is required, HDD methods will be utilized.
- Land survey and ROW labor is required. A ROW of up to 30 feet would be sufficient to accommodate the line installation and maintenance along the route.
- Minimal tree clearing will be required. The route is primarily along developed land, road ROW, or existing transmission line ROW.
- Riser/transition structures included in substation components.

Component 11: Fresh Ponds – Deans 500kV Line #1:

- Install one new deadend structure along the existing centerline of the Deans – East Windsor 500kV line to loop it into the new Fresh Ponds AC substation, towards Deans.
- Reconductor 2.2 miles from the new Fresh Ponds substation to Deans substation with double-bundle 1590 ACSR 54/19.
- Existing shield wire will be utilized along the reconductored section. One span of new shield wire will be installed into Fresh Ponds substation.
- The existing structures are in good condition and can be reused.
- No structure removals included in this component.
- The new structure will be a self-supporting steel monopole with a drilled shaft foundation.
- New insulators and hardware will be installed on the following existing structures:

- Eight single circuit deadend
- Five single circuit suspension v-string
- The reconductored line and new loop will use the existing corridor and new substation property. No additional ROW is anticipated.
- Minimal clearing will be required.

Component 12: Fresh Ponds – Deans 500kV Line #2:

- Install one new deadend structure along the existing centerline of the Deans – Smithburg 500kV line to loop it into the new Fresh Ponds AC substation, towards Deans.
- Reconductor 2.2 miles from the new Fresh Ponds substation to Deans substation with double-bundle 1590 ACSR 54/19.
- Existing shield wire will be utilized along the reconductored section. One span of new shield wire will be installed into Fresh Ponds substation.
- The existing structures are in good condition and can be reused.
- No structure removals included in this component.
- The new structure will be a self-supporting steel monopole with a drilled shaft foundation.
- New insulators and hardware will be installed on the following existing structures:
- Eight single circuit deadend
- Five single circuit suspension v-string
- The reconductored line and new loop will use the existing corridor and new substation property. No additional ROW is anticipated.
- Minimal clearing will be required.

Component 13: Fresh Ponds – Smithburg 500kV Line:

- Install one new deadend structure along the existing centerline of the Deans – Smithburg 500kV line to loop it into the new Fresh Ponds AC substation, towards Smithburg.
- The existing adjacent structure is in good condition and will not need to be modified or replaced. No structure removals are included in this component.
- The new structure will be a self-supporting steel monopole with a drilled shaft foundation.
- Existing conductor will be attached to the new steel pole. One span of new double-bundle 1590 ACSR 54/19 conductor will be installed into Fresh Ponds substation.
- Existing shield wire will be attached to the new steel pole. One span of new shield wire will be installed into Fresh Ponds substation.
- The new loop will use the existing corridor and new substation property. No additional ROW is anticipated.
- Minimal clearing will be required.

Component 14: Fresh Ponds – East Windsor 500kV Line:

- Install one new deadend structure along the existing centerline of the Deans – East Windsor 500kV line to loop it into the new Fresh Ponds AC substation, towards East Windsor.
- The existing adjacent structure is in good condition and will not need to be modified or replaced. No structure removals are included in this component.
- The new structure will be a self-supporting steel monopole with a drilled shaft foundation.
- Existing conductor will be attached to the new steel pole. One span of new double-bundle 1590 ACSR 54/19 conductor will be installed into Fresh Ponds substation.

- Existing shield wire will be attached to the new steel pole. One span of new shield wire will be installed into Fresh Ponds substation.
- The new loop will use the existing corridor and new substation property. No additional ROW is anticipated.
- Minimal clearing will be required.

Total Independent Cost Estimates

The following is the total independent cost estimate for NEETMH Proposal 250,

Independent Cost Estimate

Proposal 250	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$7,379,458,305	$5,640,000,000	$1,739,458,305

For comparison, the total proposal cost estimate for NEETMH Proposal 250 is shown below.

Proposal Cost Estimate

Proposal 250	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$7,028,535,019	$4,969,039,552	$2,059,495,467

Proposal 604

Proposal Cost Estimates

The total proposal cost for NEETMH proposal 604 is given below.

Category	Full Project
	$
Engineering & Design	276,951,000
Permitting/ Routing/Siting	21,905,303
ROW/Land Acquisition	23,009,700
Materials and Equipment	888,958,500
Construction & Commissioning	1,273,327,885
Construction Management	138,495,500

Overheads & Misc.	43,751,586
Contingency	276,951,000
Total Component Cost (Current Year)	2,943,350,474

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's Offshore consultant assembled independent cost estimates for the proposed offshore facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the Offshore portion of NEETMH proposal 604:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station (1500 MW)	1	$885,000,000	$885,000,000
Offshore Converter Station (1200 MW)	1	$708,000,000	$708,000,000
±400 kV Submarine Cable	49	$5,600,000	$274,400,000
Total Offshore Components			**$1,867,400,000**

PJM's Offshore consultant's review of the Offshore related costs is summarized in this section. A description of the values in each column is as follows:

- Independent Estimate values are costs developed based on cost data from comparable projects and prior estimates, information from equipment suppliers, and engineering judgement
- Average of Proposals Reviewed values are averages for all the proposals consultant was assigned to review.

The basic characteristics for NextEra project 604 are as follows:

- One 1,500 MW ±400 kV HVDC system
- One 1,200 MW ±400 kV HVDC system
- Submarine Cable Mileage: 49

	As Proposed	Independent Estimate	Average of Proposals Reviewed
Offshore Converter E	$808,274,461	$885,000,000	$887,319,000
Offshore Converter F	$676,956,472	$708,000,000	$709,855,200
Offshore Converter $/MW	$551,490	$590,000	$591,546
Submarine Cable Total	$246,042,322	$274,400,000	$221,779,880
Submarine Cable $/mi	$5,021,272	$5,600,000	$4,526,120
Total Offshore Portion $/MW	$642,617	$691,630	$673,687

Onshore Component Independent Cost Estimates

As part of this study, PJM's Onshore consultant performed a high-level conceptual cost estimate for the on-shore components of the Project.

The consultant's estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with substation engineering, transmission line engineering, and construction. The total does include a contingency of 30 percent as it is a concept level estimate.

The following is the independent cost estimate for the Onshore portion of NEETMH proposal 604.

Category	Total
Materials and Equipment	$492,856,666.88
Engineering and Design	$11,342,974.40
Construction and Commissioning	$82,998,099.23
Permitting/Routing/Siting	$12,500,000.00
ROW/Land Acquisition	$23,000,000.00
Construction Management	$28,634,856.00
Overheads/Misc.	$5,167,954.88
Contingency Cost (30%)	$190,350,165.42
Total Cost	$846,850,716.81

Total Independent Cost Estimates

The following is the total independent cost estimate for NEETMH Proposal 604,

Independent Cost Estimate

Proposal 604	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$2,714,250,717	$1,867,400,000	$846,850,717

For comparison, the total proposal cost estimate for NEETMH Proposal 604 is shown below.

Proposal Cost Estimate

Proposal 604	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$2,943,350,474	$1,731,273,255	$1,212,077,219

LS Power Grid Mid-Atlantic (CNTLTM) Proposals

LS Power Grid Mid-Atlantic, LLC's (LSPG) base proposal #594 "Clean Energy Gateway" will facilitate offshore interconnections of 4,000 MW using a 345 kV AC design consisting of two (2) 345 kV offshore substation platforms and eight (8) 345 kV submarine cables between the offshore substation platforms and a landing at Sea Girt, NJ. A new 345/500 kV 'Lighthouse' substation will be constructed at the landing site to tie into the onshore facilities. Expansion options are presented that would increase capacity to 6,000 MW. This is an Option 2 proposal.

Table 4. **LSPG Proposals**

Proposal ID(s)	Description(s)	Capability (MW)
594	Clean Energy Gateway	Eight (8) 345 kV HVAC Submarine cables for 4000 MW. Expandable up to 6000 MW

Project Overview

The base Project includes two new offshore 345 kV substations (Revolution substation and Prosperity substation) in a breaker-and-a-half arrangement. LSPG has identified three locations strategically located in proximity to the Hudson South call area and the Atlantic Shores/Ocean Wind leases. All three locations will be permitted and the two locations that best fit the OSW selections made by BPU in future solicitations will be constructed.

Each substation will have three primary decks: (1) a cable deck that will house control and communication equipment, firefighting equipment, and HVAC equipment; (2) a main deck that will house the GIS equipment and shunt reactors; and (3) a cooler deck that will house radiators to cool the equipment. Each substation will be fully equipped with all breakers and reactors to interconnect cables from OSW generators at 345 kV including the reactors needed to compensate generator lead lines.

Each platform will have four (4) 345 kV import line positions for future offshore wind farm connections and four (4) 345 kV export line positions. Each import and export position will have a 345 kV shunt reactor for cable compensation. The four (4) tri-core 345 kV cables from each platform will be in consolidated corridors with each cable spaced to allow for future repairs. As the cables approach the shore all eight (8) cables will merge into a single consolidated corridor.

For the Expansion Options, either six (6) cables from two (2) offshore substation platforms (total of twelve (12) submarine cables) or four (4) cables from each of three (3) offshore substation platforms (total of twelve (12) submarine cables) will be developed for a total capacity of 6,000 MW. A concern is that a single landfall becomes a potential N-1 failure point for 4,200 MW (or 6,400 MW if an expansion option is exercised) of offshore power.

The LSPG team has prepared a routing study, permitting plan, environmental protection plan, a Submerged Cultural Resource study, and a fisheries protection plan for the proposed undersea cable routes and offshore collector substation locations to identify locations for offshore infrastructure that minimize environmental impacts and impacts to fisheries and other maritime stakeholders.

Overall, the proposal appears to be well thought through with a good amount of detail to support the process, schedule, and design of the project. The 345 kV AC technology is well established and presents little technical risk. Siting and cable routing alternatives appear to have selected locations that pose the least construction impact and risk. Although the project schedule looks to be a bit optimistic given the unique nature and scale of the project, it does not seem to be unrealistic.

At present neither a specification nor an accurate one-line diagram of the onshore Lighthouse substation (an Option 1B component) for the 4,200 MW base proposal has been available to review. Consequently, there is a degree of uncertainty on exactly what is proposed and included in the proposal cost, and any related risks.

As proposed, OSW developers would be required to connect to the LS Power offshore platforms at 345 kV. This voltage differs from a more typical 66 kV OSW turbine array collection voltage and will require OSW generators to construct additional transformation platforms to accommodate inputs from generator array cables at 66 kV or similar voltage level. This differs from many of the other NJ SAA proposals which provide points of connection for wind generation developers at 66 kV.

Offshore Constructability Review

Proposal 594

Environmental (Regulatory) Analysis

Overview

Land right grants will be required from the United States Department of Interior, BOEM for the offshore substations and undersea cables in the Outer Continental Shelf and a Tideland License will be required from the State of New Jersey for undersea cable within New Jersey jurisdictional waters. These grants would be needed for all NJ SAA Option 2 projects, and as such the associated risks are similar to other projects.

Routing

LSPG conducted routing and siting studies; preliminary engineering including cable layouts, substation layouts, and detailed project specifications; prepared a public engagement plan and completed initial outreach to community leaders; identified the necessary permits; consulted with key regulatory agencies; received bids from material suppliers; and developed construction execution and commissioning plans.

A desktop routing study was performed to assist in selecting and evaluating alternative onshore and offshore routes to the POIs. A report summarizes the methods utilized and presents the results of the desktop routing study. ESS Group, Inc. and Fugro supported LS Power in preparation of this Routing Study by providing information and analysis. LS Power prepared this Routing Study so that impacts to natural resources are avoided or minimized when avoidance is not possible.

The study areas were defined to encompass the potential termination points while including a large enough area to identify an adequate number of reasonably differentiated, geographically diverse alternative routes. Various criteria, including but not limited to the presence of environmental resources, physical characteristics, hazards and obstructions, cultural resources, and potential use conflicts can have an impact on siting and routing of subsea cables.

LS Power consulted with several agencies to gather information about the study area and potential permitting requirements including the NJDEP, the USACE Philadelphia and New York Districts, BOEM, New Jersey Department of Transportation ("NJDOT"), the Pinelands Commission, and county and local officials.

Offshore routes consider viable shore landing locations and potential offshore collector substation locations and are routed to avoid or minimize interference with other uses or constraints. LSPG retained Dolan Research, Inc., to conduct a desktop study to evaluate the potential presence of submerged cultural resources that may be encountered near the undersea cable corridors and offshore collector stations.

The NJDOT Office of Maritime Resources manages New Jersey's marine transportation system infrastructure including navigation channels, port infrastructure, marinas, confined disposal facilities, and dredged material placement projects. The NJDOT Office of Maritime Resources indicated that they do not have any navigation channel infrastructure in the general area of the Sea Girt landfall or cable route (G. Clifton, personal communication, July 30, 2021).

Potential submerged cultural resources within the offshore project area include both inundated prehistoric sites and known and unknown historic shipwreck and other maritime infrastructure sites. A prehistoric context and geoarchaeological assessment was developed to assess the generalized prehistoric site potential off the New Jersey portion of the Mid-Atlantic continental shelf. Additionally, an historic content focusing on documented shipwrecks, coastal shipping patterns, and Atlantic coastal vessel types, was prepared to better under known shipwreck sites and the potential for encountering unknown sites within the project area.

The project team made efforts to develop route alternatives that best balanced the various concerns from a land use, landowner, environmental and engineering perspective. Eleven (11) potential cable landing locations, seven (7) subsea cable routes, and 12 onshore routes were identified and evaluated.

LS Power has identified three (3) potential key offshore collector substation locations to minimize the amount of infrastructure (cables and stations) built: two (2) near the Hudson South WEA and one (1) near the New Jersey WEA as discussed herein. These proposed locations have been identified to avoid and/or minimize maritime, fisheries, and environmental impacts while also being located near WEAs where they will provide the greatest cost benefit.

The Revolution-Lighthouse cable route consists of four (4) new 345 kV circuits traversing approximately 39 miles between Revolution substation and Lighthouse substation. An Expansion Option 1 would add two (2) additional circuits.

The Prosperity-Lighthouse cable route consists of four (4) new 345 kV circuits traversing approximately 37 miles between Prosperity substation and Lighthouse substation. Expansion Option 1 would add two (2) additional circuits.

An Alternate Site-Lighthouse cable route would be used in lieu of Revolution or Prosperity cable routes if it better matches the OSW selected by the BPU in future solicitations. This route traverses approximately 39 miles. An Expansion Option 2 would add four (4) 345 kV circuits along this corridor in addition to the Revolution-Lighthouse and Prosperity-Lighthouse corridors.

This proposal appears to be aware of the significant issues related to the location of offshore substation platforms and undersea cables and takes these issues into consideration. Twelve (12) different onshore/offshore route combinations were developed and evaluated against key criteria in a matrix format. Two onshore/offshore route combinations became preferred plans. Both combinations use the same offshore routes to reach the two (2) offshore platforms in the 4,200 MW Base proposal and an Alternative Platform in the 6,400 MW option.

The risks associated with these various cable routes are consistent with risks associated with other NJ SAA proposal offshore cable routes. No unusual or exceptional risks were noted based on the material provided in the proposal.

Landfall

The preferred location for the Lighthouse Substation, the cable landing joint bays, and approximately ±3,500 feet of ductbank corridor are located on the New Jersey National Guard Training Center owned by the State of New Jersey located in Sea Girt, New Jersey. LSPGMA will obtain rights for this station location, joints bays, and ductbank corridor through purchase or grant. The Lighthouse Substation is a critical project substation that is ideally located as close to the shoreline as feasible. This location has been selected as the preferred Lighthouse Substation location for the following reasons:

- The site is owned by the State of New Jersey and this project is important to the state.
- This is the one of the largest sites located adjacent to the shoreline within the most ideal cable landing location in New Jersey. Significant environmental, real estate, and stakeholder impact considerations are encountered with alternative cable landing locations.
- This is the most cost-effective location for this critical substation.
- Minimized environmental and community impacts through a single shore landing location on state land and placing new submarine cables in consolidated corridors.

Alternative locations for this station were considered. These alternative locations are viable but are not preferred for the following reasons:

- Additional impacts to the beach community as additional ductbanks/cables will be required from the shore landing to the alternative location.
- Additional costs associated with additional ductbanks/cables.
- Requires land rights from private owners; and,
- Greater impacts to the residential community given the locations and smaller parcel sizes.

Cable landings near the beaches will be installed using HDD at sufficient depths and seaward distances to avoid conflicts with the beach template, sand nourishment area, jetties, outfalls, and other shoreline infrastructure based on consultation with the USACE, NJDEP Division of Coastal Engineering, and the New Jersey Department of Transportation ("NJDOT") Office of Maritime Resources. LS Power has utilized information from USACE, NJDEP Division of Coastal Engineering, and NJDOT Office of Maritime Resources to inform near-shore routing, beach landing locations, and HDD designs.

LSPGMA discussed the proposed project, proposed uses, and proposed infrastructure locations with the New Jersey Treasury – Division of Property Management and Construction ("DPMC") in June 2021. In those discussions, LSPGMA and the DPMC conceptually agreed on infrastructure locations that would not negatively impact existing facility operations and that DPMC supported. These alignments and locations have been incorporated into LSPGMA's project design.

This proposal makes a strong argument for a single landfall at the National Guard Facility at Sea Girt. This location appears to have advantages over others due in part to its size and ownership by the State. A single landing point allows multiple cables to be sited in a single corridor reducing environmental impact for the project. However, a noted concern is that a single landfall becomes a potential single point of failure location for 4,200 MW (or 6,400 MW if an expansion option is exercised) of offshore power. This is somewhat mitigated by maintaining separations for buried cables and providing suitable protection in areas of particular concern.

Overall, the benefits of a single landfall may exceed the risks of a large single point of failure provided that facility configurations maintain adequate separation and use best practices in their designs.

Facility Conflicts

Shore Landing Area/ Substation

The Sea Girt National Guard Training Center ("NGTC") is located along the Atlantic coastline of New Jersey at the south end of the Borough of Sea Girt in southern Monmouth County, New Jersey. LSPGMA plans to land undersea cables at this location along with constructing a substation on this property. The Sea Girt NGTC encompasses 171 acres and is owned by the State of New Jersey. Although LSPGMA and the DPMC conceptually agreed on infrastructure locations that would not negatively impact existing facility operations this is a potential facility conflict area.

Existing Cables and Pipelines
A number of undersea cables are located off the New Jersey coast. These predominantly include active and inactive telecommunication cables. Crossing of these cables requires coordination and special protection measures (e.g. matting). Approximately 17 known crossings are anticipated in the base (Prosperity & Revolution) project arrangement.

Artificial Reefs
Generally, New Jersey's Sea floor consists of sandy plain with some mud and clay interrupted by submarine ridges. Within this relatively featureless and barren sea floor are 17 artificial reef sites that encompass more than 25 square miles. Three reefs in New Jersey's Artificial Reef Program are in the vicinity of the project area: Sea Girt Reef, Manasquan Inlet Reef, and Axel Carlson Reef. However, the three proposed cable corridors avoid all three of these reefs by at least one nautical mile.

Sand Borrow Areas
Sand borrow areas and beach nourishment areas have been identified using publicly available data supplemented with consultations with BOEM, USACE, and the NJDEP Division of Coastal Engineering. The NJDEP Division of Coastal Engineering provided approved sand borrow areas (S. Bates, personal communication, July 23, 2021). The USACE also provided borrow areas (BA8, BA9, BA10) being evaluated for future use (J. Shea, personal communication, July 27, 2021). Proposed routes have been modified to avoid borrow areas by greater than ¼ mile as requested by these agencies during consultation.

Shipwrecks
An analysis indicates that 73 documented shipwreck sites are within one nautical mile of the project area. The three proposed offshore cable routes do not intersect or fall within 500 feet of any of the documented shipwreck sites, except for the Mary E. Simmons and Artic sites (NJMM database). There are no documented shipwreck sites at or within one nautical mile of the locations of the three proposed offshore collector platforms.

Based on research and routing studies performed by LSPG and its consultants, this proposal appears to reasonably identify and evaluate potential facility conflicts along the undersea cable routes to reduce project risk.

Environmental Risk

Risk management is essential to ensuring a project stays on schedule and within budget. LSPG will utilize a proactive risk management process throughout Project implementation. LSPG will have a Project Director directly responsible for risk oversight.

LSPG completed a detailed routing study, permitting plan, environmental protection plan, fisheries protection plan, and preliminary project design with its outside experts (SNC-Lavalin, ESS, Fugro, and Dolan Research) that it used on multiple field visits and preparation of a construction plan that identified specific means and methods to assess the environmental and permitting risks along each of the identified routes. LSPG identified the BOEM approval process, submerged cultural resources, and fisheries resources when developing the permitting and project execution plan.

An environmental benefit of the Project is that it reduces the number of submarine cables and shore landings and places them in a consolidated corridor. The use of consolidated corridors and construction planning that avoids repeated disturbance minimizes the impact to ocean floor habitat and sensitive species. A single shore landing location with a coordinated plan for all drilling operations under the beach minimizes impacts to beach habitat and marine species.

Potential environmental and permitting risks appear to have been adequately identified in this proposal. The proposal offers plans to mitigate these risks through a proactive risk management process.

Permits

Land right grants will be required from the United States Department of Interior, BOEM for the offshore substations and undersea cables in the OCS and a Tideland License will be required from the State of New Jersey for undersea cable within New Jersey jurisdictional waters.

A ROW and Right-of-Use Grant ("ROW/RUE Grant") will be required from BOEM. A ROW grant will authorize LSPG to install undersea cables and a RUE grant will authorize LSPG to construct offshore collector substations and operate and maintain undersea cables and offshore collector substations on the OCS. LSPG consulted with BOEM concerning earlier submittal of an Unsolicited ROW/RUE Grant application but was advised that BOEM would not consider an application until a project was selected by PJM and the BPU. LSPG will submit an application upon selection by PJM and the BPU. LSPG anticipates it will take approximately 12 months to obtain a ROW/RUE Grant.

A Tideland License will be required from NJDEP for land rights to place undersea cables in New Jersey jurisdictional waters, which are located within three (3) nautical miles of shore. An issued Waterfront Development Permit is required as part of the application process.

LSPG has identified an alternate collector substation location (Alternate) and alternate cable corridor (Alternate to Lighthouse) if PJM or BPU considers Alternate a more preferred offshore collector substation than either the Prosperity or Revolution locations. If Alternate were chosen, LSPG would substitute it for either Prosperity or Revolution revising its application.

This proposal appears to have identified the many permits that will have to be obtained, the process for obtaining them, and has allocated a reasonable amount of time to do so in the overall project schedule. The proposal again makes the point that the "consolidated cable corridor" and a single shore landing point reduces the permitting footprint.

Technology and Supply Chain Risks

Technology Risk

Overall System

LSPG's solution relies on conventional 345 kV AC power system components and equipment such as XLPE tri-core submarine cables and gas insulated switchgear (GIS). In the base proposal two (2) offshore substation platforms will each connect to the same onshore substation by means of four (4) 345 kV tri-core cables. Both offshore and onshore substations would be breaker-and-a-half configurations. Base proposal capacity is 4,200 MW.

Expansion Option 1 would add two (2) bays to each offshore substation platform and two (2) additional import/export cables for a total of six (6) per platform and a total capacity of 6,000 MW.

Expansion Option 2 would instead add a third offshore substation platform with four (4) 345 kV export cables terminating at the same onshore substation to the base proposal, again with a total capacity of 6,000 MW.

HVAC System

LSPG's proposal is the only alternating current (AC)-based offshore proposal submitted for the NJ OSW SAA Proposal window. For AC applications where relatively long cables are involved, a major concern is the ability of the system to transfer desired power levels across the system while maintaining voltages within design limits throughout the system, including along the length of the power cables. This can become particularly critical at higher voltages such as 345 kV where cable charging currents can be a significant portion of the total current flowing on a cable, and when cables are lightly loaded and free-end voltages can rise significantly due to the Ferranti effect.

A cursory review of the voltage regulation and reactive compensation capability of the system was performed using information that was provided in the proposal, which seemed to indicate that the system would likely operate within limits, but more detailed studies are needed to demonstrate the suitability and operability of the system.

No studies or other information was provided to verify the ratings of major equipment. This includes expected short circuit levels when offshore wind generation is connected and a fully developed system is operating.

Offshore Platform

The base Project includes two new offshore 345 kV substations (Revolution substation and Prosperity substation) each developed with a breaker-and-a-half arrangement. LSPG has identified three locations strategically located in proximity to the Hudson South call area and the Atlantic Shores/Ocean Wind leases. All three locations will be permitted and the two locations that best fit the OSW selections made by BPU in future solicitations will be constructed. Semco and ISC have completed preliminary design for the substations, which are storm hardened to withstand extreme events. Specifically, the substations are designed for a 1-in-1000 year wave height, 140+ mph winds, accidental ship impacts, accidental explosions, and loads required to pull in cables. The topside will set on a multi-legged braced jacket structure. The topside will house substations equipped with breakers and reactors to interconnect 345 kV cables from OSW developers including the reactors needed to compensate generator lead lines.

- Expansion Option 1: involves expanding each substation by 2 bays allowing for two additional export cables and two additional OSW connections.
- Expansion Option 2: involves constructing a third identical substation (all three locations will be utilized) allowing for four additional OSW cable connections.

It should be noted that in this proposal OSW generator connections would be at 345 kV. This voltage is higher than a more typical 66 kV OSW connection voltage and may increase the cost for OSW generators who would likely have to construct additional transformation platforms.

Submarine Cable

345 kV cross-linked polyethylene (XLPE), tri-core submarine armored cable will be installed approximately six feet below the sea floor using a jet plow when possible. Where traditional installation is not feasible, (i.e. crossing of utilities), the cables will be installed at shallower depths or laid on the surface and protected with a concrete cap. The cables will be installed in consolidated corridors with each cable spaced to allow for future repairs. At the shoreline the cables will be installed within a casing placed 25-50 ft. below the beach via horizontal directional drill (HDD). Thermal grout with superior thermal resistivity will be used in the HDD casing to enable sufficient power transfer capability. At the shore the cables will be spliced to land-based cable in a splice vault and land cables will be installed in concrete encased duct banks to the Lighthouse substation.

All Project phases include at least 4 parallel networked cables allowing the OSW connected to the Project to share cable capabilities even under a failure. Emergency cable ratings are sufficient to deliver OSW generation at 100% output for the loss of any single element. Redundant fiber paths placed inside each cable provide communications for system protection and control. Spare submarine cable will be kept at LSPG's maintenance center in sufficient quantities to complete multiple repairs.

LSPG consulted with its outside engineer (SNC-Lavalin) and geotechnical consultant (Fugro) extensively on onshore and offshore soil properties and ductbank / cable design. Fugro developed a detailed geotechnical routing report based on historical boring logs to determine appropriate soil thermal properties and ambient conditions along the selected routes. SNC Lavalin used the soil properties in addition to CYMCAP (cable rating software) to design the appropriate HDD details and cable design necessary to achieve the selected cable ratings.

Overall, the risks associated with installing and operating 345 kV power cables are known from extensive existing experience. In the case of this proposal, construction risks are somewhat elevated over other proposals due to the number of cables and circuits that will be installed as part of the project.

Project Complexity

A salient feature of this proposal is that it uses proven 345 kV AC technology. The substation equipment on both the offshore and onshore platforms is essentially industry standard 345 kV GIS equipment in a breaker-and-a-half configuration. This offers a level of redundancy where overload capability can be utilized should an element such as one of the export cables fail. Industry standard relay and control systems can be employed that are both sensitive and selective to preserve the bulk of the system for an individual element failure. The proposal describes the offshore platforms in detail presenting both a technical specification and substation/platform layout detail drawings.

Generally speaking, risks associated with the overall complexity of this project are on par with other extra-high voltage (EHV)-class AC transmission projects involving power cables of similar scope.

Supply Chain Risk

LSPG has had detailed conversations with material suppliers regarding available manufacturing slots to provide equipment and materials specific to the Project design. The material suppliers have confirmed that there are manufacturing slots available for the equipment and material necessary to meet the schedule for the Project. LSPG will move quickly after award by the BPU to lock in manufacturing slots as necessary to meet the schedule for the Project with adequate float.

Further discussion of specific risks associated with supply chain matters are discussed below.

Long Lead Time Items

The Project' critical path is primarily driven by BOEM permitting, offshore substation platform manufacturing, cable procurement, and cable installation as further discussed below.

<u>Submarine Cable</u>

LSPG consulted with cable suppliers and conducted preliminary cable solicitations specific to the cable requirements for the Project. A procurement schedule for each project phase was developed based on the required lengths of cable. LSPG has assigned a cable manufacturing start date of approximately September 1, 2024. Cable suppliers have confirmed they have manufacturing slots available to meet the required delivery dates for the Project. LSPG also developed the construction schedule in coordination with submarine cable manufacturers/installers and used project-specific labor productivity assumptions for cable installation, splicing, and crossings.

<u>Offshore Platform Procurement</u>

LSPG worked with Semco, ISC, and Bladt to develop a Project specific schedule for manufacturing of offshore platforms. LSPG has assigned a manufacturing start date of approximately December 1, 2024, for Revolution.

Note that although HVDC system supply risks do not apply to the LSPG proposal, risks associated with high voltage cable supply, special vessels required for cable installation, and risks related to offshore platform fabrication and installation do apply to this project in the same general manner as with other NJ SAA proposals.

Supplier Scarcity
One of the advantages of this 345 kV AC proposal is that the technology is mature and numerous suppliers are available. This proposal can take advantage of an existing competitive network of suppliers.

Construction Schedule Risk

Permitting

LSPG has researched and developed its permitting plan in sufficient detail to demonstrate a full understanding of the process, expected durations, and milestones. As such it has mitigated permitting schedule risk by identifying permitting activities and their durations to construct an overall schedule that reflects the time and effort to obtain the necessary permits.

The overall duration of permitting in LSPG's schedule is approximately 4.8 years which seems reasonable and adequate given the scope and nature of this project. Risks related to permitting apply to this project in the same general manner as with other NJ SAA proposals.

Construction

LSPG completed a preliminary project design and detailed routing study with its outside engineer (SNC-Lavalin) and geotechnical consultant (Fugro) that it used in consultation with submarine cable suppliers and contractors to develop a schedule for the project.

The duration of construction activities in LSPG's schedule is about 4.9 years which appears to be reasonable and adequate given the scope and nature of this project. Risks related to construction apply to this project in the same general manner as with other NJ SAA proposals.

Outage Planning

Outages of existing onshore transmission infrastructure will be required to construct and connect elements of LSPG's project. No details have been provided that lay out an outage plan.

Other Overall Schedule Risk

While construction schedule risk can't be eliminated entirely, this project appears to allocate a reasonable amount of time to each of the project components. The schedule does allow a limited amount of schedule 'float' for certain components. The schedule does call for a significant amount of construction during winter months which may be unavoidable but may make keeping to a schedule difficult given winter weather in the Northeastern US.

O&M Risk

The Clean Energy Gateway will be operated by LS Power using its certified control centers that operate extra-high voltage transmission facilities across the country, including transmission facilities in PJM and New Jersey. LS Power will integrate the Project into its existing maintenance programs and will establish a new maintenance center within New Jersey in close proximity to the Project that will house spare parts and serve as the base of operations for maintenance staff dedicated to ensuring project reliability. Given the nature and maturity of the technology used any operational risks would seem to be related to operating and maintaining EHV AC substation equipment in an offshore platform environment.

Route Diversity

A key feature of the LSPG proposal is that "the project offers minimized environmental, community, and tourism impacts (onshore and offshore) through a single shore landing location on state land and placing new submarine transmission in consolidated corridors."

A drawback of consolidated corridors is the lack of route diversity and the possibility of a common point of failure. The entire distance from offshore substation platform to onshore substation, approximately 39 miles for each platform, will have four (4) 345 kV cables in relatively close proximity (90- 155m). There is approximately 10 miles of cable corridor in the base proposal where all eight (8) 345 kV cables will be in relatively close proximity. All cables will make landfall at Sea Girt, NJ, and will converge on several HDD bores to make the transition on to land at that location.

Single point of failure risk will be mitigated by installation techniques since the cables will be separated and buried four (4) to six (6) feet in general or protected where burial is not possible.

Redundancy & Operational Flexibility

As proposed by LSPG, the base project will be composed of two offshore substation platforms each with a four (4) bay 345 kV breaker-and-a-half arrangement with two (2) main bus breakers for a total of fourteen (14) circuit breakers feeding four (4) 345 kV export cables.

Breaker-and-a-half substation designs offer significant redundancy and operational flexibility. LSPG indicates that 345 kV export cables will have an emergency capacity above the normal capacity that will allow them to carry additional load should one cable fail or be out for maintenance. Further, an unplanned outage of a single cable circuit will allow the system to continue exporting power to land uninterrupted, and outages of the entire platform will not be needed to switch cables in or out of service. This differs from the HVDC-based systems in other NJ SAA proposals where outage of the full HVDC system would occur for an HVDC cable outage.

Maintenance and Spare Equipment Strategy

O&M risk is partially a function of the technology employed. Since this proposal uses industry standard 345 kV AC components it would be expected that O&M risk is somewhat reduced because of increased component availability and a knowledgeable work force. In addition, the proposal includes a spare parts list that appears to cover major long lead time components and refers to existing and proposed maintenance centers in the area. Maintenance risks over and above typical risks for EHV AC equipment relate to maintaining this equipment in a marine environment.

Cost Review

Proposal 594

Proposal Cost Estimates

The total proposal costs for NEETMH Proposal 594 are given below.

Category	Proposal 594
	$
Engineering & Design	23,298,512
Permitting/ Routing/Siting	25,718,381
ROW/Land Acquisition	3,489,952
Materials and Equipment	1,131,307,155
Construction & Commissioning	613,727,902
Construction Management	23,778,192
Overheads & Misc.	99,014,680

Contingency	48,008,369
Total Component Cost (Current Year)	1,968,343,143

Independent Cost Estimates

Independent Cost Estimates

PJM's consultant assembled independent cost estimates for the proposed facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The Independent estimates for the Proposal 594 are:

Item	Qty:	Unit Cost ($)	Subtotal
Offshore platform	2	$300,000,000	$600,000,000
Offshore switchyard - 345 kV GIS (14 bkrs x 2)	28	$8,000,000	$224,000,000
Offshore reactors and other equipment (2 x 8)	16	$5,000,000	$80,000,000
345 kV Submarine Cable to Platform 1 (37 miles x 4 ckts)	148	$3,800,000	$562,400,000
345 kV Submarine Cable to Platform 2 (39 miles x 4 ckts)	156	$3,800,000	$592,800,000
TOTAL			$2,059,200,000

Total Independent Cost Estimates

Independent Cost Estimate

Projects	Proposal 594
Total Component Cost (Current Year)	$2,059,200,000

For comparison, the total proposal cost estimates for Proposal 594 are shown below.

Proposal Cost Estimate

Projects	Proposal 594
Total Component Cost (Current Year)	$1,968,343,143

Con Edison Transmission Proposal

Con Edison Transmission's Clean Link New Jersey (CLNJ) proposal 990 consists of two 1,200 MW (2,400 MW total) HVDC links using ± 320 kV HVDC systems from two offshore platforms in the New York Bight offshore wind area to a POI at Smithburg 500 kV and Larrabee 230 kV substations. An option to change either or both POIs to Deans 500 kV substation is also given.

Table 5. **ConEd Proposal**

Proposal ID(s)	Description(s)	Capability (MW)
990	Clean Link New Jersey	2 x 1200 HVDC

Project Overview

Offshore platforms are proposed to be located adjacent to the northern part of the Hudson South Call Area and are situated to provide potential connections at 66 kV to wind energy areas in the Hudson North, Hudson South, and Atlantic Shores call areas. Definitive locations for offshore platforms are not given; the base proposal places the platforms approximately 24 miles offshore. Unit costs ($/mile) are given for additional HVDC cables should platforms be relocated to accommodate wind generator locations or permitting constraints.

Offshore wind generation connects via 66 kV collection circuits built by offshore wind generators to 66 kV switchgear breaker positions on the platforms. An option is given to develop an offshore AC network at 66 kV using 66 kV circuit positions to interconnect the platforms; units costs ($/mile) for these 66 kV cable connections are provided. CLNJ anticipates the platforms to be located within approximately 10 miles of each other to facilitate these optional links at 66 kV.

The CLNJ projects share a common power corridor approach for most of its onshore and offshore routes. Both HVDC circuits make landfall at a National Guard training center at Sea Girt, NJ. This area is also used as landfall for many charted communication cables, many of which are said to be out of service but may somewhat complicate the installation of equipment at the landfall to avoid conflicts.

The CLNJ proposal discusses details of its permitting needs and has done desktop public data research into the routes and potential encumbrances. No detailed surveys have been undertaken to develop cable routes or permitting plans. The submarine portion of these projects present similar risks as many of the other similarly configured NJ SAA proposals.

High level conceptual designs are presented for the HVDC systems, offshore platform structure, and offshore electrical components. Not as much detail is provided as in other NJ SAA proposals, but the overall designs and configurations are similar.

A significant constructability risk for the CLNJ proposal relates to the project's schedule which stipulates a COD in mid-2028. Given potential supply chain constraints, limited suppliers for HVDC systems and cables, availability of specialized installation vessels and equipment, and available construction windows for cable installation and landfall construction we feel that this proposed schedule is a bit aggressive, and a more likely COD will be in the 2030 timeframe.

Secondary risks include potential interferences from other facilities at the landfall location and the use of a common power corridor for 2,400 MW of OSW delivery with its risk of simultaneous outage (which is mitigated by design features and physical separation). Also, the system has little to no expandability beyond 2,400 MW due to the nature of HVDC systems; inclusion of optional inter-platform 66 kV AC ties may present more operational flexibility, especially at times of less-than-nameplate OSW generation, but the overall system will still be limited to delivering 1,200 MW to each of the two POIs.

The CLNJ proposal includes components for radial delivery of offshore wind generation from 66 kV wind turbine array connections to POIs located at the existing Larrabee and Smithburg substations (including AC connections to the existing substation facilities). Note that no harmonic mitigation, voltage regulating, or reactive power equipment is included, but the proposal states that provisions can be made to add this equipment if needed.

Constructability Review

Proposal 990

Environmental (Regulatory) Analysis

Overview

Con Edison Transmission's Clean Link New Jersey (CLNJ) proposal consist of two 1,200 MW HVDC links using ±320 kV HVDC systems from two offshore platforms in the New York Bight offshore wind area to a POI at Smithburg 500 kV and Larrabee 230 kV substations. Offshore platforms are proposed to be located adjacent to the northern part of the Hudson South Call Area and are situated to provide potential connections at 66 kV to wind energy areas in the Hudson North, Hudson South, and Atlantic Shores call areas.

Routing

Submarine cables from each platform would join in a common seabed corridor separated by 60-230 feet and run generally west to landfall at Sea Girt, NJ and then head inland to land converter stations and the POI connections at Smithburg and Larrabee. The overall length of each submarine cable HVDC circuit run is estimated at around 28 miles.

This offshore routing avoids more congested harbor and river areas of other SAA proposals and generally traverses open ocean sea bottom. The proposed routing is approximate and is based on a review of publicly available data but has been designed to avoid charted obstructions and other conflicting facilities where possible. The proposed cable corridor route crosses the Ambrose-Barnegat marine traffic lanes and a charted fish trap area.

The relative risk of these cable routes is similar to many of the other SAA proposals with cable routes in the same general area, and does not seem to present any constructability risks beyond those normally expected in this area.

Landfall

The proposed landfall for CLNJ's HVDC cables is at a National Guard training facility in Sea Girt, NJ. This facility includes about 1/3 of a mile of beach and open upland that transitions to parade fields and training facilities. The beach facilities are not public but appear to be used for recreational purposes. This landfall is on a publicly owned property that is not open to the public and has a history as a landfall for communication cables. These existing cables may present conflicting facilities that could complicate landfall construction; this is discussed in the next section.

This area is generally open and would provide the space for staging equipment and materials for the horizontal directional drilling (HDD) required to achieve the cable landfall. CLNJ has provided a conceptual plan for the HDD operation and locations of the bores and transition cable vaults. Adjacent areas are dense beachfront residential areas with numerous homes on small lots. The National Guard Training Center property has some of the only significant open space in the area.

The relative risks at this landfall location mainly relate to the numerous existing submarine communication cables that also make landfall at this location.

Facility Conflicts

Offshore platform locations present no obvious issues or risks that are different than other proposals with offshore platforms in the same general area.

Potential conflicts with existing land and submarine facilities will be present with this proposal due to the landfall location at Sea Girt. The National Guard Training Facility has historically been an area for landfall of submarine communication cables dating back to the early historical uses of these cables. CLNJ has met with training facility personnel to discuss use of the landfall location. This included a statement that “only one existing offshore communication cable entering the National Guard facility property is active. All other cables area no longer in service and are being planned to be abandoned or removed over the next two to three years.” These facts will need to be verified, and the extent of abandonment or removal fully understood so that landfall HDD design can avoid remaining facilities whether active or abandoned. Note that NOAA navigational charts show nine submarine cables terminating at the Sea Girt landfall; given the history of cables at this site there may also be uncharted facilities abandoned in place that may cause confusion during installation if they are encountered.

Relative to the risk of other projects that make landfall in more congested waters this landfall location could have lower risk of issues provided that the existing submarine cable locations are carefully avoided.

Environmental Risk

The general environmental risks associated with the various offshore platforms and submarine cables is similar to the risks posed by the offshore elements of other NJ SAA proposals. The environmental impacts from these proposals mainly come from the installation of the submarine cable and seabed disturbances caused by this activity.

As mentioned above, the cable route uses the National Guard Training facility at Sea Girt for landfall. This facility includes a shooting range which may have contaminated adjacent lands with hazardous materials. This may be an issue to consider when designing and locating onshore landfall facilities such as cable trenches and transition vaults. Detailed survey and design work needed to support permits would help mitigate these risks.

Permits

As with other NJ SAA proposals, the CLNJ proposal developed its understanding of permit requirements using desktop studies and publicly available information. Its discussion of this topic is reasonably thorough and identifies the required permits and pertinent issues in reasonable detail based on the preliminary nature of the studies.

Onshore components of this project run through Green Acres-encumbered properties and may require Green Acres Program Diversion Permits.

CLNJ references a NYSERDA report on the impacts of offshore cabling (April 2021 NYSERDA Final Report of the Fisheries Technical Working Group, Offshore Submarine Cabling Overview (Report Number 21-14) as a reference of best practices for this type of activity. It also provided a very detailed desktop archeological study report performed by a consultant which identifies archeological constraints for the project area from the POI substations to the offshore platforms.

It appears that the nature and complexity of permits for the CLNJ will be similar to those of other projects, and present similar risks.

Technology and Supply Chain Risks

Technology Risk

Overall System

The overall system described by this proposal will, for the most part, contain power system equipment and components that are proven and fully understood over many years of successful operation in similar circumstances. However, application of these components to installation on offshore platforms and exposure to the harsh environment that surrounds any salt water marine environment has not been commonly done using the voltage and scale being proposed. The primary risk associated with the overall system is associated with the construction and operation the offshore portions of the system, and in particular the platform-based HVDC converters and associated transformers, switchgear, and other components.

HVDC System

The HVDC systems proposed by CLNJ are symmetrical monopole voltage source converter (VSC) based systems rated at 1,200 MW and operating at ± 320 kV. VSC HVDC systems using submarine cables have been operating for many years and in general represent minimal technology risk. Systems operating at 320 kV are relatively established, although the 1,200 MW level has only been achieved within the past few years. Power capability is mainly driven by cable ampacity which is typically limited to around 2,000 amperes – which is the approximate ampacity needed to achieve a 1,200 MW rating at ± 320 kV DC.

Note that the overall conceptual HVDC design does not include any onshore AC harmonic filters. The working assumption is that harmonic mitigation would be studied, and filters added if needed. The layout of the onshore converter station allows for the potential inclusion of harmonic mitigation equipment. It appears that this equipment is not included in the proposal cost structure as presented.

A risk consideration across all SAA projects involving HVDC is application of this technology in an offshore platform environment. This has been done relatively recently in offshore wind installations in Europe at or near the power levels and voltages being considered for this project. Besides the technical risk, the primary risk is schedule related; namely can this design be qualified, designed, constructed, and commissioned within the schedules proposed.

Offshore Platform

The offshore platforms (jackets and topsides) proposed for housing the converter stations and associated switchgear will be a customized design drawn from experience in oil and gas exploration and production. The main risks associated with the offshore platforms is essentially the same for all proposals in the SAA solicitations, and it relates mainly to available facilities to build the platforms, production capabilities of those facilities, and availability and pricing of materials such as steel.

Further scheduling risk is introduced by the need for specialized equipment to install the platforms such as a semi-submersible crane vessel (SSCV), of which there are only a handful available globally. The availability of these SSCVs may be challenging due to global offshore wind construction activity expected at the time of installation. For this reason, vessels need to be booked early to ensure timely installation.

CLNJ's proposal provides only high-level conceptual information on the configuration of the offshore platform and does not provide any conceptual layouts or other physical drawings. It is assumed that this platform, which will include HVDC equipment from the same manufacturers of the HVDC equipment contemplated in other NJ SAA proposals. As such the platform will provide the necessary equipment to provide for a 1,200 MW link to the on shore POIs, but the exact makeup of this platform is not known based on the information provided. The risks associated with this platform design are based on these unknowns.

Submarine Cable

As discussed above ± 320 kV HVDC submarine cable is available and established at the power level being contemplated. Schedule and supply chain risks associated with these types of specialized cables remains as the most significant risk. Only a handful of manufacturing facilities globally are capable of supplying this type of cable, and with the quantities contemplated for these projects production capability and availability of production slots can greatly impact any planned schedule. This may be magnified by the global demand for submarine power cables associated with robust offshore wind development.

Furthermore, installation vessels for these types of cables are also limited globally and can influence the construction schedule for these projects to a great degree depending on their availability. As stated above, this could be exacerbated by global offshore wind construction activity expected at the time of installation.

Project Complexity

The relative complexity of the CLNJ project is on par with most of the other proposals involving HVDC links between offshore platforms and landfalls using submarine cables. Most of the offshore complexity resides in the construction and installation of offshore platform jackets and topsides as well as installation and commissioning of HVDC converters, converter transformers, AC switchgear, and auxiliary power and control equipment on the topside. Although construction of this technology is well established on land, installation in an offshore environment is relatively new. Most existing experience in this area lies in recent offshore wind projects in Europe.

The CLNJ project's submarine cable route is in open water from the platform location to its landfall at Sea Girt, NJ; this routing presents no apparent extraordinary risks or complexities that may be present in other projects seeking a more urban or marine-trafficked area.

Supply Chain Risk

The risks in the supply chain for these projects predominantly resides in the HVDC converters, offshore platforms, and submarine cables. The relative risks between the CLNJ proposal and other proposals in the SAA solicitation is about the same when considering HVDC systems of the same MW size and operating voltage.

Long Lead Time Items

Long lead time items of highest concern are the submarine cables, HVDC converters, and offshore platforms. The vast majority of this risk resides in the limited number of suppliers for these items which is discussed in more detail below.

Supplier Scarcity

Submarine cables, HVDC converters, and offshore platforms of the designs needed for these projects are capable of being supplied and constructed by limited number of globally based companies. Combine this with the relative scarcity of specialized equipment needed to transport and install these facilities in a marine environment, significant risk can develop should many similar projects be planned for construction in the same period of time. Note that CLNJ has not partnered with any suppliers and will begin procurement activities at the onset of the project.

Of particular concern are the vessels for transporting and laying submarine transmission cables and the heavy-lift vessels needed for offshore platform installation. Note that the potential competition for these resources will come from not only other offshore transmission projects, but also offshore wind generator projects which will need the same vessels for their own platform installations and submarine cables for their collector systems. As stated above this risk is associated with all similar SAA projects and not just for the CLNJ projects.

Construction Schedule Risk

The CLNJ proposal consists of two 1,200 MW HVDC system targeted to POIs at Smithburg and Larrabee substations. The overall schedule duration is approximately 9.5 years culminating in a Commercial Operation Date (COD) of March 31, 2031.

Permitting

The total duration for permitting and ROW services activity is approximately 4 years; the duration for permitting a majority of federal and state permits is around 2 ¼ years. ROW services includes items like road occupation permits, railroad crossing permits, and ROW acquisition. Based on the detail provided in the proposal a good level of understanding exists for the permits and processes involved. However, no specific permit plan has been developed other than on a conceptual level based on studies and research of publicly available information. Also, permitting activity for all of the other similar Option 2 proposals is assumed to be similar, hence the relative risks between SAA projects is essentially the same.

Construction

The construction schedule duration for the CLNJ proposal is approximately 2 years. The schedule presented in the proposal does not provide enough detail to effectively evaluate the reasonableness of the overall duration. However, 2 years does seem to be a rather short duration for this type and scale of project. Note that CLNJ's schedule does contemplate construction of both HVDC systems somewhat simultaneously which could be impacted by availability of specialized equipment and seasonal submarine cable installation windows.

Outage Planning

Outage planning schedule risk will relate mainly to construction for onshore facilities, and in particular those facilities being integrated into the existing POIs at Smithburg and Larrabee. These outages will drive the ability to connect and energize the offshore system and perform commissioning activities. CLNJ outlines high-level outage needs related to the Smithburg and Larrabee POIs and demonstrates a basic understanding of existing facility outages required for integration of CLNJ's facilities is included such as the two-week outage identified for one of the two 230 kV overhead lines leading to either Smithburg or Lakewood substations. The construction schedule does not show where the outages fit into the overall schedule. All transmission outages will be subject to PJM's outage scheduling procedures and will be subject to the risk of change or cancellation as are any transmission outages.

Other Overall Schedule Risk

As with other proposals, perhaps the largest overall schedule risk is related to supply chain constraints for HVDC converters and submarine cables, and the need for specialized equipment for installation of submarine cables and offshore platforms. This will be especially impactful should multiple projects be chosen for installation during the same time period. Further exacerbating this risk will be construction of offshore generating facilities which will place similar demands on the same universe of manufacturers and constructors. Given the permitting strategy for this project, it is anticipated that both wind generation and related transmission projects will be occurring at about the same time.

O&M Risk

Once installed and upon operation the various systems and components of CLNJ's transmission system will be subject to risk of failure. Some of this risk is determined by the configuration of each system and its exposure to failure, while other types of operational risk is determined by the ability of the various facilities to be brought back to service quickly.

Route Diversity

The CLNJ project seeks to follow a concept where multiple transmission lines share a common corridor for a significant portion of the overall submarine route. The combined ROW width for both cables would be 500 feet. Use of common ROWs to co-locate facilities whether on land or underwater have advantages in limiting impacts to the surrounding area by confining these impacts to the corridors themselves.

However, one disadvantage is that having multiple lines in a common corridor can expose those lines to the possibility of a simultaneous event which can outage those facilities. This exposure may be even more acute in the situation of an underwater corridor where events like anchor drags can occur for hundreds of feet and potentially impact multiple circuits. That said, the risk of such an event can be mitigated by regularly verifying cable burial depth as well as other operational measures such as monitoring shipping traffic along cable routes.

The CLNJ landfall location will contain two circuits making landfall at the same location. Although the landfalls will retain separation of circuits by using multiple HDD routes, the cables approaching the landfalls will converge until they enter the HDD bores. This can add risk for multiple submarine cable outages in this area from an event like and anchor drag.

Redundancy & Operational Flexibility

Each individual HVDC system as a symmetrical monopole system will essentially be a radial transmission link with the N-1 outage of the total system capability being the ruling contingency. Within each system is contained redundancy that can mitigate the risk of a long-term equipment failure. For example, the offshore HVDC converters contain two three-phase converter transformers which would allow operation of the system at reduced capability for loss of one of those transformers, typically slightly more than half of the total capability of the system pre-outage. Onshore converter transformers are a single bank of three single phase units rated 412 MW each which would provide 1,236 MW of capability. A fourth unit is included as a spare unit; it may provide for spare service to multiple HVDC converters if they are of the same design.

The redundancy of the CLNJ project is comparable to other similarly configured HVDC-based projects in the SAA solicitation.

Maintenance and Spare Equipment Strategy

Typically, spares are provided for long lead time equipment in transmission systems similar to those described in the CLNJ proposal. In particular, spares are usually carried for the following components:

- Converter transformers – onshore (single-phase)
- Converter transformers – offshore (three-phase)
- Submarine cables – lengths sufficient for use in a splice
- Submarine cable accessories – terminations, splices, etc.
- Critical HVDC converter components – valves, insulators, bushings
- AC switchgear circuit breakers

The CLNJ proposal does not provide a detailed listing of spare parts to be provided. A follow-up question to Con Edison Transmission mentions that two onshore material storage yards will be provided “that would accommodate spares for onshore and offshore material components” but does not describe what those spare parts would be. Because no listing of spare parts is provided it is difficult to assign a risk level to this aspect of the proposal.

Cost Review

Proposal 990

Proposal Cost Estimates

The total proposal costs for CLNJ Proposal 990 are given below.

Category	Proposal 990
	$
Engineering & Design	43,619,680
Permitting/ Routing/Siting	45,580,330
ROW/Land Acquisition	33,788,184
Materials and Equipment	1,307,353,613
Construction & Commissioning	1,028,437,227
Construction Management	15,287,999
Overheads & Misc.	116,789,541
Contingency	156,326,126
Total Component Cost (Current Year)	2,747,182,700

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's consultant assembled independent cost estimates for the proposed facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The Independent estimates for the offshore components of Proposal 990 are:

Item	Qty:	Unit Cost ($)	Subtotal
Offshore Converter Station	2	$702,000,000	$1,404,000,000
±320 kV Submarine Cable	55	$5,000,000	$275,000,000
TOTAL			$1,679,000,000

The basic characteristics for the CLNJ project are as follows:

- Two 1,200 MW ±320 kV HVDC systems
- Submarine Cable Mileage: 55

Onshore Component Independent Cost Estimates

The consultant assembled independent cost estimates for the proposed facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and various other publicly available sources. The accuracy of their estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the onshore portions of Con Edison Transmission's proposal for Clean Link New Jersey (CLNJ) #990:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station – Smithburg (Note 1)	1	$350,000,000	$350,000,000
500 kV UG AC line to POI (<1mi)	1	$15,000,000	$15,000,000
500 kV 3-breaker ring bus at Smithburg	3	$6,000,000	$18,000,000
Sub-Total Smithburg			**$383,000,000**
Onshore Converter Station – Larrabee (Note 2)	1	$350,000,000	$350,000,000
230 kV UG AC line to POI (2 ckts <1mi)	2	$5,000,000	$10,000,000
230 kV breakers at Larrabee	3	$3,000,000	$9,000,000
Sub-Total Larrabee			**$369,000,000**
±320 kV UG Land Cable to Smithburg	23	$8,500,000	$195,500,000
±320 kV UG Land Cable to Larrabee	11	$8,500,000	$93,500,000
Total Onshore Components			**$1,041,000,000**

Total Independent Cost Estimates

The following is the total independent cost estimate for CLNJ Proposal 990,

Independent Cost Estimate

Proposal 990	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$2,720,000,000	$1,679,000,000	$1,041,000,000

For comparison, the total proposal cost estimate for CLNJ Proposal 990 is shown below.

Proposal Cost Estimate

Proposal 990	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$2,747,182,700	$1,805,785,081	$941,397,619

PSE&G/Ørsted Proposals

PSE&G/Orsted's Coastal Wind Link has provided seven independent Option 2 proposals, with Option 3 solutions included. The Option 2 proposals include 4 single system Option 2 proposals (1200 or 1400 MW capability) to Sewaren or Larrabee POIs, and 3 multi-system Option 2 proposals for injections of 2400 to 4200 MW to Sewaren, Deans and Larrabee POIs. The proposals also includes three 275 kV AC connections between the offshore platforms.

Table 6. **PSEG/Orsted Coast Wind Link Proposals**

Proposal ID(s)	Description(s)	Capability (MW)
397	Sewaren 320kV Collector (Final)	1 x 1200 HVDC
214	Sewaren 400kV Collector	1 x 1400 HVDC
613	Larrabee 320kV Collector V2	1 x 1200 HVDC
230	Larrabee 400kV Collector	1 x 1400 HVDC
871	Sewaren/Deans Twin Collector (Final)	2 x 1400 HVDC
208	Sewaren/Larrabee Twin Collector	2 x 1400 HVDC
683	**Sewaren/Deans/Larrabee Tri Collector**	**3 x 1400 HVDC**

Due to expected similarities in constructability results between the Coastal Wind Link – 7 Sewaren/Deans/Larrabee Tri Collector (Proposal 683) and the other six Coastal Wind Link proposals (each representing a subset of the Tri-collector proposal), only Proposal 683 is addressed in this report.

Project Overview

The Coastal Wind Link 7 components connecting to Sewaren and Deans substations share a common power corridor for most of their offshore routes, separating in Raritan Bay. The connection to Larrabee substation stays in the Atlantic Ocean, making landfall on the shoreline. The desktop review of the routes was thorough and identified cable crossings, fishing grounds, and seabed obstructions that could impact the route. More detailed surveys will need to be conducted if this proposal is awarded. The risks in the submarine routes are similar to other proposals utilizing the same POIs.

There is some added development and schedule risk associated with these larger sized systems, and additional risk consideration should be given to application of this technology in an offshore platform environment. The primary risk is schedule relying on new designs being qualified, designed, constructed, and commissioned within the proposed timeline.

The construction schedule for the Coastal Wind Link 7 proposal seems reasonable. The complete commercial operation date for all three HVDC systems is 2033. The largest risk to the schedule will be the HVDC system and submarine cables as ±400 kV HVDC systems are still being developed. A secondary construction risk includes the vessels for transporting and laying submarine transmission cables and the heavy-lift SSCVs needed for offshore platform installation, especially if many similar projects be planned for construction in the same time period.

The relative risks at the Sea Girt landfall location relate to the numerous existing submarine communication cables that also make landfall at this location. Potential conflicts with existing submarine facilities will be present with the Sewaren and Deans systems in this proposal due to the submarine cable route which traverses through the approaches to Raritan Bay and into Raritan River. Having multiple lines in a common corridor can expose those lines to the possibility of a simultaneous event which can outage those facilities.

The costs presented in the proposal is inclusive of all the facilities required to deliver wind generation from 275 kV AC switchgear located on the offshore platforms to the onshore POI. They also include costs for 275 kV AC platform interlinks between the three offshore HVDC converter station platforms.

Onshore Constructability Review

Proposals 683

Environmental (Regulatory) Analysis

Desktop Review for Proposal 683

The on-shore portion of the Project is comprised of the construction of three new converter stations, three HVDC underground cable routes from the land fall, and two tie lines from the new conversion stations to nearby substations. Project components are as follows:

- The Larrabee to landfall HVDC component makes landfall at Sea Girt Beach in Sea Girt Borough then follows public road right-of-way (ROW) for approximately 10 miles to the new Larrabee Converter Station in Lakewood Township
- The new Larrabee Converter Station component is located in Lakewood Township off East County Line Road
- The Larrabee HVDC Tie Line component connects the Larrabee Converter Station to the Larrabee Substation. The route is proposed within public road ROW and is approximately 1.9 miles in length
- The Deans to landfall HVDC component makes landfall in the City of South Amboy then follows public road ROWs for approximately 15 miles to the new Deans Converter Station in South Brunswick Township
- The new Deans Converter Station component is located off Fresh Ponds Road in South Brunswick Township
- The Deans HVDC Tie Line component connects the Deans Converter Station to the Deans Substation. The route is proposed within an existing overhead transmission ROW and is approximately one mile in length.
- The Sewaren to landfall HVDC component makes landfall at the Woodbridge Recycling Center in Woodbridge Township then follows public road ROWs for approximately 6.3 miles to the new Sewaren Converter Station
- The new Sewaren Converter Station component is located in Woodbridge Township off of Cliff Road and is immediately adjacent to the Sewaren Substation

Study Area

An analysis of the Project was performed to assist in the identification of major environmental and socioeconomic features and to provide a base for the extrapolation and derivation of future construction, permitting, mitigation, and land costs studies for the overall Project. A summary of the environmental and socioeconomic features associated with the Project are presented in Appendix A -Tables 18 and 19. Those features that have a particularly significant direct or indirect bearing on the Project's development are discussed further below. As the HVDC components are proposed within existing ROWs, it is not anticipated that the constructed alignment will deviate significantly from the proposed locations. Therefore, the Study Area is a 200-foot buffer centered on the alignment of the HVDC components and the parcels for the proposed converter stations. At the time of this analysis, access roads were not known, therefore, impacts associated with access roads are not included in this report.

Land Use

Aerial imager was used to develop a high-level review of land use and cover in the Project Study Area. The Larrabee to landfall HVDC component and the Larrabee HVDC Tie Line component are located in existing public road ROW. Adjacent land use is largely medium to high-density residential with some forested, commercial, and transportation land use. The new Larrabee Converter Station component is proposed within institutional land use. The Deans to landfall HVDC component is located in existing public road ROW. Adjacent land use is largely medium to high-density residential with some forested, commercial, and transportation land use. The Deans HVDC Tie Line component is located in public road ROW and existing transmission line ROW. Adjacent land use is largely forested. The new Deans Converter Station component is located on an abandoned industrial site. The Sewaren to landfall HVDC component is located in existing public road ROW. Adjacent land use is largely medium to high-density residential, transportation, and industrial. The new Sewaren Converter Station component is located on an abandoned industrial site.

The Project is compatible with the land uses crossed. As the majority of the Project is expected to be constructed within existing transmission line or road ROW, conflicts with land use are expected to be minimal. Coordination with the agencies holding the existing road ROW or transmission line ROW easements would need to be conducted to negotiate use of their ROW. These negotiations can be unpredictable regarding a willingness to collocate facilities and the requirements of the existing easement language. For the new converter stations, easements or property purchases will need to be negotiated from affected landowners.

Public and Protected Lands

Crossing of public or protected lands, especially federal and state owned or managed lands, invariably requires additional scrutiny regarding regulatory requirements, consultations, ROW approvals, easement acquisition, and subsequent operation and maintenance activities. This concern is heightened by the environmental sensitivity attached to areas that support sensitive natural resources and/or recreational usage.

The desktop review showed that the Project crosses 22 public lands. The Larrabee to landfall HVDC component crosses Dolan Field, Edgar Felix Bike Path, Brice Park and Allaire State Park in Wall Township; Manasquan River Wildlife Management Area in Brick Township; Ramtown Manor Park, three municipal open spaces, and Turkey Swamp Park in Howell Township; and Brook Road Park and Metedeconk River Recreation Area in Lakewood Township. The Deans to landfall HVDC component crosses Bordentown Avenue Park, Kennedy Park, Burkes Park, and Millers Corner Park in Sayreville Borough, Fitzpatrick Field in South River Borough; and Tamarack Hollow, and Ireland Brook Conservation Area in East Brunswick Township. The Sewaren to landfall HVDC component crosses Perth Amboy City Bicycle and Pedestrian Trail in Perth Amboy City; and Sewaren Marina Park and Buffer Strip Park in Woodbridge Township. In addition to these public lands, a review of the NJ Public Access Locations Search Tool showed that four waterways along the Project are subject to public trust rights. The Deans to landfall HVDC component is adjacent to Raritan Bay, the Atlantic Ocean, and crosses South River. The Sewaren to landfall HVDC component is adjacent to Raritan River.

The review of NJ Coastal Management Program's list of Excluded Federal Lands showed that no excluded federal lands are crossed by the Project. Review of NJ Farmland Preservation Program's preserved farmland database shows that farmland conservation easements are not anticipated to be crossed.

Special Regulation Regions

Certain urban areas within NJ are deemed as "Special Areas" due to their importance for human use or stringent planning requirements. According to the Division of Land Resource Protection, these areas include Atlantic City, The Hudson River Waterfront Area, and "Special Urban Areas" which are areas the NJ Department of Community Affairs (DCA) defines as municipalities in urban aid legislation qualified to receive state aid to enable them to maintain and upgrade municipal services and offset local property taxes. The Project is not located within the boundaries of either Atlantic City or the Hudson River Waterfront Area. However, the Project crosses one municipality, Old Bridge

Township, that qualifies as a Special Urban Area (DCA 2022). NJ Admin Code 7:7-9.41 states that any development that would adversely affect the economic wellbeing of these areas is discouraged, when an alternative which is more beneficial to the Special Urban Area is feasible.

The Project components within these townships are proposed to be underground facilities within existing ROWs, therefore, impact to the economic wellbeing of the townships are likely minimal in nature. However, temporary traffic disruptions during construction may cause some short-term impacts. Furthermore, construction of the converter stations should have minimal impact due to the adjacent industrial and institutional land uses.

Based on the desktop review it is not anticipated that the Project will have adverse effects on Special Regulations Regions.

Special Landscape or Hazard Areas

Special hazard areas are areas that the NJDEP deems as having a known actual or potential hazard to public health, safety, and welfare, or to public or private property (NJDEP 2021). These areas include the navigable airspace around airports and seaplane landing areas, potential evacuation zones, hazardous material disposal sites, and areas of hazardous material contamination. Review of special hazard areas within the Study Area showed that no seaplane landing areas or airports were in the vicinity of the Project. The Project crosses five hurricane evacuation routes. The Larrabee to landfall HVDC component crosses NJ-71, NJ-34, and Garden State Parkway. The Deans to landfall HVDC component crosses the Garden State Parkway. The Sewaren to landfall HVDC component crosses the Garden State Parkway, NJ-440, and CR-611.

NJ Geodetic Controls are established as reference points used for mapping and charting activities. Review of the control locations showed that a total of eight marks were located within the Project's Study Area with an additional 11 marks in close proximity (within 100 feet of the Study Area).

Federal Emergency Management Agency's Floodplains and Floodways data was reviewed for coastal high hazard areas and flood hazard areas. A coastal high hazard floodplain is crossed by the Primary Route adjacent to the Raritan Bay. Additional floodplains and floodways are crossed by other components of the Project as well.
Based on the desktop review it is anticipated that the Project will cross Special Landscape or Hazard Areas. This may result in more rigorous permitting processes or special construction requirements.

Waterbodies and Wetlands

The presence of wetlands can impact Project permitting and construction. In addition to the need to adopt special construction techniques (including avoidance) for specific wetland types and field conditions, the types of wetlands encountered has significant implications from a permitting and compensatory mitigation perspective.
Based on the desktop review, wetlands and waterbodies appear to be crossed by the Project. This can impact Project permitting and construction. An on-site delineation would be required to determine the actual location and extent of wetlands and waterbodies present and to assess permitting implications for jurisdictional features.

Threatened and Endangered (TE) Species and Protected Habitats

Threatened and endangered species and protected habitats can impact permitting, construction schedules, and construction techniques.

The desktop assessment sought to identify federally- and state-listed threatened and endangered species that may occur within the Study Area. The review was conducted utilizing the United States Fish and Wildlife Service (USFWS) maintained Information for Planning and Consultation (IPaC) online tool, NatureServe Explorer Pro online mapping tool, and the List of TE Species of NJ published by the NJDEP. The results of this review are included in Table 2 and discussed further below.

Given the results of the desktop review of publicly available data, it is anticipated that the Project is within the range of both federally- and state-listed species, and that coordination with state and federal agencies will be required. Construction restrictions, timeframe, or mitigation may be necessary to comply with avoidance of sensitive species, however, the extent of which cannot be known until after coordination with the NJDEP takes place.

Cultural Resources

The NJ State Historic Preservation Office's (SHPO) data sets for historic districts, historic properties, and archaeological site grids were used to determine the presence of cultural resources in the Study Area. The review showed that the Project crosses through several historic districts. The Larrabee to landfall HVDC component crosses the New York and Long Branch Railroad, Manasquan Main Street, and Garden State Parkway Historic Districts. The Deans to landfall component crosses the Camden and Amboy Railroad Main Line, New York and Long Branch Railroad, Raritan River Railroad, Garden State Parkway, and Herrmann-Aukam Company, The Deans HVDC Tie Line component crosses Metuchen to Burlington Transmission Line Historic Districts. The Sewaren to landfall HVDC component crosses the Garden State Parkway, Amboy and Elizabethport Branch of the Central Railroad of NJ Historic District, and New York and Long Branch Railroad. The Sewaren to landfall HVDC and Sewaren Converter Station cross the Sewaren Generating Station Historic Districts. Additionally, historic properties were reviewed. The Sewaren to landfall HVDC component crosses the Overhead Contact System, Pennsylvania Railroad Company historic property and Garden State Parkway-Driscoll Bridge historic property. The Larrabee to landfall HVDC component crosses the Allenwood-Lakewood Road Bridge historic property. The Deans to landfall HVDC component crosses the Overhead Contact System of the Pennsylvania Railroad Company historic property.

While not pinpointing the exact location, the archaeological site grid identifies the presence of an archaeological resource within a half mile by half mile area. The Deans to landfall HVDC component cross through three grids. The Larrabee to landfall HVDC component crosses two grids with eligible resources and three grids with identified resources. Sewaren to landfall HVDC component crosses one grid with identified resources.

Impacts associated with cultural resources include both direct (physical) and indirect (viewshed) considerations. Utilization of existing ROWs for the Project should mitigate some potential concerns regarding both consideration types, however, the converter stations and other necessary construction elements such as access roads or laydown yards must also be considered when assessing impacts. Coordination with NJ Historic Preservation Office will need to be conducted to determine required surveys (if any) to assess the extent of impact to cultural resources in the Project vicinity.

Federal, State, and Local Environmental Permits

Appendix A -Table 20 lists the environmental permits, authorizations, clearances, and consultations that could be required for the Project's on-shore components. For each authorization, the table identifies the administrating agency/authority, anticipated agency review timeframe, and additional information to be considered. The table represents a list of typically required permits for similar projects in the same area and is not specific to the Project. Although the Project-specific details included in this report can assist in the planning stages of the Project, additional reviews should be conducted as the Project is further developed and the extent of environmental impacts is known.

Federal Permits and Authorizations

Depending on the outcome of the environmental survey and Division of Land Resource Protection (DLRP) inspection and the final design of Project facilities, the Project could require several federal permits, authorizations, and consultations prior to construction. In addition, USFWS consultations and authorizations under Section 7 of the Endangered Species Act (ESA) could also be required to be obtained prior to receiving federal permits. These consultation and concurrences are discussed below in greater detail.

USACE Section 404

In NJ, the NJDEP is the agency delegated responsibility to implement Section 404 of the Clean Water Act (33 U.S.C. 13574), which regulates the discharge of dredged or fill material into waters (including wetlands) of the United States.

The exception being an activity proposed in a tidal water or water designated under Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 403), for which the USACE has regulatory authority. The Sewaren to landfall HVDC component is located within 1,000 feet of Arthur Kill, a tidally influenced water. Pending the final design and the extent of impacts to jurisdictional features, the component may require a USACE Nationwide Permit 57 (Electric Utility Lines and Telecommunication Activities) or an Individual Permit. Additionally, impacts to tidal waters will require consultation with the USACE to obtain Section 10 approval. The Project is located within the jurisdictional boundary of the New York and Philadelphia Districts of the USACE. No Section 10 designated waters are crossed in the Philadelphia district. The New York District Office will need to be contacted to confirm if a Section 10 designated water is crossed by the Project within their regulatory boundary.

USFWS Endangered Species Consultation and Clearance
For federally funded or permitted projects, consultation with the USFWS is necessary to ensure that impacts to federally-listed threatened or endangered species and critical habitats are appropriately addressed under Section 7 of the ESA. The Project falls within the jurisdictional boundary of the USFWS NJ Ecological Services Field Office. Initial screening for many projects in NJ may be conducted online utilizing the IPaC online tool and county data compiled by the NJDEP. A "preliminary" screening for the Project has been completed, with results discussed in detail in the previous TE Species section of this report.

Typically, early consultation with USFWS will be of paramount importance. Coordination with the USFWS NJ Ecological Services Field Office will be required to determine the extent of survey and/or mitigation needed for each species.
USFWS authorizations are generally valid for two years. If construction is not completed after two years or new species are added to the list before construction begins, the protected species assessment must be revalidated through renewed consultation and, potentially, new or additional field surveys. Species-specific surveys and construction timeframes may be applicable.

State Permits
It is anticipated that the Project could require the following state environmental permits, consultations, clearances, and authorizations, including:

- State Protected Species Consultations
- State Historic Preservation Office (SHPO) Consultations and Clearances
- Freshwater Wetlands Permits
- Coastal Wetlands Permits
- Waterfront Development Permit
- Flood Hazard Area Permit
- Tidelands License
- Green Acres Program Diversion Permit
- NJ Pollutant Discharge Elimination System Permits (NJPDES) Basic Industrial Stormwater Permit
- Air Quality Permits

Green Acres Program Diversion Permit:
Green Acres is a NJDEP land acquisition program that supports the addition of land resources and greenways to New Jersey's state parks, forests, natural areas, and wildlife management areas. Sections of the Primary Route cross multiple Green Acres encumbered parcels, however the parcels are crossed within an existing maintained public ROW.
A diversion or disposal may be required if the portions of the project are expanded beyond the existing public ROW onto Green Acres properties. The developer noted that this Project's proposed routing was selected to avoid

encumbered Green Acres parcels and anticipates that no diversions will be required. If this project is selected, detailed review of the project routing with the NJDEP will be required.

Local Permits and Approvals

It is anticipated that the Project could require the following county and municipal permits, consultations, clearances, and authorizations:

- Zoning Permits,
- Road Permits,
- Building Permits, and
- Erosion and Sediment Control Plan.

Private Permits

Activities located within railroad ROWs require permits from the owner and operators of the rail lines. Multiple rail lines operated by Consolidated Rail Corporation (Conrail) and NJ Transit Authority are crossed by the Project. The rail lines are proposed to be crossed underground, limiting impacts to operations, but construction activities may require further permits and consultations. Railroad permits carry an average review time of six to 12 months.

Roadway Permits

Activities located within public road ROWs require permits from local, state, and federal departments of transportation. A majority of the Project is proposed to be located within public road ROWs that are anticipated to require roadway permits. Major highways proposed to be crossed include the Garden State Parkway (GSP) by HVDC components and the NJ Turnpike (NJT)/Interstate 95 by the Deans to landfall HVDC component. The NJ Turnpike Authority manages the NJT and GSP and requires a license to cross when a highway is crossed or encroached by construction activities. The Federal Highway Administration also requires consultation when crossing Interstate highways. The underground crossing of the I-95/NJ Turnpike may take additional coordination and it is anticipated the Turnpike Authority will require the installation to take place via HDD techniques. Roadway permits carry an average review time of six months.

Environmental (Regulatory) Risks

Right-of-Way and Easement Risks

- Securing easements and using previously-secured easements has been identified as a critical constraint. Easements can be held in perpetuity and may not allow for additional development, depending on the easement type and language. Each parcel crossed by the Project could have an easement with the property owner, which need to be reviewed to identify the extent of the easement and the restrictions surrounding it. ROW easements were not reviewed as part of this study and the easements may not be discovered until parcel title review is conducted.
- The easement agreements with public and private landowners for the HVDC component is critical for the feasibility of the Project and will need to be coordinated with the easement holders. The majority of the HVDC component is within public road ROW. Other underground utilities may also be present within the road ROW, which may complicate obtaining an easement and require significant coordination regarding avoidance. The underground crossing of the I-95 NJ Turnpike will be a new crossing and will require a new easement which may take additional time and engineering coordination regarding the methods used to install the crossing. Additionally, several public lands or conservation easements are crossed by the HVDC components; however, since these crossings are accomplished within existing road ROW, it is likely that there are existing agreements in place.

- Supplemental easements may be necessary for the HVDC components proposed within existing transmission line ROW, or for the development of access roads. The requirements and/or availability of obtaining such supplemental easements is unclear until coordination with the property owner or review of the easement language is conducted. Additional easements or property purchases will be required for the three greenfield converter stations and access to them.

Permitting Risks

- Components of this project run through Green Acres-encumbered properties. However, given that the project predominantly uses pre-disturbed ROW, the impacts are expected to be minimal, although any expansion required during construction could result in additional impacts and require permitting.
- Portions of the Project are proposed to cross railroad ROW and will require permits. Railroads are privately owned, and each has its own requirements. While the permit applications may be better received by the railroad due to the facilities being proposed underground, significant coordination regarding placement of the line and construction techniques may be required that prolong the permitting process. The HVDC components that are located within road ROW will also require permitting with federal, state, and local agencies that will likely involve avoidance of other underground utilities.
- The converter stations and HVDC components have the potential to impact environmental resources including streams and wetlands within coastal and freshwater ecosystems and impacts to these resources will require a number of permits from the state and county. If impacts to freshwater wetlands exceed a threshold of 0.5-acre for aboveground impacts, or one-acre of total wetland impact, general permits may not be applicable and an individual permit may need to be acquired, which will include a lengthier review time. Mitigation is also required if the Project permanently disturbs or impacts 0.1-acre or more of freshwater wetland. Consultation with the NJDEP earlier in the Project's development will help mitigate risks by addressing permitting concerns and allowing for a larger consultation and permitting timeline.

TE Species Risks

- Review of various sources that maintain TE species records indicated the potential for numerous species to be located within the Project Study Area of both the Primary Route and converter station components. The Project proponents should conduct an independent TE species review once the potential limits-of-disturbance and environmental impacts are better known to fully ascertain the requirements for mitigation associated with the sensitive

Transmission Line Risks

- Schedule risks based on outage windows required at Deans Substation.
- For the underground transmission lines, the room required in the existing railroad corridor for the new transmission line duct banks is a concern, based on the railroad company's required clearance to the rail. Although the proposed depth is four feet, that is a minimum, and with utility crossings, the depth could be much deeper, which affects the heat dissipation. If the railroad determines there is not enough room, the transmission line may need to parallel the railroad corridor, affecting cost.
- The three separate duct banks along the railroad may be an issue with two circuits on one side and one circuit on the other. One duct bank with all three circuits could be more beneficial for the railroad and transmission line construction costs. The conduits for circuits 2 and 3 could be left empty until needed. Installing a separate duct bank for each circuit could affect cost and schedule.
- Should the Alternative be chosen, extensive construction in road ROW should be anticipated which would require coordination and scheduling with municipal and department of transportation authorities as well as potentially extensive utility avoidance coordination.

Substation Risks

- Procurement of HVDC equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With HVDC equipment being relatively uncommon in the United States, unexpected delays in procurement, engineering, and construction may occur. Additionally, currency fluctuations for overseas equipment are likely to occur which will impact costs.

Construction Schedule

- The conceptual project schedule developed by the onshore consultant indicates that the on-shore aspects of each project will take approximately 84 months to complete, from Project initiation to energization. It is assumed that the engineering process can continue as siting permit is reviewed. There are four major activities on the critical path: Engineering; Siting and major permit acquisition; long lead equipment procurement; construction and commissioning. Delays in completing any of these activities would jeopardize completing the Project within the estimated schedule.
- Schedule risks identified due to impacts to traffic patterns and land use in special urban areas of Ashbury Park and Neptune township, which have potential for public opposition and delays or denials of permits
- Impacts to traffic patterns and land use in special urban areas of Lakewood Township and Woodbridge Township have potential for public opposition and delays or denials of permits, introducing risks to the construction schedule.

Offshore Constructability Review

Proposal 683

Environmental (Regulatory) Analysis

Overall

The Coastal Wind Link PSEG & Orsted proposal 683 describes a transmission system designed to connect offshore wind generation into the JCP&L and PSE&G areas in New Jersey. The proposal is to connect 4,200 MW via three offshore to onshore HVDC connections. Each 1,400 MW converter system will connect to the JCP&L Larrabee substation and the PSE&G Sewaren and Deans substations. The proposal also contains AC interconnections between the offshore platforms.

Routing

The method of cable installation varies based on the route location. While in the Atlantic Ocean cable will be installed via Offshore Trencher, via Vertical Injector while in Raritan Bay, and via Shallow Trencher in the Raritan River.

The Sewaren and Deans POI proposed routes run together in the same corridor from the offshore platforms, through federal waters into Raritan Bay. They split when the Deans cables make landfall and the Sewaren cables continues into Raritan River to make its landfall. The map books provided in the proposal identify cable crossings, fishing and dumping grounds, and potential wrecks or obstructions that the cable route will need to account for. The relative risk of these cable routes is higher than many of the other SAA proposals due to the cable routes through more heavily trafficked areas.

The Larrabee POI proposed route is entirely independent of the Sewaren and Deans POI routes, crossing through federal and state waters prior to making landfall at Sea Girt, NJ. The map books provided identify cable crossings and potential obstructions, with the amount increasing as the cable is closer to the shoreline. The relative risk of these cable routes is similar to many of the other SAA proposals with cable routes in the same general area.

The platform 275 kV interlinks are located in open water and do not cross any charted cables or pass any identified seabed obstructions.

If the whole or a portion of this proposal is chosen, more detailed studies would need to be performed to determine if the routes proposed are capable of the overall award. Several proposals suggest the same POIs and therefore offer similar routes and share the same risks.

The onshore portions of the HVDC cable will be installed in concrete two cable duct banks and spliced in pre-cast vaults. The cables will be buried beneath public roads for the majority of their routes. Special crossings have been identified for each of the three onshore routes including bridges, railroad crossings, and highway crossings. There is no information provided about other utilities already beneath the roads in the cable path. More detailed studies would need to be performed if this proposal was selected.

Landfall

A different landfall location is presented for each of the proposed offshore platforms. No secondary landfall locations are identified; they could be used if agreements with landowners of the proposed locations cannot be reached. The relative risks associated with each of these landfall locations is similar to landfall locations described in other NJ SAA proposals.

- The proposed landfall location for the offshore platform connection to the PSE&G Sewaren substation is located at the Bayshore Recycling facility in Keasbey, NJ. The proposal indicates that exclusive rights to the property have been acquired by a ROE/ROFR agreement.
- The proposed landfall location for the offshore platform connection to the PSE&G Deans substation is located at the Main Street in South Amboy, NJ. The proposal indicates that at the time of submittal, negotiations for an option agreement with the landowner were taking place.
- The proposed landfall location for the offshore platform connection to the JCP&L Larrabee substation is located at the National Guard Training Center in Sea Girt, NJ. The proposal indicates that at the time of submittal, discussions were ongoing with the landowner to determine site layout and secure property rights. This landfall is on a publicly owned property that is not open to the public and has a history as a landfall for communication cables. The relative risks at this landfall location mainly relate to the numerous existing submarine communication cables that also make landfall at this location.

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Facility Conflicts

Offshore platform locations present no obvious issues or risks that are different than other proposals with offshore platforms in the same general area. Platform interlink routes also present no obvious issues or risks.

Potential conflicts with existing submarine facilities will be present with this proposal due to the submarine cable route which traverses through the approaches to Raritan Bay and into the Raritan River. This area has historically been active with marine traffic and industrial uses, including submarine crossings of cables and pipelines.

The Sea Girt landfall location chosen by the Developer currently contains a number of other in-service and retired-in-place facilities. It has historically been used as a landfall for submarine communications cables.

Environmental Risk

The proposal includes both Environmental and Fishery protection plans. The Environmental plan summarizes the impacts on physical and biological resources. A GIS desktop study was performed and summarized in Appendix K of the proposal. The Fishery protection plan includes potential impacts to fisheries off the coast as well as an engagement and communication plan.

The general environmental risks associated with the various offshore platforms and submarine cables is similar to the risks posed by the offshore elements of other NJ SAA proposals. The environmental impacts from these proposals mainly come from the installation of the submarine cable and the seabed disturbances caused by this activity.

Permits

The proposal includes a detailed summary of the permitting needed for each of the on-shore cable routes and converter locations, and also includes a permitting matrix where major permits have been identified at the federal, state, regional, county, and municipal levels with the anticipated review periods. This proposal team is also currently working on the permitting for the previously awarded Ocean Wind projects.

It appears that the nature and complexity of permits for the Coastal Wind Link will be similar to those of other projects, and present similar risks.

Technology and Supply Chain Risks

This section offers an assessment of risks that may be apparent in the overall system, the technology being proposed, specific risks that may be inherent in specific equipment, and risks posed by supply chain considerations.

Technology Risk

The Developer's proposal centers around offshore collector / converter substations consisting of two buses of 275 kV gas insulated switchgear (GIS). Each GIS interconnects to 3 submarine cables bringing power from the wind resource areas. The 275 kV GIS is connected to two 416/275 kV step-up transformers which, in turn, feed 1,400 MW HVDC converters operating at ±400 kV. The converters supply cables exporting the power to an onshore converter and AC substation. ±400 kV is a relatively new operation voltage for submarine cable VSC HVDC systems and has never been constructed or operated at 1,400 MW in an offshore environment. The proposed system is still in development which adds risk to the project schedule.

Overall System

The interconnection system described on the proposals is based on technology currently available and, therefore, technically feasible. However, application of these components to installation on offshore platforms and exposure to the harsh environment that surrounds any salt water marine application has not been commonly done using the voltage and scale being proposed. The primary risk associated with the overall system is that associated with the construction and operation of the offshore portions of the system, and in particular the platform-based HVDC converters and associated transformers, switchgear, and other components. The provided Appendix C Basis of Design explains that 275 kV was chosen as the AC voltage for connecting wind generation based on observing turbine array collection system voltages increase over time and to avoid obsolescence at the time of energization. Note that most of the other NJ SAA proposals assume 66 kV as the wind turbine collection system voltage.

HVDC System

The HVDC system proposed is built around voltage source converter (VSC) based HVDC technology. The HVDC technology is based on Multi-level Modular Converter technology utilizing power semiconductors will be of the Insulated-Gate Bipolar Transistor (IGBT) type. IGBT designs allow for power scaling in their inherent design and the semiconductor package can be equipped with different numbers of parallel semiconductor sub-modules. The more of such sub-modules that are included, the higher current can be handled by the converter. For the proposed projects, the proposed base design is adapted to 1,400 MW export capacity at ±400 kV. However, systems operating at ±400 kV are relatively new, and although some are in operation, the total operating experience with systems using this voltage is limited when compared to ±320 kV or below. The ±400 kV risk is associated both with the submarine cables as well as the HVDC converters themselves.

Also, ±400 kV systems currently in operation are limited to systems in the 1,000 MW range. The 1,400 MW system in this proposal is still in the development stage which adds some development and schedule risk for applying this technology to an offshore system. The risk in this system lies in how much its development impacts commercial availability and the overall schedule of the project.

Offshore Platform

A general description of offshore platform is provided along with a 3D model and general layout. The proposal indicates that Siemens and Hitachi ABB Power Grids (HAPG) were consulted in the development of this project and collaborated with Aker, Dragados, and Aibel for design concepts.

Submarine Cable

The Developer proposes to install ±400 kV cable systems to connect the converter terminals. ±400 kV HVDC submarine cable is relatively untried at the power levels being contemplated. Beyond the technology risk is schedule and supply chain risk associated with these types of specialized cables.

Project Complexity

For a project of the scope set on the 2021 NJ Offshore Wind Transmission proposal, the plans proposed by the Developer present a modular approach to deliver 4,200 MW of offshore wind power in steps of 1,400 MW starting at 1,400 MW. The modular approach reduces complexity by:

1. The parent company (Orsted) of Coastal Wind have and continue to acquire experience with offshore wind projects overseas and via the Ocean Wind projects.

2. The route selection benefits from work being currently done with permitting authorities on the previously awarded Ocean Wind projects.

Risks associated with the complexity of this proposal/project are similar to those in other proposals submitted as part of the NJ SAA RFP.

Supply Chain Risk

The risks in the supply chain for these projects predominantly resides in the HVDC converters, offshore platforms, and submarine cables. The relative risks between the APT proposal and other proposals in the SAA solicitation is about the same when considering HVDC systems of the same MW size and operating voltage.

Long Lead Time Items

Long lead time items of highest concern are the submarine cables, HVDC converters, and offshore platforms. The vast majority of this risk resides in the limited number of suppliers for these items which is discussed in more detail below.

Supplier Scarcity

Submarine cables, HVDC converters, and offshore platforms of the designs needed for these projects are capable of being supplied and constructed by limited number of globally based companies. Combine this with the relative scarcity of specialized equipment needed to transport and install these facilities in a marine environment, significant risk can develop should many similar projects be planned for construction in the same time period.

Of particular concern are the vessels for transporting and laying submarine transmission cables and the heavy-lift SSCVs needed for offshore platform installation. Note that the potential competition for these resources will come from not only other offshore transmission projects, but also offshore wind generator projects which will need the same vessels for their own platform installations and submarine cables for their collector systems. As stated above this risk is associated with all similar NJ SAA projects and not just for the Coastal Wind Link project.

Construction Schedule Risk

The overall schedule duration is approximately 9.5 years culminating in a Commercial Operation Date (COD) of March 2031. This schedule utilizes a COD of March 2030 for Phase 1 (Proposal 210 - First 1200MW) and March 2031 for Phase 2 (Proposal 172 - Second 1200MW) and Phase 3 (Proposal 769 – Third 1200MW).

Permitting

Permitting for the onshore and offshore components is scheduled to last from 2021 to 2026 with the bulk of that time being dedicated to the offshore permits. The total duration for permitting activity is approximately 5 years. The duration for onshore permitting is scheduled for approximately 2 years and the offshore permitting is scheduled for approximately 5 years. Details provided in the proposal include a Project Permitting Matrix which summaries the permitting that will be necessary. The schedule for the onshore permitting is based on the various agencies review time but does not appear to account for any delays in acquiring permits and the risk to the project schedule if that were to happen. Overall permitting risk is similar to other NJ SAA projects.

Construction

The construction schedule for the Coastal Wind Link 7 proposal seems reasonable. The complete commercial operation date for all three HVDC systems is 2033. The systems are staggered in the schedule in the order of the Sewaren, Deans, and Larrabee POIs. From the schedule provided it was unclear what kind of float is accounted for in the case of delays or time shifting to still meet the proposed in-service dates. The largest risk to the schedule will be the HVDC system and submarine cables. The time allotted to the HVDC system on the schedule is approximately 3-4 years. The 1,400 MW ±400 kV HVDC system will need to be developed and commercially available in the time allowed; a limited number of suppliers of HVDC systems and submarine cables further exacerbates this risk.

Outage Planning

Outage planning schedule risk will relate mainly to construction for onshore facilities, and in particular those facilities being integrated into the existing POI substations at Sewaren, Deans, and Larrabee. These outages will drive the ability to connect and energize the offshore system and perform commissioning activities. The outages described in the proposal include 5 outages at Sewaren substation, the longest one taking approximately 14 days. The proposal includes 3 outages at Deans substation, the longest one taking approximately 14 days. The proposal includes 4 outages at Larrabee substation, the longest one taking approximately 30 days. The estimated scope and duration will need to be confirmed by the Transmission Owners that will be performing the work at the POI substations. All transmission outages will be subject to PJM's outage scheduling procedures and will be subject to the risk of change or cancellation as are any transmission outages

Other Overall Schedule Risk

Perhaps the largest overall schedule risk is related to supply chain constraints for HVDC converters and submarine cables, and the need for specialized equipment for installation of submarine cables and offshore platforms. This will be especially impactful should multiple projects be chosen for installation during the same time period. Further exacerbating this risk will be construction of offshore generating facilities which will place similar demands on the same universe of manufacturers and constructors. Given the permitting strategy for this project, it is anticipated that both wind generation and related transmission projects will be occurring at about the same time.

O&M Risk

Once installed and upon operation the various systems and components of Coastal Wind Link's transmission system will be subject to risk of failure. Some of this risk is determined by the configuration of each system and its exposure to failure, while other types of operational risk are determined by the ability of the various facilities to be brought back to service quickly.

Route Diversity

The proposal is for three separate platforms interconnecting to three individual existing substations in the New Jersey transmission system. The offshore cables connecting to Deans and Sewaren substations share a common corridor in the Atlantic Ocean and Raritan Bay and separate when one makes landfall and the other continues into Raritan River. The cables connecting to Larrabee substation take a completely independent route from the others.

However, one disadvantage is that having multiple lines in a common corridor can expose those lines to the possibility of a simultaneous event which can outage those facilities. This exposure may be even more acute in the situation of an underwater corridor where events like anchor drags can occur for hundreds of feet and potentially impact multiple circuits. That said, the risk of such an event can be mitigated by regularly verifying cable burial depth as well as other operational measures such as monitoring shipping traffic along cable routes.

Redundancy & Operational Flexibility

For this proposal platform station service power is normally provided through the tertiary winding of the converter transformer. These feed two redundant auxiliary switchboards that are each capable of supplying full station service to the platform. If isolated from the wind generation, the platform is capable of being backfed from the onshore system. The offshore platforms will each have two diesel generators approximately 1.5 MW in size. Each generator will be sized to be capable to supply the full platform load. Each diesel will have a day tank able to support eight continuous hours of 100% load and storage tanks that will be able to supply average load for at least seven days.

Redundant diesel generators, AC platform interlinks, and ability to receive station service power backfed from shore will provide for a reliable AC auxiliary power system on each platform which is a bit more robust than what is described in other proposals.

Maintenance and Spare Equipment Strategy:

The proposal includes a spare converter transformer for each of the on-shore converter stations. Comments from the developer indicates that a spare transformer for the offshore converter will be kept on shore at the Sewaren converter station. Replacement timeframes will be largely dependent on vessel availability and can take up to 22 days for commissioning and testing before adding load back onto the system.

Cost Review

Proposal 683

Proposal Cost Estimates

The total proposal cost for Proposal 683 proposal is given below.

Category	Full Project
	$
Engineering & Design	526,745,552
Permitting/ Routing/Siting	302,244,245
ROW/Land Acquisition	50,972,747

Materials and Equipment	3,284,463,196
Construction & Commissioning	1,383,598,638
Construction Management	330,080,326
Overheads & Misc.	649,717,371
Contingency	652,782,209
Total Component Cost (Current Year)	7,180,604,285

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's Offshore consultant assembled independent cost estimates for the proposed offshore facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.
The following is an independent cost estimate for the Offshore portion of APT's proposal 210:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	3	$826,000,000	$2,478,000,000
400 kV Submarine Cable	235	$5,600,000	$1,416,800,000
Total Offshore			**$3,894,800,000**

PJM's Offshore consultant's review of the Offshore related costs is summarized in this section. A description of the values in each column is as follows:

- Independent Estimate values are costs developed by consultant based on cost data from comparable projects and prior estimates, information from equipment suppliers, and engineering judgement
- Average of Proposals Reviewed values are averages for all the proposals consultant was assigned to review.

The basic characteristics for the Coastal Wind Link 7 project 683 are as follows:

- Three 1,400 MW 400 kV HVDC systems
- HVDC Submarine Cable ±400 kV - 235 miles

Onshore Component Independent Cost Estimates

As part of this study, PJM's Onshore consultant performed a high-level conceptual cost estimate for the on-shore components of the Project.
The consultant's estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of our previous experience with substation engineering, transmission line engineering, and construction. The total does include a contingency of 30 percent as it is a concept level estimate.

The following is the independent cost estimate for the Onshore portion of Proposal 683.

	Total
Materials and Equipment	$721,252,882
Engineering and Design	$73,107,839
Construction and Commissioning	$361,568,869
Permitting/Routing/Siting	$70,041,353
ROW/Land Acquisition	$77,003,390
Construction Management	$91,497,240
Overheads/Misc./Contingency Cost (30%)	$416,605,099
Total Cost	$1,811,076,672

Assumptions for Onshore Cost Estimates

- Component 1: S1 400kV Sewaren POI Upgrades:
- The substation expansion will occur entirely within the proposer's property. Land acquisition costs are not included in the estimate.
- The new substation will contain the following equipment:
  - Three 230kV Circuit Breakers
  - Eight 230kV Disconnect Switches
  - Three sets of metering CTs
  - Six 230kV CCVTs
  - Nine 230kV Surge Arresters
  - Three Breaker Control Relay Panels
  - Two Line Relay Panels
- The contractor will be performing the testing of major material, relaying installation, and construction labor.
- Component 2: S2 400kV Sewaren AC Tie Line:
- Install an overhead 230kV strain bus connection between the a-frames at Sewaren switching station to the new Sewaren converter station.
- The Tie line will fall entirely within the Sewaren Substation
- Conductor will be triple-bundle 1590 kcmil ACSR
- Component 3: S3 400kV Sewaren On-shore Converter:
- The substation expansion will occur entirely within the proposer's property. Some land acquisition costs are included in the estimate.
- The new substation will contain the following equipment:
  - One 1400MW HVDC converter hall and equipment set
  - Four 500kV Single Phase Transformers
  - Two 500kV Disconnect Switches
  - One 500kV Circuit Breaker
  - Three Metering CTs
  - Three 500kV CCVTs
  - One Control Building
  - Demolition and site prep for HVDC equipment
- The contractor will be performing the testing of major material, relays, and construction labor.
- Component 4: S4 400kV Sewaren On-shore HVDC Cable:
- The submarine cables will travel up the Raritan River and make landfall via HDDs at the Bayshore Recycling facility in Keasbey, NJ.
- Install approximately 6.3 miles of HVDC underground cable between the landing and the new Sewaren converter station, located in Woodbridge, NJ.
- The proposed conductor is 2500 mm^2 copper cable. The ±400kV HVDC circuit will comprise of two cables.

- One fiber optic cable will be installed in the duct bank.
- A five-foot-wide concrete duct bank will be installed primarily inside public road ROW, at a minimum of 4.25 feet belowground, between the landing and proposed converter station. When outside of public road ROW, a ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- The installation process will be primarily trench excavation, with a vault approximately every 2,000 feet to splice and pull cable. Where open trenching is not possible, or a crossing is required, special crossing techniques will be used to install the cable while minimizing environmental impacts:
  - Jack & Bore (J&B): used to install the cable system beneath certain infrastructure or other features that cannot be open cut (e.g., a railroad or highway).
  - Bridge Attachment: used in areas where an open-cut installation is not practical and the cable system can instead be attached to an existing bridge, thereby effectively spanning features such as water resources or highway underpasses.
  - HDD: used to install cable where open cut is not feasible (usually when crossing water bodies or highways), where there is no suitable bridge to attach to, and where J&B is not feasible (water body or too long of a crossing).
- The route is primarily along developed land, and minimal tree clearing will be required.
- Component 5: S5 400kV Sewaren Off-shore Converter:
- This component will be reviewed by others.
- Component 6: L1 400kV Larrabee POI Upgrade:
- The substation upgrade will occur entirely within the existing station. Land acquisition costs are not included in the estimate.
- The new substation will contain the following equipment:
  - Two 500kV A-frame dead ends
  - Three 500kV CCVTs
  - Three 500kV Surge Arresters
  - One 500kV Disconnect Switch
  - One 500kV Disconnect Switch with grounding switch
  - One 230kV Box Structure
  - Three 230kV CCVTs
  - Three 230kV metering units
  - Six 230kV Disconnect Switches
  - Four 230kV Circuit Breakers
- The contractor will be performing the testing of major material, relays, and construction labor.
- Component 7: L2 500kV Larrabee AC Tie Line:
- Install approximately 1.9 miles of 500kV AC single circuit underground transmission line between the new Larrabee converter station and the existing Larrabee Substation.
- The proposed conductor is 2000 mm^2 copper cable. The 500kV AC circuit will comprise of three phases, with two cables per phase, totaling 6 cables.
- One fiber optic cable will be installed in the duct bank.
- A five-foot-wide concrete duct bank will be installed primarily inside public road ROW, at a minimum of six feet belowground, between the landing and proposed converter station. When outside of public road ROW, a ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- The installation process will be primarily trench excavation, with a vault approximately every 2,000 feet to splice and pull cable. Where open trenching is not possible, or a crossing is required, special crossing techniques will be used to install the cable while minimizing environmental impacts:
  - J&B: used to install the cable system beneath certain infrastructure or other features that cannot be open cut (e.g., a railroad or highway).
  - Bridge Attachment: used in areas where an open-cut installation is not practical and the cable system can instead be attached to an existing bridge, thereby effectively spanning features such as water resources or highway underpasses.

    - HDD: used to install cable where open cut is not feasible (usually when crossing water bodies or highways), where there is no suitable bridge to attach to, and where J&B is not feasible (water body or too long of a crossing).
- The route is primarily along developed land, and minimal tree clearing will be required.
- Component 8: L3 400kV Larrabee On-shore Converter:
- The substation expansion will occur entirely within the proposer's property. Some land acquisition costs are included in the estimate.
- The new substation will contain the following equipment:
    - One 1400MW HVDC converter hall and equipment set
    - Four 500kV Single Phase Transformers
    - Two 500kV Disconnect Switches
    - One 500kV Circuit Breaker
    - Three Metering CTs
    - Three 500kV CCVTs
    - One Control Building
    - Demolition and site prep for HVDC equipment
- The contractor will be performing the testing of major material, relays, and construction labor.
- Component 9: L4 400kV Larrabee On-shore HVDC Cable:
- The submarine cables will make landfall via HDDs at the National Guard Training Center in Sea Girt, NJ.
- Install approximately 11.9 miles of HVDC underground cable between the landing and the new Larrabee converter station, located in Lakewood, NJ.
- The proposed conductor is 2500 mm^2 copper cable. The ±400kV HVDC circuit will comprise of two cables.
- One fiber optic cable will be installed in the duct bank.
- A five-foot-wide concrete duct bank will be installed primarily inside public road ROW, at a minimum of 4.25 feet belowground, between the landing and proposed converter station. When outside of public road ROW, a ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- The installation process will be primarily trench excavation, with a vault approximately every 2,000 feet to splice and pull cable. Where open trenching is not possible, or a crossing is required, special crossing techniques will be used to install the cable while minimizing environmental impacts:
    - J&B: used to install the cable system beneath certain infrastructure or other features that cannot be open cut (e.g., a railroad or highway).
    - Bridge Attachment: used in areas where an open-cut installation is not practical and the cable system can instead be attached to an existing bridge, thereby effectively spanning features such as water resources or highway underpasses.
    - HDD: used to install cable where open cut is not feasible (usually when crossing water bodies or highways), where there is no suitable bridge to attach to, and where J&B is not feasible (water body or too long of a crossing).
- The route is primarily along developed land, and minimal tree clearing will be required.
- Component 10: L5 400kV Larrabee Off-shore Converter:
- This component will be reviewed by others.
- Component 11: D1 Deans POI Upgrade:
- The existing substation will not need to be expanded to accommodate the new equipment
- The new substation will contain the following equipment:
    - Two 500kV H-frame structures
    - Three 500kV CCVTs
    - Three 500kV Surge Arresters
    - Four 500kV Disconnect Switches
    - One 500kV Disconnect Switch with grounding switch
    - Two 500kV Circuit Breakers
    - Three 500kV metering units
- The contractor will be performing the testing of major material, relays, and construction labor. Component 12: D2 500kV Deans AC Tie Line:

- Install approximately 1.36 miles of 500kV AC single circuit underground transmission line between the new Deans converter station and the existing Deans Substation.
- The proposed conductor is 2500 mm^2 copper cable. The 500kV AC circuit will comprise of three phases, with two cables per phase, totaling 6 cables.
- One fiber optic cable will be installed in the duct bank.
- A five-foot-wide concrete duct bank will be installed inside public road ROW and along existing overhead transmission line ROW, at a minimum of six feet belowground. When outside of public road ROW, a ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- The installation process will be primarily trench excavation, with a vault approximately every 2,000 feet to splice and pull cable. Where open trenching is not possible, or a crossing is required, special crossing techniques will be used to install the cable while minimizing environmental impacts:
  - J&B: used to install the cable system beneath certain infrastructure or other features that cannot be open cut (e.g., a railroad or highway).
  - Bridge Attachment: used in areas where an open-cut installation is not practical and the cable system can instead be attached to an existing bridge, thereby effectively spanning features such as water resources or highway underpasses.
  - HDD: used to install cable where open cut is not feasible (usually when crossing water bodies or highways), where there is no suitable bridge to attach to, and where J&B is not feasible (water body or too long of a crossing).
- The route is primarily along developed land and existing transmission line ROW. Minimal tree clearing will be required.

Component 13: D3 Deans On-shore Converter:

- The substation expansion will occur entirely within the proposer's property. Some land acquisition costs are included in the estimate.
- The new substation will contain the following equipment:
  - One 1400MW HVDC converter hall and equipment set
  - Four 500kV Single Phase Transformers
  - Two 500kV Disconnect Switches
  - One 500kV Circuit Breaker
  - Three Metering CTs
  - Three 500kV CCVTs
  - One Control Building
  - Demolition and site prep for HVDC equipment
- The contractor will be performing the testing of major material, relays, and construction labor.

Component 14: D4 400kV Deans On-shore HVDC Cable:

- The submarine cables will make landfall via HDDs at Main Street in South Amboy, NJ.
- Install approximately 16.3 miles of HVDC underground cable between the landing and the new Deans converter station, located in Monroe, NJ.
- The proposed conductor is 2500 mm^2 copper cable. The ±400kV HVDC circuit will comprise of two cables.
- One fiber optic cable will be installed in the duct bank.
- A five-foot-wide concrete duct bank will be installed primarily inside public road ROW, at a minimum of 4.25 feet belowground, between the landing and proposed converter station. When outside of public road ROW, a ROW of 20 feet would be sufficient to accommodate the line installation and maintenance along the route.
- The installation process will be primarily trench excavation, with a vault approximately every 2,000 feet to splice and pull cable. Where open trenching is not possible, or a crossing is required, special crossing techniques will be used to install the cable while minimizing environmental impacts:
  - J&B: used to install the cable system beneath certain infrastructure or other features that cannot be open cut (e.g., a railroad or highway).
  - Bridge Attachment: used in areas where an open-cut installation is not practical and the cable system can instead be attached to an existing bridge, thereby effectively spanning features such as water resources or highway underpasses.

  - HDD: used to install cable where open cut is not feasible (usually when crossing water bodies or highways), where there is no suitable bridge to attach to, and where J&B is not feasible (water body or too long of a crossing).
- The route is primarily along developed land, and minimal tree clearing will be required.

Total Independent Cost Estimates

The following is the total independent cost estimate for Proposal 683,

Independent Cost Estimate

Proposal 683	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$5,705,876,672	$3,894,800,000	$1,811,076,672

For comparison, the total proposal cost estimate for Proposal 683 is shown below.

Proposal Cost Estimate

Proposal 683	Full Project	Offshore Components	Onshore Components
Total Component Cost (Current Year)	$7,180,604,285	$3,520,941,652	$3,659,662,633

Anbaric Proposals

For Option 2 proposals submitted as part of the NJ State Agreement Approach (SAA) competitive process, Anbaric has described in its Boardwalk Power proposals 12 HVDC-based transmission systems connecting to three Point of Interconnections (POIs) (Sewaren, Deans, and Larrabee) to achieve various levels of offshore wind generation connectivity. These systems use several identified submarine cable corridors which could require Right of Way (ROW) widths of 800-1,000 feet depending on the number of systems ultimately selected. Several offshore wind energy areas can be connected using these systems, and Boardwalk has also proposed DC cable links between offshore platforms in 7 separate Option 3 proposals. The Option 3 proposals are 700 MW HVDC-based cable links connecting various combinations of offshore platforms proposed in separate Option 2 proposals. These systems use several identified submarine cable corridors which could require ROW widths of 800-1000 feet depending on the number of systems ultimately selected.

Table 7. **Anbaric Boardwalk Power Proposals**

Proposal ID(s)	Description(s)	Capability (MW)
131	Sewaren to Atlantic Shores 3 (SM Cable)	Option 2.12 – 1400 MW HVDC
145	Deans to Ocean Wind 2	Option 2.8 – 1148 MW HVDC
183	**Sewaren to Atlantic Shores 3**	**Option 2.5 – 1400 MW HVDC**
285	Larrabee to Atlantic Shores 2	Option 2.7 – 1400 MW HVDC
568	**Deans to Atlantic Shores 1**	**Option 2.10 – 1510 MW HVDC**
574	**Deans to Atlantic Shores 3**	**Option 2.3 – 1400 MW HVDC**
802	Sewaren to Hudson South 2 (SM Cable)	Option 2.11 – 1400 MW HVDC
831	**Deans to Hudson South 2**	**Option 2.2 – 1400 MW HVDC**
841	**Deans to Hudson South 1**	**Option 2.1 – 1400 MW HVDC**
882	**Deans to Ocean Wind 2 (320 kV)**	**Option 2.9 – 1148 MW HVDC**
921	**Larrabee to Atlantic Shores 2**	**Option 2.6 – 1200 MW HVDC**
944	**Sewaren to Hudson South 2**	**Option 2.4 – 1400 MW HVDC**
137	**Atlantic Shores 2 to Atlantic Shores 1 HVDC Interlink**	**Option 3.7 – 700 MW**
243	**Atlantic Shores 2 to Ocean Wind 2 HVDC Interlink**	**Option 3.5 – 700 MW**
248	**Ocean Wind 2 to Atlantic Shores 1 HVDC Interlink**	**Option 3.6 – 700 MW**
428	**Hudson South 1 to Hudson South 2 HVDC Interlink**	**Option 3.1 – 700 MW**
748	**Hudson South 2 to Atlantic Shores 2 HVDC Interlink**	**Option 3.3 – 700 MW**
889	**Hudson South 1 to Atlantic Shores 3 HVDC Interlink**	**Option 3.2 – 700 MW**
896	**Atlantic Shores 2 to Atlantic Shores 3 HVDC Interlink**	**Option 3.4 – 700 MW**

- Due to expected similarities in constructability results between the Proposals 183 and 131 (both Sewaren to Atlantic Shores 3 cable link proposals), only the Proposal 183 (primary route) was addressed in this report.
- Similarly, for Proposals 802 and 944 (both Sewaren to Hudson South 2 cable link proposals), only the Proposal 802 (primary route) was addressed in this report.
- Due to expected similarities in constructability results between the Proposals 882 and 145 (both Deans to Ocean Wind 2 cable link proposals), only the Proposal 882 (unique Anbaric 320 kV HVDC alternative for OW2) was addressed in this report.
- Due to expected similarities in constructability results between the Proposals 921 and 285 (both Larrabee to Atlantic Shores 2 cable link proposals), only Proposal 921 was addressed in this report.

Project Overview

Since the numerous individual proposals share many common risks associated with submarine facility locations and routing as well as landfall locations, the following review has been done grouping the Option 2 proposals by POIs and landfalls. The landfall/POI pairs are:

- Perth Amboy, NJ for Sewaren POI (proposals 183 and 944)
- Keyport, NJ for Deans POI (proposals 568, 574, 831, 841, 882)
- Bay Head, NJ for Larrabee POI (proposal 921)

The High Voltage Direct Current (HVDC) systems proposed by Boardwalk Power for most of its projects will be Voltage Source Converter (VSC) based and have power ratings in the 1,400 and 1,510 MW range and will operate at ±400 kV. Offshore and submarine cable VSC HVDC systems operating at these power and voltage levels are relatively new, and although some are in operation, the total operating experience with systems using this voltage is limited when compared to ±320 kV or below. Also, ±400 kV systems in operation are limited to systems in the 1,000 MW range. Commercial offerings for the 1,400 and 1,510 MW systems being proposed for some of the Boardwalk projects are still in the development stage. Therefore, there is some added development and schedule risk associated with these larger sized systems, and additional risk consideration should be given to application of this technology in an offshore platform environment. The primary risk is schedule related; can these new designs be qualified, designed, constructed, and commissioned within the schedules proposed.

Notwithstanding these potential schedule impacts, Boardwalk Power's overall schedules indicate commercial operation dates of February 22, 2030, for all Option 2 projects that were reviewed. This schedule seems reasonable given the overall complexity of the projects should only 2-3 projects be selected. Additional projects would likely extend the overall schedule due to risks associated with limited HVDC supplier options and availability of specialized equipment for transport and installation of platforms and submarined cables.

Anbaric's Option 2 proposals describe a complete delivery system for offshore wind power starting at 66 kV connections to wind turbine arrays and delivering power to POIs on the PJM system. No AC harmonic filters are included in the design based on use of VSC HVDC technology, but the proposals state that a harmonic filter can be included at or near a POI should it be determined to be necessary in detailed design.

Anbaric's Option 3 interlink cables will only be switched using disconnectors in the HVDC switchgear to be supplied as part of Anbaric's Option 2 proposals. As such they can only be switched under de-energized conditions which would require interruption of offshore generation to achieve the desired HVDC circuit reconfiguration. The interlink cables may also permit multi-terminal HVDC system operation, although this operating mode is relatively new; Anbaric's analysis points out that several multi-terminal systems have been built in China, and three are currently under construction in Europe and scheduled to become operational over the next few years. Future development and availability of HVDC circuit breakers may increase the operational flexibility of the overall system at some point in the future.

The following table summarizes the various proposals, and their lengths.

Proposal No.	Length (mi)
137	11
243	35
248	24
428	25

748	15
889	19
896	15

Constructability Review

Anbaric Option 2 Proposals

Environmental (Regulatory) Analysis

Overview

Anbaric has proposed several HVDC-based transmission systems connecting to three POIs (Sewaren, Deans, and Larrabee) to achieve various levels of offshore wind generation connectivity. These systems use several identified submarine cable corridors which could require ROW widths of 800-1,000 feet depending on the number of systems ultimate selected.

Risks of simultaneous outages related to having multiple circuits in the same ROW and using the same landfall may exist depending on the ultimate combination of proposals selected. Several proposals route submarine cables through the approaches to New York Harbor and into Raritan Bay which may subject the projects to greater routing and schedule risk due to higher concentrations of marine traffic and numerous subsurface facilities and obstructions.

Routing

The Sewaren POI proposals involve connection of 1,400 MW of Offshore Wind (OSW) generation via HVDC submarine cables originating at offshore converter station platforms associated with the Atlantic Shores 3 (proposal 183) and Hudson Shores 2 (proposal 944) offshore wind energy areas. The proposed cable routes for these proposals generally run from these platforms northward until turning west around Sandy Hook into Raritan Bay. The routes then run generally west through Raritan Bay and turn north to the landfall location at Perth Amboy.

The Deans POI proposals involve HVDC systems rated 1,148 to 1,400 MW which connect offshore converter station platforms associated with the Atlantic Shores 1 (proposal 568), Atlantic Shores 3 (574), Hudson Shores 1 (841), Hudson Shores 2 (831), and Ocean Wind 2 (proposal 882) wind energy areas. Proposed cable routes generally run from these platforms northward until turning west around Sandy Hook into Raritan Bay. The routes then run generally west through Raritan Bay and turn south to the landfall location at Keyport, NJ.

The Larrabee POI proposal includes an HVDC system rated 1,200 MW which connects an offshore converter station platform associated with the Atlantic Shores 2 wind energy area (proposal 921). The proposed cable route runs generally northward from the converter station platform to a point where it turns west toward landfall at Bay Head, NJ.

Depending on selection of other Boardwalk proposals these routes could involve additional HVDC submarine cable circuits requiring a ROW widths of 800-1,000 feet.

All routes include portions which are in federal and state waters, and they all include crossings of navigational channels and designated shipping traffic lanes. The Sewaren and Deans POI routes include passage into Raritan Bay which is a busy marine traffic area being part of the overall entry into New York Harbor and the Raritan River. This area also includes numerous submarine facilities including power cables, telecommunications cables, and pipelines; it notably also includes the Neptune Regional Transmission System submarine HVDC cable, which is a

Merchant Transmission facility under PJM operational control. It also has the potential for discovery of uncharted facilities and unknown sunken objects given the long history of commercial and naval marine operations in these waters.

Routings outside of the Raritan Bay include areas with marine traffic, fisheries, and numerous underwater facilities and obstructions which can include communications cables, shipwrecks, disposal areas, unexploded ordinances, and other located and unlocated obstructions.

The cable routings presented in these proposals are based on desktop analysis using publicly available data on underwater facilities, geotechnical information, navigational information, environmental data, and similar data sets. This analysis allows for initial identification of conflicts or areas to avoid as well as identification of the likely permits that will be needed for the route. Note that no field surveys or cable burial studies have been undertaken to determine the viability of these conceptual routes; should any of these proposals be awarded detailed studies and surveys would be needed to properly determine a suitable routing for the submarine cables.

Landfall

The Boardwalk Power projects submarine cable routes converge at three landfall locations for ultimate interconnection to three POIs. These three landfall/POI pairs are:

- Perth Amboy, NJ for Sewaren POI (proposals 183 and 944)
- Keyport, NJ for Deans POI (proposals 568, 574, 831, 841, 882)
- Bay Head, NJ for Larrabee POI (proposal 921)

The Perth Amboy landfall location is located just east of the NJTransit railroad bridge which crosses Raritan Bay. The submarine cable route heading west from Sandy Hook turns northward just prior to the railroad bridge and crosses the shoreline between the NJTransit ROW and 2nd Street. The land area immediately adjacent to Raritan Bay appears to be generally clear of any current uses and would be seemingly able to accommodate the necessary temporary equipment needed for horizontal directional drilling equipment, cable installation, and transition vaults. The proposals describe in reasonable detail the process for directional drilling, installation of gravity cells and transition vaults, and coordination with submarine and land cable installations; however, the descriptions, although reasonably complete, are somewhat generic and not the result of detailed surveys of the landfall site.

The Deans POI landfall location is at the site of a former marina at the end of Prospect Street in Keyport, NJ. This area appears to be generally clear of any current uses and can accommodate the temporary equipment needed for the directional drilling rigs, transition vaults, and cable installation. As with the Perth Amboy landfall, the descriptions, although reasonably complete, are somewhat generic and not the result of detailed surveys of the landfall site.

The Larrabee landfall site is at the end of Bridge Avenue in Bay Head, NJ where the street ends at the beach. It is a dense residential area which will tend to limit setup areas for directional drilling equipment to the width of the street. As with the other landfall locations the descriptions in the proposal, although reasonably complete, are somewhat generic and not the result of detailed surveys of the landfall site.

Facility Conflicts

Potential conflicts with existing submarine facilities will be present with all of the proposals. The majority of concerns will be avoiding dumping grounds, wrecks, hazards, or other submerged obstructions as well as a myriad of submarine communications cables which exist across the entire area from the wind energy areas to the shoreline. Many of these cables may be abandoned, but many others may be uncharted and could only be discovered during submarine cable installation.

Many of the communications cables make landfall in the Sea Girt, NJ area at a current National Guard training site. This site is approximately 3.5 miles north of the proposed landfall site for the Larrabee POI project at Bridge Avenue in Bay Head. The cable route described in proposal 921 to the Atlantic Shores 2 offshore wind energy area will cross many of these communication cables approximately 6-7 miles offshore.

The Deans and Sewaren POI projects route submarine cables through the approaches to New York Harbor and into Raritan Bay. These areas have higher concentrations of marine traffic and numerous subsurface facilities and obstructions.

Environmental Risk

The environmental risks associated with the various HVDC platforms and submarine cables is similar to the risks posed by the offshore elements of other proposals. The environmental impacts from these proposals mainly come from the installation of the submarine cable and the seabed disturbances caused by it.

Permits

These proposals contain a detailed description of a permitting approach for the project elements. Both state and local permits will be required for the submarine cables and platforms, and local permits will also be required for the landfalls and any on-shore cable routes and facility locations.

Specifically, on-shore components of this project run through Green Acres-encumbered properties and may require NJ State Green Acres Program Diversion Permits.

The permitting approach is based on the conceptual configurations of the system as presented in the proposals which were developed from desktop research of publicly available information. Some detailed shoreline and shipboard offshore High Resolution Geophysical (HRG) seabed surveys have been performed to assess the majority of the submarine cable routes for installation feasibility. Actual permit filings will require detailed surveys to conform to the final configuration.

The offshore platforms and portions of the submarine cable routes are located in waters of the Outer Continental Shelf (OCS) and will require a Bureau of Ocean Energy Management (BOEM) Right of Way/Right of Use Grant or Easement (BOEM ROW/RUE). Anbaric applied to BOEM for a ROW/RUE Easement Grant for rights of way in federal waters of the OCS off of the New Jersey shore in 2018. Per the proposal the portions of submarine cable routes traversing through New Jersey State Waters, out and around to Sandy Point, then south back into state waters near Atlantic City, is currently under review by the New Jersey Department of Environmental Protection (NJDEP) and United States Army Corps of Engineers (USACE).

Technology and Supply Chain Risks

This section offers an assessment of risks that may be apparent in the overall system, the technology being proposed, specific risks that may be inherent in specific equipment, and risks posed by supply chain considerations.

Technology Risk

Overall System

The overall system described by this proposal will, for the most part, contain power system equipment and components that are proven and fully understood over many years of successful operation in similar circumstances. However, application of these components to installation on offshore platforms and exposure to the harsh environment that surrounds any salt water marine environment has not been commonly done using the voltage and scale being proposed. The primary risk associated with the overall system is associated with the construction and operation the offshore portions of the system, and in particular the platform-based HVDC converters and associated transformers, switchgear, and other components.

HVDC System
The majority of the HVDC systems for the Boardwalk Power Option 2 proposals are modular multi-level (MMC) voltage source converter (VSC) based systems operating at ±400 kV DC. Proposal 882 (Deans to Ocean Wind 2) specifies a ±320 kV system.

VSC HVDC systems using submarine cables have been operating for many years and in general represent minimal technology risk. However, systems operating at ±400 kV are relatively new, and although some are in operation, the total operating experience with systems using this voltage is limited when compared to ±320 kV or below. The ±400 kV risk is associated both with the submarine cables as well as the HVDC converters themselves.

Also, the ±400 kV systems in operation are limited to systems in the 1,000 MW range. Commercial offerings for the 1,400 and 1,510 MW systems being proposed for some of the Boardwalk projects are still in the development stage. Therefore, the is some added development and schedule risk associated with these larger sized systems, and additional risk consideration should be given to application of this technology in an offshore platform environment. The primary risk is schedule related, namely can these new designs be qualified, designed, constructed, and commissioned within the schedules proposed.

Anbaric has not partnered with any one HVDC supplier but has had continued discussions with qualified suppliers. When appropriate Anbaric is positioned to select appropriate suppliers and contractors through a competitive process.

Offshore Platform
The offshore platforms (jackets and topsides) proposed for housing the converter stations and associated switchgear will be a customized design drawn from experience in oil and gas exploration and production. The main risks associated with the offshore platforms is essentially the same for all proposals in the NJ SAA solicitations, and it relates mainly to available facilities to build the platforms, production capabilities of those facilities, and availability and pricing of materials such as steel.

Further scheduling risk is introduced by the need for specialized equipment to install the platforms such as a semi-submersible crane vessel (SSCV), of which there are only a handful available globally. The availability of these SSCVs may be challenging due to global offshore wind construction activity expected at the time of installation. For this reason, Anbaric has stated that vessels need to be booked early to ensure timely installation.

HVDC equipment suppliers generally partner with offshore platform designers and manufacturers for the construction of the foundation, the topside, and the integration of the safety and utility systems. Based on this proposal Anbaric is planning to conduct its procurement of the offshore HVDC system and platform as a single package from the HVDC suppliers.

Submarine Cable
As discussed above, 400 kV HVDC submarine cable is relatively untried at the power levels being contemplated. Beyond the technology risk is schedule and supply chain risk associated with these types of specialized cables. Only a handful of manufacturing facilities globally are capable of supplying this type of cable, and with the quantities contemplated for these projects production capability and availability of production slots can greatly impact any planned schedule. This may be magnified by the global demand for submarine power cables associated with robust offshore wind development.

Furthermore, installation vessels for these types of cables are also limited globally and can influence the construction schedule for these projects to a great degree depending on their availability. As stated above, this could be exacerbated by global offshore wind construction activity expected at the time of installation.

As with the HVDC systems, Anbaric has not partnered with any one cable supplier but has had continued discussions with qualified suppliers. When appropriate Anbaric is positioned to select appropriate suppliers and contractors through a competitive process.

Project Complexity

The relative complexity of the Boardwalk Power Option 2 projects is on par with most of the other proposals involving HVDC links between offshore platforms and landfalls using submarine cables. Most of the offshore complexity resides in the construction and installation of offshore platform jackets and topsides as well as installation and commissioning of HVDC converters, converter transformers, AC switchgear, and auxiliary power and control equipment on the topside. Although construction of this technology is well established on land, installation in an offshore environment is relatively new. Most existing experience in this area lies in recent offshore wind projects in Europe.

Incremental risks among the Boardwalk Power projects associated with project complexity can be found in projects with landfalls in Raritan Bay (the Deans and Sewaren POI projects). This is mainly installation and schedule risks due to the issues of marine traffic, underwater obstructions, and conflicting submarine facilities inherent in a busier and historically active waterway. These issues may require alternations in proposed schedules to accommodate seasonal or commercial issues that may arise.

Further installation and operational complexity will be introduced should any of the Option 3 projects be incorporated into these Option 2 projects. This is due to the installation of HVDC switchgear and additional submarine cable exits on the offshore platforms.

Supply Chain Risk

The risks in the supply chain for these projects predominantly resides in the HVDC converters, offshore platforms, and submarine cables. The relative risks between the Boardwalk Power proposals, and other proposals in the SAA solicitation, is about the same when considering HVDC systems of the same MW size and operating voltage.

Long Lead Time Items

Long lead time items of highest concern are the submarine cables, HVDC converters, and offshore platforms. The vast majority of this risk resides in the limited number of suppliers for these items which is discussed in more detail below.

Supplier Scarcity

Submarine cables, HVDC converters, and offshore platforms of the designs needed for these projects are capable of being supplied and constructed by limited number of globally based companies. Combine this with the relative scarcity of specialized equipment needed to transport and install these facilities in a marine environment, significant risk can develop should many similar projects be planned for construction in the same period of time.

Of particular concern are the vessels for transporting and laying submarine transmission cables and the heavy-lift SSCVs needed for offshore platform installation. Note that the potential competition for these resources will come from not only other offshore transmission projects, but also offshore wind generator projects which will need the same vessels for their own platform installations and submarine cables for their collector systems.

As stated above this risk is associated with all similar projects and not just for the Boardwalk Power projects. Relative supplier scarcity risk between Boardwalk Power projects is also the same.

Construction Schedule Risk

The eight Boardwalk Power Option 2 proposals consisting of HVDC systems targeted to POIs at Sewaren, Deans, and Larrabee all have the same relative schedules with a total duration of approximately 8 years culminating in a Commercial Operation Date (COD) of February 22, 2030.

Permitting

The total duration for permitting activity is approximately 4 years which includes a 4-year duration for offshore related federal and state permits. Based on the detail provided in the proposals, a good level of understanding exists for the permits and processes involved. However, no specific permit plan has been developed for any project other than on a conceptual level based on some specific surveys and research of publicly available information. Also, permitting activity for all of the Option 2 proposals is assumed to be similar, hence the relative risks between projects is essentially the same.

Construction

The construction portion of the proposal schedules ranges between approximately 2 years for the offshore platforms to 3 months for the submarine cables. It should be noted that the actual durations will likely vary and be extended should multiple Boardwalk Power proposals be chosen due to the availability of specialized installation equipment and seasonal limitations often imposed on submarine cable installation time windows.

Outage Planning

Outage planning schedule risk will relate mainly to construction for onshore facilities, and in particular those facilities being integrated into existing POI substations. These outages will drive the ability to connect and energize the offshore systems and perform commissioning activities.

Anbaric has provided conceptual designs for connections at the various POI substations but has not provided a discussion of construction sequencing or the need for outages of existing facilities. In some cases construction schedules show equipment installation at utility substations mainly during summer months; this time period is historically the most difficult time to obtain outages and will likely drive modifications to this proposed schedule.

Other Overall Schedule Risk

Perhaps the largest overall schedule risk is related to the supply chain limits for HVDC converters and submarine cables, and the need for specialized equipment for installation of submarine cables and offshore platforms. This will be especially impactful should multiple projects be chosen for installation during the same time period. Further exacerbating this risk will be construction of offshore generating facilities which will place similar demands on the same universe of manufacturers and constructors.

O&M Risk

Once installed and upon operation the various systems and components of CLNJ's transmission system will be subject to risk of failure. Some of this risk is determined by the configuration of each system and its exposure to failure, while other types of operational risk is determined by the ability of the various facilities to be brought back to service quickly.

Route Diversity

The Boardwalk Power projects seek to follow a concept they define as "transmission link corridors" which can be used to route multiple transmission circuits along a single underwater ROW which can vary in width from 200-1,000 feet depending on the number of circuits. Use of common ROWs to co-locate facilities whether on land or underwater have advantages in limiting impacts to the surrounding area by confining these impacts to the corridors themselves.

However, one disadvantage is that having multiple lines in a common corridor can expose those lines to the possibility of a simultaneous event which can outage those facilities. This exposure may be even more acute in the situation of an underwater corridor where events like anchor drags can occur for hundreds of feet and potentially impact multiple circuits. That said, the risk of such an event can be mitigated by regularly verifying cable burial depth as well as other operational measures such as monitoring shipping traffic along cable routes.

The Boardwalk Power proposals have multiple transmission link corridors proposed, and if multiple proposals are accepted the routing of the transmission links can potentially be optimized to minimize this risk. One item to note is an area approximately 7 miles off the Larrabee POI landfall where the two major transmission corridors will cross. A detailed study and design of this crossing area should be considered to minimize the risk of multiple facility outages in this area.

Also, it should be noted that all landfalls may, depending on the number of Boardwalk Power projects selected, result in multiple circuits making landfall at the same location. This is particularly pronounced at the Deans landfall in Keyport, NJ, where up to six HVDC circuits could pass through this landfall area. Although the landfalls will retain separation of circuits by using multiple HDD routes, the cables approaching the landfalls will converge until they enter the HDD bores. This can add risk for multiple submarine cable outages in this area from an event like and anchor drag.

Redundancy & Operational Flexibility

Each individual HVDC system as a symmetrical monopole system will essentially be a radial transmission link with the N-1 outage of the total system capability being the ruling contingency. Within each system is contained redundancy that can mitigate the risk of a long-term equipment failure. For example, the offshore HVDC converters contain two three-phase converter transformers which would allow operation of the system at reduced capability for loss of one of those transformers, typically slightly more than half of the total capability of the system pre-outage. Onshore converter transformers are single phase units which, when coupled with a spare, can restore full system capability for loss of one of the single-phase units. Note that this spare single-phase unit may provide for spare service to multiple HVDC converters if they are installed together.

The redundancy of each Boardwalk Power project is comparable to the other projects as well as other similarly configured HVDC-based projects in the NJ SAA solicitation.

Maintenance and Spare Equipment Strategy

Typically, spares are provided for long lead time equipment in transmission systems similar to those described in the Boardwalk Power proposals. In particular, spares are usually carried for the following components:

- Converter transformers – onshore (single-phase)
- Converter transformers – offshore (three-phase)
- Submarine cables – lengths sufficient for use in a splice
- Submarine cable accessories – terminations, splices, etc.
- Critical HVDC converter components – valves, insulators, bushings
- AC switchgear circuit breakers

The Boardwalk Power Option 2 proposals do not provide a detailed listing of spare parts to be provided. The proposals do mention that spare parts will be located in a warehouse facility near Boardwalk Power's primary operations center. Because no listing of spare parts is provided it is difficult to assign a risk level to this aspect of the proposals.

Anbaric Option 3 Proposals

Environmental (Regulatory) Analysis

Overview

Anbaric has proposed several HVDC based links connecting the offshore platforms proposed in their Option 2 proposals. As the proposed interlinks are all located in federal waters, there are no siting and regulatory risks unique to the Option 3 proposals that would not be present in the Option 2 proposals. Risks of simultaneous outages related to having multiple circuits in the same ROW may exist depending on the ultimate combination of proposals selected and the final cable routes chosen.

Routing

The proposed routes for the HVDC platform interlinks are relatively simple. Proposal documentation provided identifies where the proposed interlinks will need to cross existing submarine cables. The number of crossings in the link proposals range from zero to ten cable crossings. The cable route, descriptions and maps do not indicate or mention any potential wrecks or debris that could be encountered. It is assumed these would be identified after detailed surveying and the routes would be adjusted accordingly.

Landfall

As these proposals are all HVDC links between the proposed offshore platforms, there is no landfall associated with these projects.

Facility Conflicts

Potential conflicts with existing submarine facilities will be present with all of the proposals. The majority of concerns will be avoiding dumping grounds, wrecks, hazards, or other submerged obstructions as well as a myriad of submarine communications cables which exist across the entire area from the wind energy areas to the shoreline. Many of these cables may be abandoned, but many others may be uncharted and could only be discovered during submarine cable installation.

Environmental Risk

The environmental risks associated with the various HVDC platforms and submarine cables is similar to the risks posed by the offshore elements of other proposals. The environmental impacts from these proposals mainly come from the installation of the submarine cable and the seabed disturbances caused by it.

Permits

Because these proposals exclusively consist of offshore components, there are no state or local permits required for the construction of the platform interlinks. The only required permits are federal through 5 different agencies.

Note that, as a practical matter, it would be expected that permitting activities for interlink cables would proceed together with the proceedings for the land connection cables and offshore platforms since the same federal agencies and processes are involved.

Technology and Supply Chain Risks

This section offers an assessment of risks that may be apparent in the overall system, the technology being proposed, specific risks that may be inherent in specific equipment, and risks posed by supply chain considerations.

Technology Risk

Overall System

The overall system described by this proposal will, for the most part, contain power system equipment and components that are proven and fully understood over many years of successful operation in similar circumstances. However, application of these components to installation on offshore platforms and exposure to the harsh environment that surrounds any salt water marine environment has not been commonly done using the voltage and scale being proposed. The primary risk associated with the overall system is associated with the construction and operation the offshore portions of the system, and in particular the platform-based HVDC converters and associated transformers, switchgear, and other components.

HVDC System

The HVDC system that the Boardwalk Power Option 3 proposals primarily make use of are detailed in the Boardwalk Power Option 2 proposals, of which there are 8 proposed offshore platforms. VSC HVDC systems using submarine cables have been operating for many years and in general represent minimal technology risk. However, systems operating at ±400 kV are relatively new, and although some are in operation, the total operating experience with systems using this voltage is limited when compared to ±320 kV or below. The ±400 kV risk is associated both with the submarine cables as well as the HVDC converters themselves

Offshore Platform

HVDC switchyard equipment will be installed as part of the offshore platform Option 2 proposals. The technology risks of this equipment are discussed in more detail in the Anbaric Option 2 proposals.

Note that the offshore platforms, including the HVDC switchgear portion, will need to be built and ready to accept the interlink cables prior to their installation.

Submarine Cable

The capacity of the proposed ±400 kV HVDC cable is 700 MW. As discussed above , ±400 kV HVDC submarine cable is relatively untried at the power levels being contemplated. Beyond the technology risk is schedule and supply chain risk associated with these types of specialized cables. Only a handful of manufacturing facilities globally are capable of supplying this type of cable, and with the quantities contemplated for these projects production capability and availability of production slots can greatly impact any planned schedule. This may be magnified by the global demand for submarine power cables associated with robust offshore wind development.

Furthermore, installation vessels for these types of cables are also limited globally and can influence the construction schedule for these projects to a great degree depending on their availability. As stated above, this could be exacerbated by global offshore wind construction activity expected at the time of installation.

Project Complexity

These proposals are of a relatively low complexity compared to other proposals of which the majority of include offshore platforms as part of the proposal. When compared to other Option 3 proposals or components of proposals these proposals are slightly more complex than most. The Boardwalk Power Option 3 proposals all consist of HVDC links between offshore platforms.

Supply Chain Risk

The risks in the supply chain for these projects come from the cable manufacturing. There are only a limited number of manufacturers for HVDC cable and there are a number of large HVDC projects planned over the next 5 to 10 years.

Construction Schedule Risk

The 7 Boardwalk Power Option 3 proposals consisting of HVDC platform interlinks spanning between 11 and 35 miles long each consist of a project schedule with a duration of 28 months.

Permitting

Permitting and ROW makes up the largest part of the 28-month schedule with a 24-month duration. This 24-month period accounts for Federal offshore permits and route acquisition for the offshore submarine cable. As a practical matter, permitting for platform interlinks would occur as part of the same proceeding as permitting activities for the Option 2 POI connection projects.

Construction

The construction portion of the proposal schedules is 1.5 months, of which 0.5 months is route preparation and 1 month is laying cable and pulling it to their terminations. Construction techniques will be the same as for the Option 2 projects, and the same or similar installation equipment will be needed, making construction of the interlinks dependent on equipment availability and usage for the land connection cables.

Note that the offshore platforms and HVDC switchgear will need to be built and ready to accept the interlink cables prior to their installation.

Outage Planning

As the scope of these proposals is connected only to new construction, there is not any outage planning required with existing transmission infrastructure. The laying and pulling of the submarine cable would need to be coordinated and in line with construction and energization of the associated offshore platforms.

O&M Risk

Once installed and upon operation the various systems and components of CLNJ's transmission system will be subject to risk of failure. Some of this risk is determined by the configuration of each system and its exposure to failure, while other types of operational risk is determined by the ability of the various facilities to be brought back to service quickly.

Once installed and upon operation the various systems and components of Boardwalk Power's transmission systems will be subject to risk of failure. Some of this risk is determined by the configuration of each system and its exposure to failure.

Route Diversity

Corridor width for cables is planned to be 200ft and if multiple Boardwalk Power proposals are accepted, there will be 300ft of separation between the circuits. This space between circuits is expected to be enough separation to make cable repairs and offer some protection from anchor drags. This can mitigate some of the risk associate with simultaneous outage of all cables in a submarine corridor.

Redundancy & Operational Flexibility

The interlink proposals provide flexibility for offshore platforms to inject to different onshore locations when there is an outage between an onshore and offshore converter station. The HVDC platform interlinks will be operated normally open and will require de-energized switching of HVDC equipment in order to be utilized. Offshore platforms will be able to transmit up to 700 MW per interlink to other offshore platforms, but the total amount of wind generation that can be transferred to the existing transmission system will be limited by the capabilities of the onshore converters and the cables connecting them to the offshore platforms.

Future development of HVDC circuit breakers may enhance the operational flexibility of the interlinks by allowing them to be operated normally energized. This allows cables to be switched while energized so that power can be redirected without having to interrupt generation. At present designs for HVDC circuit breakers are in development and require their own platform due to their size and equipment involved which is much more complex than an AC circuit breaker of comparable voltage.

Maintenance and Spare Equipment Strategy

The proposals indicate that spare cable will be acquired but does not specify how much cable will be kept for repairs. The spare equipment for the offshore components will be kept in a warehouse at Anbaric's primary operations facility common with Option 2 proposals.

Cost Review

Anbaric Option 2 Proposals

Proposal Cost Estimates

The total proposal costs for Anbaric's Option 2 Proposals are as follows:

Category	Proposal 183	Proposal 568	Proposal 574	Proposal 831
	$	$	$	$
Engineering & Design	79,364,002	92,746,470	89,729,219	89,729,220
Permitting/ Routing/Siting	11,114,761	8,675,392	8,675,392	8,675,392
ROW/Land Acquisition	30,000,000	8,489,017	8,489,017	8,489,017
Materials and Equipment	751,528,928	925,031,699	803,758,649	852,238,942
Construction & Commissioning	532,148,061	621,288,955	595,179,135	607,018,872

Construction Management	90,441,399	92,452,899	90,441,400	90,441,399
Overheads & Misc.	34,496,638	49,387,281	49,387,283	49,387,283
Contingency	152,909,379	179,807,172	164,566,010	170,598,013
Total Component Cost (Current Year)	1,682,003,168	1,977,878,885	1,810,226,105	1,876,578,138

Category	Proposal 841	Proposal 882	Proposal 921	Proposal 944
	$	$	$	$
Engineering & Design	89,729,220	79,068,277	77,934,232	79,364,002
Permitting/ Routing/Siting	8,675,392	8,675,392	11,114,761	11,114,761
ROW/Land Acquisition	8,489,017	8,489,017	2,000,000	30,000,000
Materials and Equipment	797,001,659	820,627,706	671,349,438	800,009,219
Construction & Commissioning	587,028,959	564,530,157	518,315,099	543,987,798
Construction Management	90,441,398	83,334,103	89,574,217	90,441,398
Overheads & Misc.	49,387,283	49,387,283	34,496,638	34,496,638
Contingency	163,075,293	161,411,193	140,478,439	158,941,382
Total Component Cost (Current Year)	1,793,828,221	1,775,523,128	1,545,262,824	1,748,355,198

Independent Cost Estimates

Offshore Component Independent Cost Estimates

PJM's consultant assembled independent cost estimates for the proposed facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 183:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$826,000,000	$826,000,000
±400 kV Submarine Cable	87	$5,600,000	$487,200,000
Total Offshore			**$1,313,200,000**

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 568:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$890,900,000	$890,900,000
±400 kV Submarine Cable	109	$5,600,000	$610,400,000
Total Offshore			**$1,501,300,000**

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 574:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$826,000,000	$826,000,000
±400 kV Submarine Cable	83	$5,600,000	$464,800,000
Total Offshore			**$1,290,800,000**

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 831:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$826,000,000	$826,000,000
±400 kV Submarine Cable	105	$5,600,000	$588,000,000
Total Offshore			**$1,414,000,000**

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 841:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$826,000,000	$826,000,000
±400 kV Submarine Cable	80	$5,600,000	$448,000,000
Total Offshore			**$1,274,000,000**

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 882:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$671,580,000	$671,580,000
±320 kV Submarine Cable	133	$5,000,000	$665,000,000
Total Offshore			**$1,336,580,000**

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 921:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$708,000,000	$708,000,000
±400 kV Submarine Cable	57	$5,600,000	$319,200,000

Total Offshore			**$1,027,200,000**

The following is an independent cost estimate for the Offshore portions of Anbaric's proposal 944:

Item	Qty	Unit Cost	Subtotal
Offshore Converter Station	1	$826,000,000	$826,000,000
±400 kV Submarine Cable	109	$5,600,000	$610,400,000
Total Offshore			**$1,436,400,000**

Onshore Component Independent Cost Estimates

The consultant assembled independent cost estimates for the proposed facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and various other publicly available sources. The accuracy of their estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 183:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$375,000,000	$375,000,000
±400 kV Underground Land Cable	6.0	$9,000,000	$54,000,000
230 kV Underground Land Cable	1.2	$20,000,000	$24,000,000
Sewaren Sub upgraded/expansion	1	$4,000,000	$4,000,000
Total Onshore			$457,800,000

The basic onshore characteristics for the Anbaric Proposal 183 are as follows:

- Approximately 6.0 miles of 400 kV DC underground cable installed in a concrete encased duct bank from the shoreline landing point at Perth Amboy to a converter station at Buckeye Point, approximately 1 mile north of Sewaren Substation.
- A 1400 MW 400 kV DC to 230 kV AC converter station located at Buckeye Point.
- Approximately 1.2 miles of 230 kV AC underground circuit installed in a concrete encased duct bank from the converter station at Buckeye Point to Sewaren Substation. Each phase of the circuit will consist of four cables.
- Upgrade/Expansion of Sewaren Substation to transition from (3 x 4) underground cables to an available overhead breaker position and upgrade of that position relays and controls

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 568:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$400,000,000	$400,000,000
±400 kV Underground Land Cable	21	$9,000,000	$189,000,000
500 kV Underground Land Cable	0.2	See Note (1)	$10,000,000
Deans 500 kV Upgrade (New breaker and a half string)	1	$12,000,000	$12,000,000
Total Onshore			$611,000,000

Note 1: Due to the short distance, the cost cannot be estimated on a per mileage basis. The cost was determined based on engineering judgement and past experiences with similar projects.

The basic onshore characteristics for the Anbaric Proposal 568 are as follows:

- 1510 MW Onshore Converter station
- 21 miles ±400 kV HVDC Underground Cable
- 0.2 miles 500 kV AC Underground Cable
- Deans POI upgrades – New Breaker and a half string

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 574:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$375,000,000	$375,000,000
±400 kV Underground Land Cable	21	$9,000,000	$189,000,000
500 kV Underground Land Cable	0.2	See Note (1)	$10,000,000
Deans 500 kV Upgrade (New breaker and a half string)	1	$12,000,000	$12,000,000
Total Onshore			$586,000,000

Note 1: Due to the short distance, the cost cannot be estimated on a per mileage basis. The cost was determined based on engineering judgement and past experiences with similar projects.

The basic onshore characteristics for the Anbaric Proposal 574 are as follows:

- 1400 MW Onshore Converter station
- 21 miles ±400 kV HVDC Underground Cable
- 0.2 miles 500 kV AC Underground Cable
- Deans POI upgrades – New Breaker and a half string

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 831:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$375,000,000	$375,000,000
±400 kV Underground Land Cable	21	$9,000,000	$189,000,000
500 kV Underground Land Cable	0.2	See Note (1)	$10,000,000
Deans 500 kV Upgrade (New Breaker and a half string)	1	$12,000,000	$12,000,000
Total Onshore			$586,000,000

Note 1: Due to the short distance, the cost cannot be estimated on a per mileage basis. The cost was determined based on engineering judgement and past experiences with similar projects.

The basic onshore characteristics for the Anbaric Proposal 831 are as follows:

- 1400 MW Onshore Converter station
- 21 miles ±400 kV HVDC Underground Cable
- 0.2 miles 500 kV AC Underground Cable

- Deans POI upgrades – New Breaker and a half string

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 841:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$375,000,000	$375,000,000
±400 kV Underground Land Cable	21	$9,000,000	$189,000,000
500 kV Underground Land Cable	0.2	See Note (1)	$10,000,000
Deans 500 kV Upgrade (New Breaker and a half string)	1	$12,000,000	$12,000,000
Total Onshore			$586,000,000

Note 1: Due to the short distance, the cost cannot be estimated on a per mileage basis. The cost was determined based on engineering judgement and past experiences with similar projects.

The basic onshore characteristics for the Anbaric Proposal 841 are as follows:

- 1400 MW Onshore Converter station
- 21 miles ±400 kV HVDC Underground Cable
- 0.2 miles 500 kV AC Underground Cable
- Deans POI upgrades – New Breaker and a half string

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 882:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$350,000,000	$350,000,000
±320 kV Underground Land Cable	21	$8,500,000	$178,500,000
500 kV Underground Land Cable	0.2	See Note (1)	$10,000,000
Deans 500 kV Upgrade (New breaker and a half string)	1	$12,000,000	$12,000,000
Total Onshore			$542,900,000

Note 1: Due to the short distance, the cost cannot be estimated on a per mileage basis. The cost was determined based on engineering judgement and past experiences with similar projects.

The basic onshore characteristics for the Anbaric Proposal 882 are as follows:

- 1148 MW Onshore Converter station
- 21 miles ±320 kV HVDC Underground Cable
- 0.2 miles 500 kV AC Underground Cable
- Deans POI upgrades – New Breaker and a half string

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 921:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$360,000,000	$360,000,000
±400 kV Underground Land Cable	10.3	$9,000,000	$92,700,000
230 kV Underground Land Cable	0.09	See Note (1)	$5,000,000
Larrabee Upgrade (New breaker and a half breaker position)	1	$6,000,000	$6,000,000
Total Onshore			$463,700,000

Note 1: Due to the short distance, the cost cannot be estimated on a per mileage basis. The cost was determined based on engineering judgement and past experiences with similar projects.

The basic onshore characteristics for the Anbaric Proposal 882 are as follows:

- 1200 MW Onshore Converter station
- 10.3 miles ±400 kV HVDC Underground Cable
- 0.09 miles 230 kV AC Underground Cable
- Larrabee POI upgrades – New Breaker and a half breaker position

The following is an independent cost estimate for the Onshore portions of Anbaric's proposal 944:

Item	Qty	Unit Cost	Subtotal
Onshore Converter Station	1	$375,000,000	$375,000,000
±400 kV Underground Land Cable	6.0	$9,000,000	$54,000,000
230 kV Underground Land Cable	1.2	$20,000,000	$24,000,000
Sewaren Sub upgraded/expansion	1	$4,000,000	$4,000,000
Total Onshore			$457,000,000

The basic onshore characteristics for the Anbaric Proposal 944 are as follows:

- Approximately 6.0 miles of 400 kV DC underground cable installed in a concrete encased duct bank from the shoreline landing point at Perth Amboy to a converter station at Buckeye Point, approximately 1 mile north of Sewaren Substation.
- A 1400 MW 400 kV DC to 230 kV AC converter station located at Buckeye Point.
- Approximately 1.2 miles of 230 kV AC underground circuit installed in a concrete encased duct bank from the converter station at Buckeye Point to Sewaren Substation. Each phase of the circuit will consist of four cables.
- Upgrade/Expansion of Sewaren Substation to transition from (3 x 4) underground cables to an available overhead breaker position and upgrade of that position relays and controls

Total Independent Cost Estimates

The following are the total independent cost estimates for Anbaric Option 2 proposals.

Independent Cost Estimates				
Category	Proposal 183	Proposal 568	Proposal 574	Proposal 831
Offshore Component Costs	$1,313,200,000	$1,501,300,000	$1,290,800,000	$1,414,000,000
Onshore Component Costs	$457,800,000	$611,000,000	$586,000,000	$586,000,000
Total Costs	1,771,000,000	2,112,300,000	1,876,800,000	2,000,000,000

Independent Cost Estimates				
Category	Proposal 841	Proposal 882	Proposal 921	Proposal 944

Offshore Component Costs	1,274,000,000	$1,336,580,000	$1,027,200,000	$1,436,400,000
Onshore Component Costs	$586,000,000	$542,900,000	$463,700,000	$457,000,000
Total Costs	1,860,000,000	1,879,480,000	1,490,900,000	1,893,400,000

For comparison, the total proposal cost estimates for Anbaric Option 2 proposals are shown below.

Proposal Cost Estimates				
Category	Proposal 183	Proposal 568	Proposal 574	Proposal 831
Offshore Component Costs	1,218,147,256	1,381,387,764	1,220,137,868	1,287,722,315
Onshore Component Costs	463,855,912	596,491,121	590,088,237	588,855,823
Total Costs	1,682,003,168	1,977,878,885	1,810,226,105	1,876,578,138

Proposal Cost Estimates				
Category	Proposal 841	Proposal 882	Proposal 921	Proposal 944
Offshore Component Costs	1,211,018,515	1,241,716,346	1,103,119,267	1,285,282,084
Onshore Component Costs	582,809,706	533,806,782	442,143,557	463,073,114
Total Costs	1,793,828,221	1,775,523,128	1,545,262,824	1,748,355,198

Anbaric Option 3 Proposals

Proposal Cost Estimates

The total proposal costs for Anbaric's Option 3 Proposals are as follows:

Category	**Proposal 137**	**Proposal 243**	**Proposal 248**	**Proposal 428**
	$	$	$	$
Engineering & Design	2,275,418	2,275,418	2,275,418	2,275,418
Permitting/ Routing/Siting	5,000,000	5,000,000	5,000,000	5,000,000
ROW/Land Acquisition	0	0	0	0
Materials and Equipment	12,989,665	38,748,550	26,944,673	27,803,770

Construction & Commissioning	32,829,602	39,553,933	36,472,543	36,696,809
Construction Management	1,815,000	1,815,000	1,815,000	1,815,000
Overheads & Misc.	0	0	0	0
Contingency	5,490,969	8,739,290	7,250,763	7,359,100
Total Component Cost (Current Year)	60,400,654	96,132,191	79,758,397	80,950,097

Category	Proposal 748	Proposal 889	Proposal 896
	$	$	$
Engineering & Design	2,275,418	2,275,418	2,275,418
Permitting/ Routing/Siting	5,000,000	5,000,000	5,000,000
ROW/Land Acquisition	0	0	0
Materials and Equipment	17,550,761	21,462,954	16,639,974
Construction & Commissioning	34,020,272	35,041,546	33,782,511
Construction Management	1,815,000	1,815,000	1,815,000
Overheads & Misc.	0	0	0
Contingency	6,066,145	6,559,492	5,951,290
Total Component Cost (Current Year)	66,727,596	72,154,410	65,464,193

Independent Cost Estimates

PJM's consultant assembled independent cost estimates for the proposed facilities using historical data from similar projects, information collected from original equipment vendors and contractors supplying similar services, and other publicly available sources. The accuracy of consultant's estimates is expected to be ±25%. The estimates are in 2022 dollars and generally include a ~15% contingency.

The following is an independent cost estimate for Anbaric's proposal 137:

Item	Qty	Unit Cost	Subtotal
±400 kV Submarine Cable (700 MVA)	11	$4,500,000	$49,500,000
Total			**$49,500,000**

The following is an independent cost estimate for Anbaric's proposal 243:

Item	Qty	Unit Cost	Subtotal

±400 kV Submarine Cable (700 MVA)	35	$4,500,000	$ 157,500,000
Total			**$ 157,500,000**

The following is an independent cost estimate for Anbaric's proposal 248:

Item	Qty	Unit Cost	Subtotal
±400 kV Submarine Cable (700 MVA)	24	$4,500,000	$108,000,000
Total			**$108,000,000**

The following is an independent cost estimate for Anbaric's proposal 428:

Item	Qty	Unit Cost	Subtotal
±400 kV Submarine Cable (700 MVA)	25	$4,500,000	$112,500,000
Total			**$112,500,000**

The following is an independent cost estimate for Anbaric's proposal 748:

Item	Qty	Unit Cost	Subtotal
±400 kV Submarine Cable (700 MVA)	15	$4,500,000	$ 67,500,000
Total			**$ 67,500,000**

The following is an independent cost estimate for Anbaric's proposal 889:

Item	Qty	Unit Cost	Subtotal
±400 kV Submarine Cable (700 MVA)	19	$4,500,000	$ 85,500,000
Total			**$ 85,500,000**

The following is an independent cost estimate for Anbaric's proposal 896:

Item	Qty	Unit Cost	Subtotal
±400 kV Submarine Cable (700 MVA)	15	$4,500,000	$ 67,500,000
Total			**$ 67,500,000**

Appendix A – Onshore Permit Tables

APT Proposals 210, 172, and 769 Permit Tables

Table 8. NJDEP Division of Land Resources Protection Special Areas (On-shore only)

Special Area	Presence	Facility Involved	Comment
Atlantic City	No	-	-
Beaches	No	-	-
Canals	Yes	HVDC Cable Route	American Snuff Company Raceway
Coastal bluffs	Not Likely	-	Based on review of aerial imagery
Coastal high hazard areas	Yes	HVDC Cable Route	Floodplain VE in Raritan Bay
Critical wildlife habitats	Unknown	Unknown	Until maps are publicly available, sites must be considered on a case-by-case basis by the NJDEP's Division of Fish and Wildlife.
Dredged material management areas	Yes	HVDC Cable Route	South Amboy-North and South Public Processing Facility Sites
Dry borrow pits	Not Likely	-	Based on review of aerial imagery
Dunes	Not Likely	-	Based on review of aerial imagery
Endangered or threatened wildlife or plant species habitat	Likely	All Facilities	Natural Heritage Priority Sites: Helmetta, South River Marshes Natural Heritage Grids: Study Area crosses 21 grids
Erosion hazard areas	Not Likely	-	Based on review of aerial imagery
Excluded federal lands	No	-	-
Existing lagoon edges	Not Likely	-	Based on review of aerial imagery
Farmland conservation areas	No	-	-
Filled water's edge	Yes	HVDC Cable Route	9 areas along route where Historic fill data overlaps mapped wetlands or streams
Finfish migratory pathways	Yes	HVDC Cable Route	South River-Alewife Deep Run-Alewife
Flood hazard areas	Yes	All Facilities	Floodplain Types Present: A, AE, AO, VE Floodway Types Present: AE
Geodetic control reference marks	Yes	HVDC Cable Route -	8 located within Route ROW, 11 in close proximity (100') of proposed route
Hackensack Meadowlands District	No	-	-
Historic and archaeological resources	Yes	All Facilities	Historic Districts: Camden and Amboy Railroad Line Historic District New York and Long Branch Railroad Historic District Old Bridge Historic District G.W. Helme Snuff Mill Historic District Raritan River Railroad Historic District Metuchen to Burlington Transmission Line Garden State Parkway Historic District

Special Area	Presence	Facility Involved	Comment
Hudson River Waterfront Area	No	-	-
Intermittent stream corridors	Yes	HVDC Cable Route	Tennent Brook, Deep Run, South River, Cedar Brook, Cedar Brook UNT, Manalapan Brook UNTs, Lawrence Brook UNTs, Uncoded Tributaries
Lands and waters subject to public trust rights	Yes	HVDC Cable Route	Raritan Bay Raritan River South River
Overwash areas	Not Likely	-	Based on review of aerial imagery
Pinelands National Reserve and Pinelands Protection Area	No	-	-
Public open space	Yes	HVDC Cable Route	Pigeon Swamp-South Brunswick Township Jamesburg Park-East Brunswick Township Deep Run Preserve- Old Bridge Township Julian Capik nature Reserve-Sayreville Borough
Riparian zones	Yes	All Facilities	Tennent Brook, Deep Run, South River, Cedar Brook, Cedar Brook UNT, Manalapan Brook UNTs, Lawrence Brook UNTs, Uncoded Tributaries
Shellfish habitat	No	-	-
Special hazard areas	Yes	HVDC Cable Route	Hurricane Evacuation Route: Garden State Parkway
Special urban areas	Yes	HVDC Cable Route	Old Bridge Township
Specimen trees	No	-	-
Submerged vegetation habitat	No	-	-
Wet borrow pits	Not Likely	-	Based on review of aerial imagery
Wetland buffers	Yes	All Facilities	See Wetland Below
Wetlands	Yes	All Facilities	Types Present: Modified and Managed Wetlands Coniferous and Deciduous Scrub/Shrub wetlands Coniferous and Deciduous Wooded wetlands Freshwater Tidal marshes Herbaceous wetlands Phragmites Dominant Coastal Wetlands Saline Marsh Vegetated Dune Communities
Wild and scenic river corridors	No	-	-

Table 9. **Federally- and State-Listed Threatened and Endangered Species**

Common Name	Species Name	Status
Federal[1]		
Northern Long-Eared Bat	Myotis septentrionalis	Threatened
Bog Turtle	Glyptemys muhlenbergii	Threatened
Monarch Butterfly	Danaus plexippus	Candidate
Seabeach Amaranth	Amaranthus pumilus	Threatened
Swamp Pink	Helonias bullata	Threatened
State-Listed[2]		
Triangle Floater	Alasmidonta undulata	Threatened
Brook Floater	Alasmidonta varicose	Endangered
Grasshopper Sparrow	Ammodramus savannarum	Threatened
Short-eared Owl	Asio flammeus	Endangered
Long-eared Owl	Asio otus	Threatened
Upland Sandpiper	Bartramia longicauda	Endangered
Silver-bordered Fritillary	Boloria selene myrina	Threatened
Cattle Egret	Bubulcus ibis	Threatened
Red-shouldered Hawk	Buteo lineatus	Endangered
Loggerhead Sea Turtle	Caretta caretta	Endangered
Henslow's Sparrow	Centronyx henslowii	Endangered
Northern Harrier	Circus hudsonius	Endangered
Bobolink	Dolichonyx oryzivorus	Threatened
Horned Lark	Eremophila alpestris	Threatened
Peregrine Falcon	Falco peregriuns	Endangered
American Kestrel	Falco sparverius	Threatened
Wood Turtle	Glyptemys insculpta	Threatened
Bale Eagle	Haliaeetus leucocephalus	Threatened
Golden Winged Warbler	Vermivora chrysoptera	Endangered
Eastern Lampmussel	Lampsilis radiata	Threatened
Loggerhead Shrike	Lanius ludovicianus	Endangered
Green Floater	Lasmigona subviridis	Endangered
Eastern Pondmussel	Ligumia nasuta	Threatened
Bobcat	Lynx rufus	Endangered
Red-headed Woodpecker	Melanerpes erythrocephalus	Threatened
Yellow-crowned Night-Heron	Nycticorax violacea	Threatened
Black-crowned Night-Heron	Nycticorax nycticorax	Threatened
Osprey	Pandion haliaetus	Threatened
Savannah Sparrow	Passerculus sandwichensis	Threatened

Common Name	Species Name	Status
Northern Pine Snake	Pituophis melanoleucus melanoleucus	Threatened
Pied-billed Grebe	Podilymbus Podiceps	Endangered
Vesper Sparrow	Pooecetes gramineus	Endangered
Black Skimmer	Rynchops niger	Endangered
Least tern	Sternula antillarum	Endangered
Barred Owl	Strix varia	Threatened
Seabeach Amaranth	Amaranthus pumilus	Endangered
Puttyroot	Aplectrum hyemale	Endangered
Pawpaw	Asimina triloba	Endangered
Eaton's Beggartick	Bidens eatonii	Endangered
Buttonbush Dodder	Cuscuta cephalanthi	Endangered
Lancaster Flat Sedge	Cyperus lancastriensis	Endangered
Squirrel-corn	Dicentra canadensis	Endangered
Swamp Pink	Helonias bullata	Endangered
Featherfoil	Hottonia inflata	Endangered
Goldenseal	Hydrastis canadensis	Endangered
Floating Marsh-Pennywort	Hydrocotyle ranunculoides	Endangered
Torrey's Rush	Juncus torreyi	Endangered
Slender Water-milfoil	Myriophyllum tenellum	Endangered
Wild Blue Phlox	Phlox divaricate ssp. Divaricate	Endangered
Torrey's Mountainmint	Pycnanthemum torrei	Endangered
Southern Arrowhead	Sagittaria australis	Endangered
Deathcamas	Zigadenus leimanthoides	Endangered

Notes:

[1] Species listed are according to the USFWS Information for Planning and Consultation (IPaC) Online Tool.

[2] According to the NatureServe Biodiversity Report.

Table 10. **Preliminary Permits, Authorizations, and Clearances (On-shore Only)**

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Federal			
Section 10 Permit Authorization	USACE – New York District	3 months	Required when spanning or impacting a navigable waterway. Not anticipated for on-shore portion of project
Endangered Species Act of 1973 Consultation	USFWS	6-12 months	Required if proposed activities have potential effect on federally listed species.
Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act		2-4 months	Required if activities have the potential to effect migratory birds or protected eagles.
State of New Jersey			
Certificate of Public Convenience and Necessity	NJ Board of Public Utilities	12-18 months	
Freshwater Wetlands General/Individual Permit	NJDEP DLRP	12-18 months	May be required if aboveground structures, access roads, open trench construction, or facilities are proposed in freshwater wetlands or transition areas.
Coastal Wetlands General/Individual Permit	NJDEP DLRP	6-12 months	Project is not located within the CAFRA zone. NJDEP Coastal Wetland Maps will need to be referenced to determine if impacts to regulated coastal wetlands are proposed.
Waterfront Development General/Individual Permit	NJDEP DLRP	3-9 months	
Federal Coastal Zone Consistency Determination	NJDEP DLRP	-	
Flood Hazard Area- General/Individual Permit	NJDEP DLRP	6-12 months	Will need to be determined following field surveys to determine if tributaries are located upstream of C1 Waters on southern end of the Project
State Species Consultation	NJDEP DLRP	N/A	To be included with the DLRP permits
Air Quality Pre-Construction Permit	NJDEP Bureau of Stationary Sources	3-6 months	For converter station backup generator
Tidelands License	NJ Tidelands Council- NJDEP Bureau of Tidelands Management	3-9 months	
NJPDES General Construction Stormwater Permit (5G3)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	To be filed prior to construction	Coordination may be required with the local Soil Conservation District
NJPDES Basic Industrial Stormwater Permit (5G2)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	6 Months	

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Green Acres Division	NJDEP Bureau of Legal Services and Stewardship – Green Acres Program	12-18 months	Primary Route crossed green acres property within existing ROW that may pre-date Green Acres regulations.
Roadway permits	NJ Department of Transportation Division of Right of Way and Access Management	12-18 Months	Federal Highway Administration approval for crossing of interstate 95, Primary Route also crosses Garden State Parkway
License to cross	New Jersey Turnpike Authority	TBD	New Jersey Turnpike Authority maintains and manages the New Jersey Turnpike and Garden State Parkway The Turnpike Authority encourages submittal of license to cross as soon as possible
Middlesex County			
Consultation on NJDEP permits (air, waste, noise, water)	Middlesex County Environmental Health Division	-	
Road Permit (potential, for work on county roads)	Office of Public Works	1-3 months	
Site plan application (potential, for work on county roads)	Office of Planning	3-6 months	
Municipal			
Excavation Street Opening Permit	South Amboy	-	South Amboy and South Brunswick may require additional permits for landfall and converter station connections
Construction Permit	South Amboy	-	
Floodplain Permit	South Amboy	-	
Street Opening Permit	Sayreville Borough, Old Bridge Township, East Brunswick Township, Spotswood Borough, Helmetta Township, Monroe Township	1-3 Months	Additional local approvals and authorizations could be required for structures and permanent land alterations
Site Plan Approval (Underground cables as well as fresh pond road converter station)	South Brunswick Township	3-9 months	NJ Board of Public Utilities may be able to override local regulatory approvals Additional approvals from local authorities could be required for structures and permanent land alterations
Variance/Rezoning	South Brunswick Township	3-12 months	Assuming only aboveground structures will be associated with the proposed converter station
Zoning Permit	South Brunswick Township	-	
Building Permit	South Brunswick Township	1-3 months	

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Street Opening Permit	South Brunswick Township	1-3 months	
Private			
Railroad Permit	Consolidated Rail Corporation (Conrail)	TBD	

NEETMH Proposal 15 Permit Tables

Table 11. **NJDEP Division of Land Resources Protection Special Areas**

Special Area	Presence	Facility Involved	Comment
Atlantic City	No	-	-
Beaches	Yes	HVDC	Asbury Park Beach
Canals	No	-	-
Coastal bluffs	Not Likely	-	Based on review of aerial imagery
Coastal high hazard areas	Yes	HVDC	Floodplain VE at Asbury Park Beach
Critical wildlife habitats	Unknown	Unknown	Until maps are publicly available, sites must be considered on a case-by-case basis by the NJDEP's Division of Fish and Wildlife.
Dredged material management areas	No	-	-
Dry borrow pits	Not Likely	-	Based on review of aerial imagery
Dunes	Not Likely	-	Based on review of aerial imagery
Endangered or threatened wildlife or plant species habitat	Yes	Larrabee-Oceanview	Natural Heritage Priority Sites: Shark River Station Site Natural Heritage Grids: Study Area crosses 14 grids
Erosion hazard areas	Not Likely	-	Based on review of aerial imagery
Excluded federal lands	No	-	-
Existing lagoon edges	No	-	-
Farmland conservation areas	Yes	Larrabee-Oceanview	Tullo Vaccaro Farm
Filled water's edge	Yes	All Facilities	13 areas along the Project where Historic fill data overlaps mapped wetlands or streams
Finfish migratory pathways	No	-	-
Flood hazard areas	Yes	All Facilities	Floodplain Types Present: A, AE, VE
Geodetic control reference marks	Yes	HVDC	1 located within Route ROW,
Hackensack Meadowlands District	No	-	-
Historic and archaeological resources	Yes	All Facilities	Archaeological Site Grids: Study Area Crosses 6 grids Historic Districts: Library Square Historic District New York and Long Branch Railroad Historic District Garden State Parkway Historic District New Jersey Southern Railroad Historic District Historic Properties: 154 Squankum Rd Schneider Building and Collingwood s Flea Market Building Anthony Ventura Studio

Special Area	Presence	Facility Involved	Comment
Hudson River Waterfront Area	No	-	-
Intermittent stream corridors	Yes	All Facilities	Hollow Brook, Betty Brook, Jumping Brook, UNT to Jumping Brook, Reevy Branch, Shark River Brook, UNTs to Shark River Brook, Webley's Brook, Tree Swamp Brook, UNT to Tree Swamp Brook, Mingamahone Brook, Manasquan River, UNT to Manasquan River, Squankum Brook, Muddy Ford Brook, UNT to Muddy Ford Brook, Woodcock Brook, Tarkiln Brook, Haystack Brook, Dick's Brook, North Branch Metedeconk River
Lands and waters subject to public trust rights	Yes	HVDC	Atlantic Ocean
Overwash areas	Not Likely	-	Based on review of aerial imagery
Pinelands National Reserve and Pinelands Protection Area	No	-	-
Public open space	Yes	HVDC Larrabee-Oceanview	Turkey Swamp Park Howell Township Municipal Open Space Sunnyfield Park Bear Swamp Natural Area Allaire State Park Shark River Park Asbury Park City Boardwalk and Beach
Riparian zones	Yes	All Facilities	Hollow Brook, Betty Brook, Jumping Brook, UNT to Jumping Brook, Reevy Branch, Shark River Brook, UNTs to Shark River Brook, Webley's Brook, Tree Swamp Brook, UNT to Tree Swamp Brook, Mingamahone Brook, Manasquan River, UNT to Manasquan River, Squankum Brook, Muddy Ford Brook, UNT to Muddy Ford Brook, Woodcock Brook, Tarkiln Brook, Haystack Brook, Dick's Brook, North Branch Metedeconk River
Shellfish habitat	No	-	-
Special hazard areas	Yes	HVDC Larrabee-Oceanview	Monmouth Co. Reclamation Transfer Station Rosano Howell Land, LLC. Solid Waste Recycling Facility Class B John Blewett, Inc. Solid Waste Recycling Facility Class B Resource Engineering, LLC. Solid Waste Recycling Facility Class B Hurricane-Evacuation Routes: I-195, NJ-33, NJ-71, CR-16 Garden State Parkway-, NJ-66, NJ-18
Special urban areas	Yes	All Facilities	Asbury Park City Neptune Township
Specimen trees	No	-	-
Submerged vegetation Habitat	No	-	-
Wet borrow pits	Not Likely	-	Based on review of aerial imagery

Special Area	Presence	Facility Involved	Comment
Wetland buffers	Yes	All Facilities	See Wetland Below
Wetlands	Yes	All Facilities	Types Present: Deciduous Wooded wetlands Mixed Scrub/Shrub wetlands Mixed Wooded wetlands Deciduous Scrub/Shrub wetlands Herbaceous Wetlands Modified wetlands
Wild and scenic river corridors	No	-	-

Table 12. **Federally and State Listed Threatened and Endangered Species**

Common Name	Species Name	Status
Federal[1]		
Northern Long-Eared Bat	Myotis septentrionalis	Threatened
Piping Plover	Charadrius melodus	Threatened
Bog Turtle	Glyptemys muhlenbergii	Threatened
Monarch Butterfly	Danaus plexippus	Candidate
American Chaffseed	Schwalbea americana	Endangered
Kienskern's Beaked-rush	Rhynchospora knieskernii	Threatened
Seabeach Amaranth	Amaranthus pumilus	Threatened
Swamp Pink	Helonias bullata	Threatened
State-Listed[2]		
Shortnose Sturgeon	Acipenser brevirostrum	Endangered
Atlantic Sturgeon	Acipenser oxyrinchus	Endangered
Grasshopper Sparrow	Ammodramus savannarum	Threatened
Balaenoptera physalus	Fin Whale	Endangered
Upland Sandpiper	Bartramia longicauda	Endangered
Silver-bordered Fritillary	Boloria selene myrina	Threatened
American Bittern	Botaurus lentiginosus	Endangered
Red-shouldered Hawk	Bueto lineatus	Endangered
Red Knot	Calidris canutus	Endangered
Loggerhead Sea Turtle	Caretta	Endangered
Piping Plover	Charadrius melodus	Endangered
Green Sea Turtle	Chlonia mydas	Threatened
Northern Harrier	Circus hudsonius	Endangered
Timber Rattlesnake	Crotalus horridus	Endangered
Leatherback Sea Turtle	Dermochelys coriacea	Endangered
Bobolink	Dolichonyx oryzinvorus	Threatened
Horned Lark	Ermophila alpestris	Threatened
North Atlantic Right Whale	Eubalaena glacialis	Endangered
Peregrine Falcon	Falco peregrinus	Endangered
American Kestrel	Falco sparverius	Threatened
Wood Turtle	Glyptemys insculpta	Threatened
Bog Turtle	Glyptemys muhlenbergii	Endangered
Bald Eagle	Haliaeetus leucocephalus	Threatened
Pine Barrens Treefrog	Hyla andersonii	Threatened
Southern Gray Treefrog	Hyla chrysocelis	Endangered
Loggerhead Shrike	Lanius ludovicianus	Endangered

Common Name	Species Name	Status
Kemp Ridley Sea Turtle	Lepidochelys kempii	Endangered
Bobcat	Lynx rufus	Endangered
Humpback Whale	Megaptera novaeangliae	Endangered
Red-headed Woodpecker	Melanerpes erythrocephalus	Threatened
Yellow-crowned Night-Heron	Nyctanassa violacea	Threatened
Black-crowned Night-heron	Nycticorax nycticorax	Threatened
Osprey	Pandion haliaetus	Threatened
Savannah Sparrow	Passerculus sandwichensis	Threatened
Northern Pinesnake	Pituophis melanoleucus	Threatened
Pied-billed Grebe	Pdilymbus falcinellus	Endangered
Vesper Sparrow	Pooecetes gramineus	Endangered
Black Skimmer	Rynchops niger	Endangered
Least Tern	Sternula antillarum	Endangered
Barred Owl	Strix varia	Threatened
Seabeach Amaranth	Amaranthus pumilus	Endangered
Saline Orache	Atriplex subspicata	Endangered
Pickering's Reedgrass	Calamagrostis pickeringii	Endangered
Schweinitz's Flatsedge	Cyperus schweinitzii	Endangered
Pine Barrens Boneset	Eupatorium resinosum	Endangered
Seabeach Sandwort	Honckenya peploides var. robusta	Endangered
Floating Marsh-pennywort	Hydrocotyle verticillate ranunculoides	Endangered
New Jersey Rush	Juncus Caesariensis	Endangered
Awl-leaf Mudwort	Limosella australis	Endangered
Hairy Woodrush	Luzula acuminata	Endangered
Slender Water-milfoil	Myriophyllum tenellum	Endangered
Dwarf Plantain	Plantago pusilla	Endangered
Seabeach Knotweed	Polygonum glaucum	Endangered
Saltmarsh Bulrush	Schoenoplectus maritimus	Endangered
Seabeach Purslane	Sesuvium maritimum	Endangered
Beaked Cornsalad	Valerianella radiata	Endangered

Notes:

1 Species listed are according to the USFWS Information for Planning and Consultation (IPaC) Online Tool.

2 According to the NatureServe Biodiversity Report.

Table 13. **Preliminary Permits, Authorizations, and Clearances**

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Federal			
Section 10 Permit Authorization	USACE – New York/ Philadelphia Districts	3 months	Required when spanning or impacting a navigable waterway. Majority of the Project construction is located within the New York District
Endangered Species Act of 1973 Consultation	USFWS	6-12 months	Required if proposed activities have potential effect on federally listed species.
Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act		2-4 months	Required if activities have the potential to effect migratory birds or protected eagles.
State of New Jersey			
Certificate of Public Convenience and Necessity	New Jersey Board of Public Utilities	12-18 months	
Freshwater Wetlands General/Individual Permit	NJDEP DLRP	12-18 months	May be required if aboveground structures, access roads, or other facilities are proposed in freshwater wetlands or transition areas.
Coastal Wetlands General/Individual Permit	NJDEP DLRP	6-12 months	NJDEP Coastal Wetland Maps will need to be referenced to determine if impacts to regulated coastal wetlands are proposed.
CAFRA Permit	NJDEP DLRP	6-12 months	0.71 miles of the Project are located in the Metropolitan Planning Area of the CAFRA Zone. This portion of the Project is proposed to be underground and follow road ROWs.
Waterfront Development General/Individual Permit	NJDEP DLRP	3-9 months	
Federal Coastal Zone Consistency Determination	NJDEP DLRP	-	
Flood Hazard Area- General/Individual Permit	NJDEP DLRP	6-12 months	Will need to be determined further along in project development to determine if C1 Waters are proposed to be impacted during construction.
State Species Consultation	NJDEP DLRP	N/A	To be included with the DLRP permits
Air Quality Pre-Construction/General Permit	NJDEP Bureau of Stationary Sources	3-6 months	The converter station's backup generator and temporary equipment may qualify for air quality general permits
Tidelands License	New Jersey Tidelands Council- NJDEP Bureau of Tidelands Management	3-9 months	Sections of the Project are within tidelands areas
NJPDES General Construction Stormwater Permit (5G3)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	To be filed prior to construction	Coordination may be required with the local Soil Conservation District

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
NJPDES Basic Industrial Stormwater Permit (5G2)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	6 Months	For the Neptune Converter Station
NJPDES Short Term De Minimis GP (B7)	NJDEP Department of Water Quality Bureau of Surface Water and Pretreatment Permitting	3-6 months	Required when discharging water to lower groundwater table during construction activities
Green Acres Division	NJDEP Bureau of Legal Services and Stewardship – Green Acres Program	12-18 months	Portions of the Project are within existing ROW, some impacts may pre-date Green Acres regulations. The HVDC landfall crosses a beach area that is Green Acres encumbered. Major or minor diversion/disposal of Green Acres property may be required.
Access Permits	New Jersey Department of Transportation Division of Right of Way and Access Management	6 Months	Joint Federal Highway Administration approval is anticipated for the crossing of interstate highway I-195. The Garden State Parkway and NJ-18 are also proposed to be crossed by the Project.
License to Cross	New Jersey Turnpike Authority	TBD	The New Jersey Turnpike Authority manages the Garden State Parkway and encourages submittal of a License to Cross as soon as possible in Project development
Monmouth County			
Consultation on NJDEP Permits (air, waste, noise, water)	Monmouth County Environmental Health Division	-	County Submittal to follow NJ applications issued within BOEM and NEPA. Conservation district issues SE&SC permits
Road Permit (potential, for work on county roads)	Office of Public Works	1-3 months	
Site Plan Application (potential, for work on county roads)	Office of Planning	3-6 months	
Municipal			
Excavation Street Opening Permit	Asbury Park and Neptune Township	-	Pending final design
Construction Permit	Neptune Township	-	The Neptune Converter Station will require a local site plan and construction approvals. The transmission line reconductor component may require approvals or notifications.
Floodplain Permit		-	
Street Opening Permit	Asbury Park and Neptune Township	1-3 Months	Additional local approvals and authorizations could be required for structures and permanent land alterations.

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Site Plan Approval (Underground cables as well as fresh pond road converter station)	Asbury Park and Neptune Township	3-9 months	NJ Board of Public Utilities may be able to override local regulatory approvals Additional approvals from local authorities could be required for structures and permanent land alterations
Variance/Rezoning	Neptune Township	3-12 months	Assuming only aboveground structures will be associated with the proposed converter station
Zoning Permit	Asbury Park and Neptune Township	-	Proposed property for Neptune Converter Station may require re-zoning
Building Permit	Asbury Park and Neptune Township	1-3 months	Additional local approvals could be required for structures and permanent land alterations
Private			
Railroad Permit	Consolidated Rail Corporation (Conrail), NJ Transit Corporation	TBD	Crossing of NJ transit line proposed to be buried. The Conrail line is crossed by existing transmission lines, an agreement may be in place for future crossings.

NEETMH Proposal 250 Permit Tables

Table 14. **NJDEP Division of Land Resources Protection Special Areas**

Special Area	Presence	Facility Involved	Comment
Atlantic City	No	-	-
Beaches	Yes	HVDC	South Amboy beach
Canals	No	-	-
Coastal bluffs	No	-	Based on review of aerial imagery
Coastal high hazard areas	Yes	HVDC	Floodplain VE in Raritan Bay
Critical wildlife habitats	Unknown		Until maps are publicly available, sites must be considered on a case-by-case basis by the NJDEP's Division of Fish and Wildlife.
Dredged material management areas	No	-	-
Dry borrow pits	Not Likely	-	Based on review of aerial imagery
Dunes	Not Likely	-	Based on review of aerial imagery
Endangered or threatened wildlife or plant species habitat	Likely	All Facilities	Natural Heritage Grids: Study Area crosses 6 grids
Erosion hazard areas	Likely	HVDC	Narrow Beach
Excluded federal lands	No	-	-
Existing lagoon edges	No	-	Based on review of aerial imagery
Farmland conservation areas	No	-	-
Filled water's edge	Yes	All Facilities	2 areas along route where Historic fill data overlaps mapped wetlands or streams
Finfish migratory pathways	Yes	HVDC	South River-Alewife
Flood hazard areas	Yes	HVCD Reconductor	Floodplain Types Present: A, AE Floodway Types Present: AE
Geodetic control reference marks	No		-
Hackensack Meadowlands District	No	-	-

Special Area	Presence	Facility Involved	Comment
Historic and archaeological resources	Yes	All facilities	Historic Districts: Metuchen to Burlington Transmission Line Historic District, Raritan River Railroad Historic District, Camden and Amboy Railroad Main Line Historic District, Garden State Parkway Historic District, New York and Long Branch Railroad Historic District Historic Properties: Camden and Amboy Railroad Bridge Electrical Substation in South Brunswick Township Archaeological Site Grids: 3 Grids Crossed (2 Eligible,1 Identified)
Hudson River Waterfront Area	No	-	-
Intermittent stream corridors	Yes	HVCD Reconductor	South River, Sawmill Brook UNT, Ireland Brook, Lawrence Brook UNTs, Uncoded Tributary
Lands and waters subject to public trust rights	Yes	HVDC	Raritan Bay, South River
Overwash areas	Not Likely	-	Based on review of aerial imagery.
Pinelands National Reserve and Pinelands Protection Area	No	-	-
Public open space	Yes	All Facilities	Davidson Mill Park, Pigeon Swamp State Park, Tamarack Hollow, Ireland Brook Conservation Area, Causeway Park, Raritan Bay Waterfront Park
Riparian zones	Yes	HVCD Reconductor	South River, Sawmill Brook UNT, Ireland Brook, Lawrence Brook UNTs, Uncoded Tributary
Shellfish habitat	Yes	HVDC	Raritan Bay
Special hazard areas	Yes	HVDC	Hurricane Evacuation Routes: Garden State Parkway
Special urban areas	Yes	HVCD	Old Bridge Township
Specimen trees	No	-	-
Steep slopes			
Submerged vegetation habitat	No	-	-
Wet borrow pits	Not Likely	-	Based on review of aerial imagery
Wetland buffers	Yes	HVDC Reconductor	See Wetlands Below
Wetlands	Yes	HVDC Reconductor	Deciduous Wooded Wetlands, Modified, Saline Marsh (High Marsh) wetlands
Wild and scenic river corridors	No	-	-

Table 15. **Federally- and State-Listed Threatened and Endangered Species**

Common Name	Species Name	Status
Federal[1]		
Northern Long-Eared Bat	Myotis septentrionalis	Threatened
Piping Plover	Chardrius melodus	Threatened
Red Knot	Calidris canutus rufa	Threatened
Monarch Butterfly	Danaus plexippus	Candidate
Seabeach Amaranth	Amaranthus pumilus	Threatened
Swamp Pink	Helonias bullata	Threatened
State-Listed[2]		
Triangle Floater	Alasmidonta undulata	Threatened
Brook Floater	Alasmidonta varicose	Endangered
Grasshopper Sparrow	Ammodramus savannarum	Threatened
Short-eared Owl	Asio flammeus	Endangered
Long-eared Owl	Asio otus	Threatened
Upland Sandpiper	Bartramia longicauda	Endangered
Silver-bordered Fritillary	Boloria selene myrina	Threatened
Cattle Egret	Bubulcus ibis	Threatened
Red-shouldered Hawk	Buteo lineatus	Endangered
Loggerhead Sea Turtle	Caretta	Endangered
Henslow's Sparrow	Centronyx henslowii	Endangered
Northern Harrier	Circus hudsonius	Endangered
Bobolink	Dolichonyx oryzivorus	Threatened
Horned Lark	Eremophila alpestris	Threatened
Peregrine Falcon	Falco peregriuns	Endangered
American Kestrel	Falco sparverius	Threatened
Wood Turtle	Glyptemys insculpta	Threatened
Bale Eagle	Haliaeetus leucocephalus	Threatened
Golden Winged Warbler	Vermivora chrysoptera	Endangered
Eastern Lampmussel	Lampsilis radiata	Threatened
Loggerhead Shrike	Lanius ludovicianus	Endangered
Green Floater	Lasmigona subviridis	Endangered
Eastern Pondmussel	Ligumia nasuta	Threatened
Bobcat	Lynx rufus	Endangered
Red-headed Woodpecker	Melanerpes erythrocephalus	Threatened
Yellow-crowned Night-Heron	Nycticorax violacea	Threatened
Black-crowned Night-Heron	Nycticorax nycticorax	Threatened
Osprey	Pandion haliaetus	Threatened

Common Name	Species Name	Status
Savannah Sparrow	Passerculus sandwichensis	Threatened
Northern Pine Snake	Pituophis melanoleucus	Threatened
Pied-billed Grebe	Podilymbus Podiceps	Endangered
Vesper Sparrow	Pooecetes gramineus	Endangered
Black Skimmer	Rynchops niger	Endangered
Least tern	Sternula antillarum	Endangered
Barred Owl	Strix varia	Threatened
Seabeach Amaranth	Amaranthus pumilus	Endangered
Puttyroot	Aplectrum hyemale	Endangered
Pawpaw	Asimina triloba	Endangered
Eaton's Beggartick	Bidens eatonii	Endangered
Buttonbush Dodder	Cuscuta cephalanthi	Endangered
Lancaster Flat Sedge	Cyperus lancastriensis	Endangered
Squirrel-corn	Dicentra canadensis	Endangered
Swamp Pink	Helonias bullata	Endangered
Featherfoil	Hottonia inflata	Endangered
Goldenseal	Hydrastis canadensis	Endangered
Floating Marsh-Pennywort	Hydrocotyle ranunculoides	Endangered
Torrey's Rush	Juncus torreyi	Endangered
Slender Water-milfoil	Myriophyllum tenellum	Endangered
Wild Blue Phlox	Phlox divaricate ssp. Divaricate	Endangered
Torrey's Mountainmint	Pycnanthemum torrei	Endangered
Southern Arrowhead	Sagittaria australis	Endangered
Deathcamas	Zigadenus leimanthoides	Endangered

Notes:

1. Species listed are according to the USFWS Information for Planning and Consultation (IPaC) Online Tool.
2. According to the NatureServe Biodiversity Report.

Table 16. **Preliminary Permits, Authorizations, and Clearances**

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Federal			
Section 10 Permit Authorization	USACE – New York District	3 months	Required when spanning or impacting a navigable waterway.
Endangered Species Act of 1973 Consultation	USFWS	6-12 months	Required if proposed activities have potential effect on federally listed species.
Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act	USFWS	2-4 months	Required if activities have the potential to affect migratory birds or protected eagles.
State of NJ			
Certificate of Public Convenience and Necessity	NJ Board of Public Utilities	12-18 months	
Freshwater Wetlands General/Individual Permit	NJDEP DLRP	12-18 months	May be required if above ground structures, access roads or other facilities are proposed in freshwater wetlands or transition areas or underground lines impact surface features.
Coastal Wetlands General/Individual Permit	NJDEP DLRP	6-12 months	Project is not located within the CAFRA zone. NJDEP Coastal Wetland Maps will need to be referenced to determine if impacts to regulated coastal wetlands are proposed.
Waterfront Development General/Individual Permit	NJDEP DLRP	3-9 months	
Federal Coastal Zone Consistency Determination	NJDEP DLRP	-	
Flood Hazard Area- General/Individual Permit	NJDEP DLRP	6-12 months	
State Species Consultation	NJDEP DLRP	N/A	To be included with the DLRP permits
Air Quality Pre-Construction Permit	NJDEP Bureau of Stationary Sources	3-6 months	The converter station's backup generator and temporary equipment may qualify for air quality general permits
Tidelands License	NJ Tidelands Council- NJDEP Bureau of Tidelands Management	3-9 months	
NJPDES General Construction Stormwater Permit (5G3)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	To be filed prior to construction	Coordination may be required with the local Soil Conservation District
NJPDES Basic Industrial Stormwater Permit (5G2)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	6 Months	
NJPDES Short term De Minimis General Permit (B7)	NJDEP Department of Water Quality		Required when discharging water to lower groundwater table during construction activities

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Green Acres Division	NJDEP Bureau of Legal Services and Stewardship – Green Acres Program	12-18 months	Landfall of the HVDC and converter station components are proposed on Green Acres property. Portions of Project are within existing ROW and may pre-date green acres regulations.
Access Permits	NJ Department of Transportation Division of Right of Way and Access Management	Months	Joint Federal Highway Administration approval for crossing of interstate highways Oversized load permits may be required for converter station construction.
License to Cross	NJ Turnpike Authority	TBD	The NJ Turnpike Authority manages the NJ Turnpike and Garden State Parkway and encourages submittal of a License to Cross as soon as possible in Project development
Consultation with NJDEP Parks and Forestry	NJDEP Division of Park and Forestry	As soon as possible	The converter station is proposed on NJDEP property within Pigeon Swamp State Park
Middlesex County			
Consultation on NJDEP permits (air, waste, noise, water)	Middlesex County Environmental Health Division	-	
Road Permit (potential, for work on county roads)	Office of Public Works	1-3 months	
Site plan application (potential, for work on county roads)	Office of Planning	3-6 months	
Municipal			
Excavation Street Opening Permit	Sayreville Borough, East Brunswick Township, South River Borough, South Brunswick Township, City of South Amboy	-	South Amboy and South Brunswick may require additional permits for landfall and converter station
Construction Permit	South Amboy, South Brunswick Township	-	
Floodplain Permit	South Amboy	-	
Street Opening Permit	Sayreville Borough, East Brunswick Township, South River Borough, South Brunswick Township, City of South Amboy	1-3 Months	Additional local approvals and authorizations may be required for structures and permanent land alterations

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Site Plan Approval (Underground cables as well as fresh pond road converter station)	South Brunswick Township, South Amboy	3-9 months	NJ Board of Public Utilities may be able to override local regulatory approvals Additional approvals from local authorities could be required for structures and permanent land alterations
Variance/Rezoning	South Brunswick Township	3-12 months	Assuming only aboveground structures will be associated with the proposed converter station Converter station property may require re-zoning, currently zoned as rural residential
Zoning Permit	South Brunswick Township	-	
Building Permit	South Brunswick Township	1-3 months	
Private			
Railroad Permit	Consolidated Rail Corporation (Conrail), NJ Transit Corporation	TBD	

NEETMH Proposal 604 Permit Tables

Table 17. **Atlantic and Camden Counties, New Jersey Permits**

Agency	Permit/Approval	Trigger	Potential for Need	Permit Risk	Lead/ Processing Time	Permit Fees	Future Actions/Comments
FEDERAL							
Lead Federal Agency	National Environmental Policy Act (NEPA) Review - Categorical Exclusion (CE), Environmental Assessment (EA), or Environmental Impact Statement (EIS)	Any Project that has a federal nexus, such as a Project that occurs on federally-managed land, receives federal funding, or requires a federal permit or other federal authorization will require a NEPA review (National Environmental Policy Act of 1969, 42 U.S.C. §4332).	High	High Risk	CE - Lead: 2 months EA - Lead: 2 months Processing: 6 to 10 months; EIS - Lead: 3 months Processing: 12 to 20 months	No fees; however, Applicant is typically responsible for cost of preparing the environmental document and supporting studies, as appropriate. (**This note may apply to numerous permits or approvals below**)	NEPA review will be required if the Project will be built on or crosses a federal easement or federally owned or managed lands such as but not limited to: National Forest Service (NFS), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), Bureau of Land Management (BLM) and etc., or if the Project relies on a U.S. Department of Agriculture (USDA) Farm Service Agency (FSA) real estate mortgage, a Department of Energy (DOE), or Rural Development (RD) Rural Energy for America Program (REAP) loan guarantee, etc. Consultant recommends further review and determination of NEPA triggers that may be associated with the Project as additional Project details become available.
	Federal Section 106 Review	Any Project requiring a federal permit or other authorization is subject to National Historic Preservation Act of 1966 (as amended) (NHPA) Section 106 Review.	High	High Risk	Lead: 1 month; Processing: 4-6 months	None	Determine whether a federal nexus exists for the Project. This nexus would trigger Section 106 compliance under the National Historic Preservation Act (NHPA) and should be completed prior to ground disturbance associated with any project. The federal lead agency would determine scope of work in coordination with the New Jersey Historic Preservation Office and appropriate Tribal Historic Preservation Offices (THPOs).

U.S. Army Corps of Engineers (USACE)	Clean Water Act (CWA) Nationwide Permit (NWP). Authorization for discharge of fill to Waters of the US (WOTUS) under Section 404 of the CWA. Applicable NWPs include: NWP 14 Linear Transportation projects, NWP 18 Minor Discharges, NWP 33 Temporary Construction, Access, and Dewatering, NWP 57 Electric Utility Line and Telecommunications Activities.	Discharge of fill to a jurisdictional waters of the US.	High	Moderate Risk	Lead: 4 weeks; 30 day completeness review, 45 days for notification of permit coverage by USACE	None	Project is located in USACE Philadelphia District. 100 Penn Square East, Wanamaker Bldg, Philadelphia, PA 19107-3390. 215-656-6728 Information to consider: a desktop wetland evaluation can be completed for planning. An on-site wetland delineation within construction footprint is required to obtain NWP coverage for projects that result in discharge to WOTUS greater than 0.1 ac in extent. Delineations must be conducted in conformance with the 1987 USACE Wetlands Delineation Manual and the applicable Regional Supplement. The U.S. Army Corps of Engineers (USACE) generally regulates the discharge of dredged and fill material into waters of the U.S. under Section 404 of the Federal Clean Water Act (CWA) however in the State of New Jersey, Section 404 Jurisdiction has been assumed by the State and is enforced through the Freshwater Wetlands Protection Act. In most cases, the State of New Jersey maintains sole jurisdiction over wetlands, however the USACE still works closely with the NJDEP and maintains joint jurisdiction over navigable waters and other interstate waters.
	Approved Jurisdictional Determination (AJD)	This is the at Applicants request; it is not required by the USACE.	TBD on project to project basis	No Issue	Lead: 2 weeks; Processing: 4-12 months (dependent on complexity of water resources)	None	An AJD is an official USACE determination that jurisdictional wetlands or WOTUS are either present or absent on the property. AJDs can generally be relied upon for five years and may be appealed through the USACE administrative appeal process.
	Preliminary Jurisdictional Determination (PJD)	This is the at Applicants request; it is not required by the USACE.	TBD on project to project basis	No Issue	Lead: 2 weeks; Processing: 1 month	None	A PJD is a non-binding written indication from the USACE that waters, including wetlands, may be WOTUS. A permit decision made on the basis of a PJD will often treat all waters and wetlands in the review area as if they are jurisdictional waters of the U.S. A PJD is advisory in nature and may not be appealed.
	CWA Section 404 Regional General Permit (RGP) or Nationwide Permit (NWP) for authorization of discharge to WOTUS.	Generally speaking, discharge or fill placed in a jurisdictional WOTUS resulting in loss of more than 0.1 acre of WOTUS.	High	Moderate Risk	Lead: 1 month; Processing: 2-4 months	None	Consultant recommends designing the Project to avoid/minimize impacts to wetland and water resources to the greatest extent practicable. It is also recommended to design the Project in order to take advantage of applicable non-reporting NWPs or RGPs. A Pre-Construction Notification (PCN) is required for the locations, impact thresholds, and activities listed in the particular RGP or NWP. Section 404 Jurisdiction has been assumed by the State and is enforced through the Freshwater Wetlands Protection Act.
	CWA Section 404 Individual or Standard Permit (IP or SP) for authorization of discharge to WOTUS exceeding RGP or NWP limits, resulting in more than minimal adverse effects to WOTUS.	Discharge or fill placed in a jurisdictional WOTUS resulting in loss of more than 0.5 acre of WOTUS.	Moderate-High	Moderate Risk	Lead: 1 month; Processing: 6-12 + months	Permit issuance fee of $10 for non-commercial Projects and $100 for commercial Projects. Applicant is responsible for studies and mitigation costs if applicable.	Consultant recommends designing the Project to avoid/minimize impacts to wetland and water resources to the greatest extent practicable. An individual permit will require an alternatives analysis demonstrating that the Project has been designed to avoid and minimize temporary and permanent impacts to WOTUS. Generally speaking, compensatory mitigation will be required for all permanent WOTUS impacts exceeding 1,000 square feet. A 30 day public notice period is required.

	Rivers and Harbors Act Section 10 Crossing Permit	Construction of any structure in, over or under a navigable water (Section 10 Waters) of the U.S.	High	Moderate Risk	Lead: 1 month; Processing: 4 to 6 months	Permit issuance fee of $10 for non-commercial projects and $100 for commercial projects. Applicant is responsible for studies and mitigation costs if applicable.	Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through the USACE, for construction of any structure or work in, under or over any navigable water of the US. Requires PCN. Section 10 waters are major water bodies such as the Delaware River. Project development will cross several portions of the New Jersey Intracoastal Waterway, triggering the need for a Section 10 Crossing Permit. As such, additional conditions will be required for the Project, even if the overhead transmission line does not discharge dredged or fill material into the waters. Minimal clearance guidelines for aerial transmission lines over navigable waters are specified in the Regional General Conditions for the State of New Jersey. Notification must also be provided to the National Oceanic and Atmospheric Administration, Nautical Data Branch that the clearance guidelines have been met. Consultant recommends beginning consultation with USACE officials regarding Project development in the Atlantic Ocean.
U.S. Department of the Interior Bureau of Ocean Management (BOEM)	Outer Continental Shelf (OCS) Renewable Energy Lease	Required for "commercial activities" conducted in Federal OCS lands.	High	Moderate Risk	Lead: 1 month; Processing: 4 to 12 + months	TBD	The Energy Policy Act of 2005 (EPAct) authorized BOEM to issue leases, easements and rights of way to allow for renewable energy development on the Outer Continental Shelf (OCS). EPAct provided a general framework for BOEM to follow when authorizing these renewable energy activities. For example, EPAct requires that BOEM coordinate with relevant Federal agencies and affected state and local governments, obtain fair return for leases and grants issued, and ensure that renewable energy development takes place in a safe and environmentally responsible manner. An OCS Renewable Energy Lease under 30 CFR Ch. V (7–1–14 Edition) is required for any commercial activities conducted in Federal OCS lands. Commercial activities for renewable energy leases and grants is defined as all activities associated with the generation, storage, or transmission of electricity or other energy product from a renewable energy project on the OCS. It is likely that construction of a transmission line for an offshore renewable energy projects in the OCS will trigger the need for an OCS Renewable Energy Lease. Consultant recommends further review of the OCS areas and the proposed offshore renewable energy project to determine the need for an OCS Renewable Energy Lease.

U.S. Fish and Wildlife Service (USFWS)	Section 7 Endangered Species Act (ESA) Consultation	Any project with a federal nexus that may adversely affect a listed threatened, endangered, or candidate species as determined by the lead federal agency.	Initial Consultation Completed	Moderate Risk	Lead: 1 month; Processing: 2 to 6 months	None	The U.S. Fish and Wildlife Service (USFWS) (2022) Information for Planning and Consultation (IPaC) request identified nine federally endangered and threatened species as potentially occurring within the Project Area or surrounding region. These species include the federally endangered American chaffseed (Schwalbea americana), the federally threatened northern long-eared bat (Myotis septentrionalis; NLEB), Piping Plover (Charadrius melodus), Red Knot (Calidris canutus rufa), Eastern Black Rail (Laterallus jamaicensis jamaicensis), Knieskern's beaked-rush (Rhynchospora knieskernii), seabeach amaranth (Amaranthus pumilus), and swamp pink (Helonias bullata), and the candidate for listing monarch butterfly (Danaus plexippus). The species identified in the IPaC and their probability of occurrences are described in more detail in the Report prepared for #604. It is recommended that all tree clearing take place during the inactive season (November 1 – March 31), or, at a minimum, outside of the pup-rearing season which occurs from June 1 – July 31. If the Project Area will be requiring wetlands permitting, swamp pink habitat evaluation or surveys may be required. Nesting surveys for bald eagles are recommended. If present, all active eagle nests require at least a 660' construction buffer during the breeding season.
	Section 10a ESA Incidental Take Permit	Potential for "Take" of a federally endangered or threatened species resulting from a project requiring federal funding, permit, or approval.	TBD	No Issue	Lead: 6-8 months; Processing: 12 to 24 months	The cost of a Biological Assessment and Habitat Conservation Plan are borne by the project proponent.	If lead federal agency determines that a project may adversely affect a listed species a Biological Assessment (BA) must be prepared to identify impacts to federally-listed species in the project area are likely to occur. A Habitat Conservation Plan (HCP) must be prepared to identify conservation measures to offset the permitted take of listed species under ESA Section 10. EA, and 30 day public notice required.
Environmental Protection Agency (EPA)	Oil Pollution Act (OPA) Spill Prevention Control and Countermeasure (SPCC) Rule	Onsite above-ground oil storage tanks with an aggregate capacity of 1,320 gallons or underground storage tanks with total capacity over 42,000 gallons in a location where discharge may reach navigable waters or adjoining shorelines.	Low	No Issue	Lead: 3 weeks; Processing: 1 month	None	Assumes the Project will have no oil or petroleum storage that would surpass triggers; if not, reassess whether an SPCC Plan is required. If temporary storage is needed above the threshold, a SPCC Plan still applies.
	Resource Conservation and Recovery Act (RCRA) Notification requirements for regulated waste activity	Generation of not more than 100 kg (220 lbs.) of hazardous waste and less than 1 kg (2.2 lb.) of acute hazardous waste,	Low	No Issue	Lead: 1 week; Processing: 1 week	None	Assess the potential volume of hazardous waste that will be generated by the Project. Confirm that the Project will not generate not more than 100 kg (220 lbs.) of hazardous waste and less than 1 kg (2.2 lb.) of acute hazardous waste, and no more than 100 kg of acute spill residue or soil per month to qualify as a Very Small Quantity Generator. In the event that any of these thresholds are

		and no more than 100 kg of acute spill residue or soil per month.					exceeded, evaluate record keeping and reporting requirements at 40 CFR part 262.
U.S. Department of Agriculture (USDA)	Form AD-1006, Farmland Conversion Impact Rating for Farmland Conversion under Farmland Protection Policy Act (FPPA)	A project that uses federal financing, loans, or assistance and will convert farmland to nonagricultural use.	TBD	No Issue	Lead: 3 weeks; Processing: 1 month	None	Confirm that the Project does not involve federal funding or assistance and, therefore, does not require Form AD-1006. A discussion with the local Natural Resources Conservation Service (NRCS) may be necessary.
	Form AD-1026, Highly Erodible Land Conservation (HELC)	A project that converts land enrolled in federal farm programs to make production of a commodity crop possible.	TBD	No Issue	Lead: 3 weeks; Processing: 1 to 3 months	None	Confirm that the Project will not convert federal farm program wetlands or highly erodible lands to make production of a commodity crop possible.
	Environmental Assessment (EA) for Class I Action (Form RD1940-21)	Leased lands include property encumbered by federal Farm Service Agency (FSA) or Farmers Home Administration (FmHA) real estate mortgages. Projects that use federal financing, loans, or assistance.	Low	No Issue	Lead: 1 month; Processing: 2 to 3 months	None	If Project plans call for leasing land, determine whether leased lands for the Project are encumbered by FSA or FmHA federally guaranteed real estate mortgages as soon as possible. Also confirm whether Project will use federal financing, loans, or assistance.
	Conservation Reserve Program (CRP) Contract Amendment	Project affects lands enrolled in CRP.	Low	No Issue	Lead: 2 weeks; Processing: 1 to 2 months	Reimbursement of past CRP payments plus interest for impact area.	Obtain confirmation from landowners that affected lands are not enrolled in CRP.
	A loan guarantee from USDA RD Rural Business-Cooperative Service (RBCS)	Application for a RBCS loan guarantee.	Low	No Issue	Lead: 1 month; Processing: 1-2 months	None	Determine whether a federal loan guarantee is sought as soon as possible.

Federal Aviation Administration (FAA)	Form 7460-1 Notice of Proposed Construction or Alteration (Determination of No Hazard)	Needed for construction of any structure exceeding 200 feet in height.	Low	No Issue	Lead: 1 week; Processing: 3 to 6 months, possibly longer if there are identified constraints.	None	The proposed Project is unlikely to trigger Form 7460-1 Notice of Proposed Construction or Alteration (Determination of No Hazard) through the Federal Aviation Administration (FAA) for construction of any structure exceeding 200 feet in height.
	Notice of Actual Construction or Alteration (Form 7460-2)	Needed for construction of any structure exceeding 200 feet in height.	Low	No Issue	Lead: 1 week; Processing: 1 week	None	Should the filing of Form 7460-1 reveal that the proposed Project has potential to impact navigable airspace, Notice of Actual Construction or Alteration will be required prior to initiating construction activities.
STATE							
New Jersey Board of Public Utilities (BPU)	NJ Rev Stat § 40:55D-19 - Appeal	An electric utility may appeal a disapproval from a single municipality in the event of the Project being denied in accordance with local municipal regulations.	TBD	No Issue	Lead: 35 days; Processing: 35 days	TBD	If a public utility, as defined in R.S.48:2-13, or an electric power generator, as defined in section 3 of P.L.1999, c.23 (C.48:3-51), is aggrieved by the action of a municipal agency through said agency's exercise of its powers under this act, with respect to any action in which the public utility or electric power generator has an interest, an appeal to the Board of Public Utilities of the State of New Jersey may be taken within 35 days after such action without appeal to the municipal governing body pursuant to section 8 of this act unless such public utility or electric power generator so chooses. In such case appeal to the Board of Public Utilities may be taken within 35 days after action by the governing body. A hearing on the appeal of a public utility to the Board of Public Utilities shall be had on notice to the agency from which the appeal is taken and to all parties primarily concerned, all of whom shall be afforded an opportunity to be heard. If, after such hearing, the Board of Public Utilities shall find that the present or proposed use by the public utility or electric power generator of the land described in the petition is necessary for the service, convenience or welfare of the public, including, but not limited to, in the case of an electric power generator, a finding by the board that the present or proposed use of the land is necessary to maintain reliable electric or natural gas supply service for the general public and that no alternative site or sites are reasonably available to achieve an equivalent public benefit, the public utility or electric power generator may proceed in accordance with such decision of the Board of Public Utilities, any ordinance or regulation made under the authority of this act notwithstanding. This act or any ordinance or regulation made under authority thereof, shall not apply to a development proposed by a public utility for installation in more than one municipality for the furnishing of service, if upon a petition of the public utility, the Board of Public Utilities shall after hearing, of which any municipalities affected shall have notice, decide the proposed installation of the development in question is reasonably necessary for the service, convenience or welfare of the public.

New Jersey Historic Preservation Office (HPO)	Cultural and Historic Resources Review (Technical Assistance)	Required for State and Federal Undertakings, including a variety of NJDEP Permits listed below.	High	Moderate Risk	Lead: 1 month; Processing: Estimated 30 days	None	Depending on other permit triggers including the Department of Environmental Protections Freshwater Wetlands Permit, CAFRA Permit, and more, a Cultural and Historic Resources Review (Email Submittal Form) may be required as a part of Project development. Any federal undertakings will require a Cultural and Historic Resources review under Section 106.
New Jersey Department of Environmental Protection (NJDEP)	5G3 - Construction Activity Stormwater General Permit	Construction activity disturbing one or more acres of land. Requires development of site specific SWP3 and compliance with all SWP3 conditions.	High	Moderate Risk	Lead: 4 weeks; Processing: Estimated 3-4 weeks	TBD	Permit Number: NJ0088323 (5G3 - Construction Activity Stormwater General Permit) became effective on March 1, 2022 and will expire February 28, 2027. Project development will require NJ0088323 for disturbances greater than one acre. Prepare a Stormwater Pollution Prevention Plan (SWPPP) as part of construction plans; prepare and submit the NJ0088323 application along with a complete Request for Authorization (RFA) and the appropriate fee required under N.J.A.C. 7:14A-3.1(j) shall be submitted via the NJDEP Online Portal. Authorization becomes effective when the Department certifies the RFA. Local conservation district approval of a Soil Erosion and Sediment Control (SESC) Plan may be required prior to RFA certification.
	401 Water Quality Certification	Projects requiring fill in Water of the US require a Water Quality Certification. Typically associated with USACE Permits and State Individual Permits.	TBD	Moderate Risk	Lead: 1 month; Processing: Estimated 1-6 months	TBD	A 401 Water Quality Certification authorization is required as a part of federal waterway/wetland permitting. Design project to avoid/minimize wetlands to the extent practicable. Align infrastructure to avoid temporary and permanent impacts to wetlands, waterways, and drainages. If the Project design includes impacts to wetlands or waterways, it is recommended to request an early coordination meeting with NJDEP staff to ensure all State permitting requirements are met.
	Freshwater Wetlands (FWW) Individual Permit and FWW General Permits	The maintenance or construction of utility lines within freshwater wetlands, transition areas, and/or State open waters requires a Freshwater Wetlands (FWW) permit or FWW Transition Area waiver. Several FWW General Permits (GP) are available for these types of activities.	High	Moderate Risk	Lead: 1 month; Processing: Estimated 1-6 months	TBD	General Permits provide a means to perform a variety of activities within a regulated freshwater wetland, freshwater wetland transition area and/or State open water, provided that the various conditions are met for the type of general permit requested. There are requirements, conditions and restrictions that apply to all general permits which must be considered prior to applying for a permit. If the proposed activity does not meet the applicable requirements, conditions, and/or restrictions, a FWW Individual Permit is available. Several noteworthy General Permits applicable to Project development include: underground utility lines (GP2), Non-tributary wetlands (GP6), above ground utility lines (GP 21), redevelopment of previously disturbed areas (GP26), and others. The #604 Project crosses numerous wetlands and watercourses and will likely require FWW General Permits or an Individual Permit. Consultant recommends initiating consultation with the NJDEP to ensure the proper permitting process is selected for construction of a transmission line with respect to freshwater wetland impacts.

	Flood Hazard Area (FHA) Individual Permit and Streams/Rivers & Flood Hazard General Permits; Permit-by-Rule (PBR) 33	Required for any structure or activity that in any manner changes, expands, or diminishes the course, current or cross-section of any watercourse or flood hazard area.	High	Moderate Risk	Lead: 1 month; Processing: Estimated 1-6 months	TBD	Placement of utility poles would likely be authorized under Permit-By-Rule 33 which is for the placement of one or more utility poles, provided that the proposed design meets the applicable conditions of the permit. There are also permit-by-rules for open-frame or monopole towers. Road or bridge construction to facilitate access would like be authorized under Regional General Permit 9 if the regulated water has a drainage area less than 50 acres, otherwise an Individual Permit would likely be required. Additionally, if the Project is regulated to the Coastal Zone Management Rules at N.J.A.C. 7:7, then no separate Flood Hazard approval is required. In these instances, the applicant need only submit a report and plans demonstrating compliance with the Flood Hazard Area Control Act Rules as part of the coastal permit application. General Permits provide a means to perform a variety of activities within a regulated flood hazard area and regulated streams/rivers, provided that the various conditions are met for the type of general permit requested. There are requirements, conditions and restrictions that apply to all general permits which must be considered prior to applying for a permit. If the proposed activity does not meet the applicable requirements, conditions, and/or restrictions, a FHA Individual Permit is available. Several noteworthy General Permits applicable to Project development include: Habitat Creation/Restoration/Enhancement (GP4), Reconstruct and/or Elevation-Building in Floodway (GP5), Development SFH/Duplex and Driveway (GP6), In-kind replacement of public infrastructure (GP15), and others. The #604 Project crosses numerous special flood hazard areas and will likely require a Streams/Rivers & Flood Hazard General Permits; Permit-by-Rule (PBR) 33, or Flood Hazard Area (FHA) Individual Permit. Consultant recommends initiating consultation with the NJDEP to ensure the proper permitting process is selected for construction of a transmission line with respect to FHA impacts.

	Coastal Permitting General Permits, Waterfront Development (WFD) Individual Permit and Coastal Zone Management Federal Consistency, CAFRA Individual Permit, Coastal Wetlands Individual Permit	Required for waterfront developments and/or coastal zone impacts.	High	Moderate Risk	Lead: 1 month; Processing: Estimated 1-6 months	TBD	Activities conducted in tidal waters (at or below the mean high water line) that do not meet the requirements of a Permit-by-rule, General Permit-by-certification, or General Permit will require a Waterfront Development Individual Permit. Activities conducted in the CAFRA zone that do not meet the requirements of a Permit-by-rule, General Permit-by-certification, or General Permit will require a CAFRA Individual Permit. Activities conducted within wetlands subject to the Wetlands Act of 1970 that do not meet the requirements of will require a Coastal Wetlands Individual Permit. Activities conducted within wetlands subject to the Wetlands Act of 1970 that do not meet the requirements of a Permit-by-rule, General Permit-by-certification, or General Permit will require a Coastal Wetlands Individual Permit. Applicable general permits include Landfall of Utilities (GP12), Eroded Shoreline Stabilization (GP17), Mod of Existing Electrical Substations (GP19), Geotechnical Survey Borings (GP23), and more. If the project is regulated pursuant to the Coastal Zone Management Rules at N.J.A.C. 7:7, then no separate Flood Hazard approval is required. In these instances, the applicant need only submit a report and plans demonstrating compliance with the Flood Hazard Area Control Act Rules as part of the coastal permit application. The #604 Project is partially located in the Coastal Area Facilities Review Act (CAFRA) Boundary and will likely require Coastal Permit-by-rule, General Permit-by-certification, General Permit, or Individual Permit. Consultant recommends initiating consultation with the NJDEP to ensure the proper permitting process is selected for construction of a transmission line.
	Tidelands License/Grant	Private use of State tidelands for Utility or Utility related project (Tidelands Act 12:3 (1 to 28) NJSA 13:1B-13.1 to 13.14).	High	Moderate Risk	Lead: 1 month; Processing: 3-12 months	Fair Market Value of Land for Grant, annual license fees depend on total amount of area licensed.	The #604 Project is partially located across sixteen (16) New Jersey Riparian Tidelands in the Atlantic Central Tidelands Region. Of the 16 identified tidelands, 11 are considered "claimed" tidelands. The State of New Jersey claims ownership of these tidelands and holds them in trust for the people of the state. The management of the tidelands is overseen by the Tidelands Resource Council, a twelve member Governor-appointed board of volunteers, along with DEP staff at the Bureau of Tidelands Management. Since tidelands are public lands, a developer must obtain written permission from the State and pay a fee in order to use these lands. Some tidelands may be sold in the form of a Riparian Grant while others may only be rented through either a Tidelands License or Lease. Consultant recommends contacting the Bureau of Tidelands Management to determine whether a Tidelands License or a Tidelands Grant would be best suited for the proposed Project.

	Permit-by-rule (PBR) 8	Construction of a utility line attached to a bridge or culvert.	TBD	No Issue	Lead: 1 month; Processing: Estimated 1-3 months	TBD	PBR 8 - authorizes construction of a utility line, including cable (electric, television, or fiber optic), telecommunication, wastewater, petroleum, natural gas, or water, attached to a bridge or culvert, provided: No excavation, dredging or filling is undertaken within the water body over which the utility line crosses; The utility line is firmly attached to the existing bridge or culvert structure so that no part of the utility line, its encasement, or any attachment device extends above or below the existing bridge or culvert structure; If the crossing is a bridge, the utility line, its encasement, and all attachment devices must be located entirely above the elevation of the low chord of the superstructure and entirely below the elevation of the bridge surface; If the crossing is a culvert, the utility line, its encasement, and all attachment devices must be located entirely above the overt elevation of the culvert and entirely below the elevation of the top of the culvert; If the utility line is a pipeline that conveys any substance other than potable water, the utility line must be sufficiently encased within ductile iron or concrete to protect the utility line from damage from impact with floating debris during floods; and If there is a predominant direction of flow within the water body, the utility line must be attached to the downstream face of the bridge or culvert; The installation of the utility line has no adverse impacts to special areas as described at N.J.A.C. 7:7-9; and Construction equipment is operated from land, the top of the bridge or culvert, or from barges, and shall under no circumstances be allowed to enter the water body. Please be advised, this PBR only applies to that portion of the utility line that will be constructed across the tidal waterway up to the mean high water line, provided a tidelands instrument has been obtained for the utility line. In addition, this PBR does not relieve the permittee from the obligation of obtaining all necessary approvals from the U.S. Army Corps of Engineers. See N.J.A.C. 7:7-4.8 for complete rule requirements.
	New Jersey Natural Heritage Program) - State T&E Species Consultation	Routinely recommended; natural resources investigations including wildlife will be required for the various coastal, wetlands, and waterway permits.	Routinely recommended	Moderate Risk	Lead: 1 week; Processing: 1-2 weeks	TBD	A Data Request was submitted to the New Jersey Natural Heritage Program for information regarding State-listed threatened and endangered species. No response has been received to date; Consultant will update the Permit Matrix and Project Reports once a response has been received.
	Construction Dewatering Permit	For temporary ground and surface water control (dewatering) diversions in excess of 100,000* gallons of water per day, the project owner must obtain a Dewatering	Low	No Issue	Lead: 1 month; Processing: Estimated 1 month	TBD	Consultant recommends review of the listed permit triggers to determine if a dewatering approval will be necessary, and to determine the appropriate permit selection.

		Allocation Permit, or Dewatering Permit-by-Rule or Short Term Permit-by-Rule depending on the duration of the diversion and the method employed.					
	Air Quality Permit	Permit requirements dependent on construction techniques and equipment used in Project development.	TBD	No Issue	Lead: 1 month; Processing: Estimated 1-2 months	TBD	Depending on the construction techniques and equipment used for Project development, a variety of air quality permit thresholds may be met. Consultant recommends reviewing construction techniques and equipment used with the Air Quality permitting thresholds discussed on the NJDEP Air Quality, Energy & Sustainability webpage.
New Jersey Department of Community Affairs	Development Plan Review	Required in the event that the local municipalities where the subcode officials and construction official do not possess code enforcement licenses of the appropriate class.	TBD	No Issue	Lead: 1 month; Processing: Estimated 1-2 months	TBD	Should any of the local permit issuing municipalities not possess code enforcement licenses of the appropriate class, a review from the Department of Community Affairs would be required. Class I : A Departmental plan review and release is required prior to the issuance of a construction permit unless the construction official and each appropriate subcode official in the municipal enforcing agency is certified as a HHS construction official or subcode official; Class II: A Departmental plan review and release is required prior to the issuance of a construction permit unless the construction official and each appropriate subcode official in the municipal enforcing agency is certified as a HHS or ICS construction official or subcode official; Class III: A Departmental plan review shall not be required except when the Department acts as the enforcing agency. Application should be made to the local construction office, not the Department. Refer to the local permitting section below for additional information.
New Jersey Pinelands Commission	Application for Development in the Pinelands Area	Required for developments located in the Pinelands Area.	High	Moderate Risk	Lead: 1 month; Processing: 30 days	$187.50 per acre of all land in ROW, $250 minimum	Project development will require approval of an Application for Development in the Pinelands Area through the NJ Pinelands Commission. The Project and Application should be designed in conjunction with the Pinelands Comprehensive Management Plan.
New Jersey Department of Transportation (NJDOT)	Oversize/Overweight Application for Special Hauling Permit	Permit required for vehicles exceeding the weights adopted in N.J.A.C. 13:18, Subchapter 1: Permits for Over dimensional or Overweight Vehicles	Moderate	No Issue	Lead: 1 week; Processing: 1 days to 1 week	Dependent on vehicle size and number of trips	Determine if construction of the Project will require travel on state roads with oversize/overweight vehicles. If so, determine the length, weight, and number of trips necessary to complete the Project. Consult with the DOT to select the most appropriate permit. Typically, these types of permits will be sought out by the contractor responsible for transporting materials.

	Driveway Access Permit Application	Required for driveway access construction using a State roadway.	Moderate	No Issue	Lead: 1 week; Processing: Estimated 2-4 weeks	TBD	If Project development will require any driveway access using NJDOT roadways, prior permit approval will be required.
	Application for Utility Opening (MT17A)	Required for utility infrastructure openings in NJDOT roadways.	High	Moderate Risk	Lead: 1 week; Processing: 2-4 weeks	TBD, based on square footage of opening; $725-$1,580	If Project development will require any openings on NJDOT roadways for installation of utility infrastructure, prior permit approval will be required. The Project crosses numerous New Jersey Highways and a US Highway; therefore, it is likely that approval of MT17A will be required.
	Highway Occupancy Permit (MT120A)	Permit required for construction or alteration of utility facilities.	High	Moderate Risk	Lead: 3 weeks; Processing: Estimated 2-4 weeks	TBD based on construction activities	If Project development will require any occupancies on NJDOT roadways for installation of utility infrastructure, prior permit approval will be required. The Project crosses numerous New Jersey Highways and a US Highway; therefore, it is likely that approval of MT120A will be required.
LOCAL							
Atlantic County, NJ	Development Review	Any site plans that abut a County road or County drainage structure will require Atlantic County approval in addition to local municipal approvals.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	N.J.S.A. 40: 27 - 6.2 permits planning boards to review and either approve or disapprove site plans which are along a County road or which affect County drainage. The Project crosses County roadways and likely County drainages, a Development Review from the Atlantic County Development Review Committee (DRC) will be required for Project development. The Site Plans must be designed in conformance with the County Land Development Standards. Submission Requirements are detailed in Chapter 504.
	Highway Occupancy Permit	Permit required for construction or alteration of utility facilities occupying a County road right-of-way.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Project development will likely require approval of a Highway Occupancy Permit from Atlantic County for placement of utility infrastructure in County road rights-of-way. The Development Review must be approved prior to the Highway Occupancy Permit submittal. Several attachment forms are available for Highway Occupancies, Utility Openings, and Bridge Attachments.
Cape Atlantic Conservation District (CACD)	Soil Erosion and Sediment Control (SESC) Plan Approval	Construction activities resulting in one or more acres of earth disturbance require SESC Plan Approval from the local soil conservation district. Any land disturbances of 5,000 square feet or more need to apply for certification.	High	No Issue	Lead: 1 month; Processing: 30 days	TBD	Permittees are required to submit their applications and payment electronically online utilizing the NJDEP's Stormwater Construction Activity E-Permitting System, or via paper application to the NJDEP's Bureau of Permits Management. Soil Erosion and Sediment Control Plan applications must still be submitted to the local district offices for certification. However, for those projects requiring a NJPDES Stormwater Construction Activity permit, the district shall issue a SCD Certification Code to the permittee verifying that the 251 Plan has been approved. This code is necessary to complete either the online E-Permitting or paper RFA process. Project development may require SESC Plan Approval from CACD prior to receiving NJDEP Approval for 5G3 - Construction Activity Stormwater General Permit. Submit a SESC Plan following the Standards for Soil Erosion and Sediment Control in New Jersey document (Appendix A2). Note that a 48 hour advance notice of soil disturbance is required by CACD.

Hamilton Township, Atlantic County, NJ	Zoning Permit	Required before the construction or installation of any structure on a property.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 45 days	TBD, based on size of project	According to the Township's Zoning Map, the Project Area is located is across numerous Forested, Agricultural, Growth Areas, and Designed Commercial Zoning Districts. According to the Land Use Regulations for the Pinelands Area, public utility substations are listed as a permitted use in the Growth Areas Zoning District; however, electric transmission lines and substations are not listed as a permitted or conditional use in the Forested, Agricultural, or Designed Commercial Zoning Districts. Consultant recommends initiating a consultation meeting with Hamilton Township Staff to determine the appropriate permitting process for construction of the Project.
	Site Plan Review	Likely required to assess stormwater plans.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The proposed Project will likely require approval of a Site Plan Review prior to submittal of the Zoning Permit. Site Plan Review Procedures are detailed in § 163-21 of the Hamilton Township Code of Ordinances.
	Construction Permit	No building or structure shall be erected, expanded or structurally altered until a permit therefor has been issued by the Construction Official.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Applications for a Construction Permit shall be made in accordance with the requirements of the New Jersey State Uniform Construction Code.
	Floodplain Development Permit	Required for construction activities conducted in a special flood hazard area.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The Project contains some areas of Zone A, characterized by a 1.0% annual chance of flooding. Should any construction activities impact a floodplain, prior permit approval would be necessary.
	Road Opening Permit	Required excavation of any Township street, sidewalk, curb, gutter roadway or any portion of a Township right of way.	TBD	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Consultant recommends reviewing Project design plans to determine if any street openings will be required for Project development. Apply for permit as needed.
Egg Harbor Township, Atlantic County, NJ	Zoning Permit	Required before the construction or installation of any structure on a property.	High	No Issue	Lead: 2-3 weeks; Processing: 10 days	$100	Zoning Permits are required as a condition precedent to the commencement of a use or the construction, reconstruction, alteration, conversion or installation of a structure or building. It acknowledges that such use, structure or building complies with the provisions of Chapter 225 (Zoning) of the Township Code or by a variance authorized by the Planning Board or Zoning Board of Adjustment. Public utility installations, public services, distribution lines and mains, and substations less than 400 square feet in floor area, but not including equipment material storage yards and maintenance facilities, shall be permitted uses in all zoning districts, subject to applicable state and federal regulations.

	Site Plan Review	Required for issuance of zoning and construction permits.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The proposed Project will require approval of a Site Plan Review prior to submittal of the Zoning and Construction Permit. Site Plan Review Procedures are detailed in § 198-15 of the Township Code of Ordinances. The Planning Board will review the Application for conformity to the Township Ordinances.
	Construction Permit	No building or structure shall be erected, expanded or structurally altered until a permit therefor has been issued by the Construction Official.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD, based on size of project	Prior to issuing a Construction Permit, a Zoning Permit must be approved by Egg Harbor Township. Applications for a Construction Permit shall be made in accordance with the requirements of the New Jersey State Uniform Construction Code.
	Road Opening Permit	Required for road opening construction activities.	TBD	No Issue	Lead: 1-2 weeks; Processing: Estimated 2-4 weeks	TBD	Consultant recommends reviewing Project design plans to determine if any street openings will be required for Project development. Apply for permit as needed.
Hammonton Town, Atlantic County, NJ	Zoning Permit	Required before the construction or installation of any structure on a property.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	According to the Township's Zoning Map, the Project Area is located is across the Forested Area (FA) and Agricultural Production (AP) Zoning Districts. According to the Land Use Regulations, public service infrastructure is listed as a permitted use in the AP and FA Zoning Districts. Consultant recommends initiating a consultation meeting with Hammonton Township Staff to confirm the appropriate permitting process for construction of the Project. A Joint Land Use Board Application may be required as a part of the Zoning Permit.
	Site Plan Review	Required for issuance of zoning and construction permits.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The proposed Project will require approval of a Site Plan Review prior to submittal of the Zoning and Construction Permit. Site Plan Review Procedures are detailed in § 175-52 of the Town Code of Ordinances. The Planning Board will review the Application for conformity to Town Ordinances.
	Construction Permit	No building or structure shall be erected, converted, expanded or altered until a permit has been issued by the Construction Official.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD, based on size of project	Applications for a Construction Permit shall be made in accordance with the requirements of the New Jersey State Uniform Construction Code.
	Floodplain Development Permit	Required for construction activities conducted in a special flood hazard area.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The Project contains some areas of Zone A, characterized by a 1.0% annual chance of flooding. Should any construction activities impact a floodplain, prior permit approval would be necessary.
	Tree Removal Permit	Required for removal of trees in each of four categories: Street	TBD	No Issue	Lead: 1-2 weeks; Processing: Estimated 2-4 weeks	$150	In accordance with Hammonton Municipal Code, Chapter 267, Article II, §267-7 through §267-18, removal of trees in each of the previously mentioned categories will trigger the need for a Tree

		Trees, Town Trees, Trees on Developed Lots, and Trees on Undeveloped Lots.					Removal Permit. Consultant recommends reviewing Project design plans to determine the need for tree removal in the Project Area.
Atlantic City, Atlantic County, NJ	Zoning Permit	Construction or alteration of any building or part of any building, or the change in the use of any land or building.	High	No Issue	Lead: 1-2 months; Processing: Estimated 1-2 months	TBD	According to the City's Zoning Map, the Project Area is located outside of all Zoning Districts in "water". According to the Land Use and Development Regulations, no regulations are listed for a Water Zoning District. Consultant recommends initiating consultation with the City and NJDEP/USACE to ensure Project development will be allowed via Federal, State, and local zoning permit approvals.
	Site Plan Review	Essential services are listed as exempt development, no site plan approval will be required prior to issuance of a development permit.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The proposed Project will likely require approval of a Site Plan Review prior to submittal of the Zoning and Construction Permit. Site Plan Review Procedures are detailed in Article XIX of the City Code of Ordinances. The Planning Board will review the Application for conformity to City Ordinances.
	Construction Permit	Any minor work, repairs, alterations, new buildings, additions, renovations, and more require prior Construction Permit Approval.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Applications for a Construction Permit shall be made in accordance with the requirements of the New Jersey State Uniform Construction Code.
	Street Opening Application	Required for any street opening construction activities.	TBD	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Consultant recommends reviewing Project design plans to determine if any street openings will be required for Project development. Apply for permit as needed.
Brigantine City, Atlantic County, NJ	Zoning Permit	Construction or alteration of any building or part of any building, or the change in the use of any land or building.	High	No Issue	Lead: 1-2 months; Processing: Estimated 1-2 months	TBD	According to the City's Zoning Map, the Project Area is located Conservation (C1) Zoning District. According to the Land Use and Development Regulations, no construction of any type shall be allowed except works undertaken by the City of Brigantine as approved by the Division of Coastal Resources, New Jersey Department of Environmental Protection and/or United States Army Corps of Engineers. Consultant recommends initiating consultation with the City and NJDEP/USACE to ensure Project development will be allowed via Federal, State, and local zoning permit approvals.
	Land Use Certificate	Certificate of land use compliance shall be required prior to the sale or any other type of transfer of title of	Low	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	$50	It is unlikely that Project development will trigger the need for a Land Use Certificate.

		any structure in the City of Brigantine.					
	Site Plan Review	Site plan review and approval required to determine conformity to the Land Use Ordinance.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The proposed Project will likely require approval of a Site Plan Review prior to submittal of the Zoning and Construction Permit. Site Plan Review Procedures are detailed in Section 198-12 of the City Code of Ordinances. The Planning Board will review the Application for conformity to City Ordinances.
	Construction Permit	Any building, electrical, plumbing, demolition, or other work requires construction permit approval.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Applications for a Construction Permit shall be made in accordance with the requirements of the New Jersey State Uniform Construction Code.
	Floodplain Development Permit	Required for construction activities conducted in a special flood hazard area.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The Project contains numerous special flood hazard areas in Brigantine City. Any construction activities that impact a floodplain will require prior permit approval.
	Road Opening / Right-of-Way Excavation Permit	Required for any street opening or excavation construction activities in a City right-of-way (ROW).	TBD	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Consultant recommends reviewing Project design plans to determine if any street openings or ROW excavations will be required for Project development. Apply for permit as needed.
Absecon City, Atlantic County, NJ	Zoning Permit	A Zoning Permit is required for new residential dwellings and improvements to existing dwellings such as additions, decks and swimming pools. Zoning permits are also required for fences, walls and residential storage sheds.	High	No Issue	Lead: 2-3 weeks; Processing: 10 days	TBD	According to the City's Zoning Map, the Project Area is located Conservation-Recreation (CR) and a minor portion of the Highway Development (HD-1) Zoning Districts. According to the Land Use and Development Regulations, Utility transmission lines, subject to Planning Board approval) are considered a permitted use in the CR Zoning District. The Highway Development District did not list transmission lines as a permitted, conditional, or excluded land use. Project development will likely be allowed via approval of a Zoning Permit through the Planning Board. Consultant recommends initiating consultation with the City to ensure Project development will be allowed in the HD-1 Zoning District upon approval of a Zoning Permit.
	Construction Permit	No building or structure shall be erected, expanded or structurally altered until a permit therefor has been issued by the	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD, based on size of project	Applications for a Construction Permit shall be made in accordance with the requirements of the New Jersey State Uniform Construction Code.

		Construction Official.					
	Site Plan Review	Required for issuance of zoning and construction permits.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The proposed Project will require approval of a Site Plan Review prior to submittal of the Zoning and Construction Permit. Site Plan Review Procedures are detailed in Article XX of the City Code of Ordinances. The Planning Board will review the Application for conformity to City Ordinances.
Pleasantville City, Atlantic County, NJ	Zoning Permit / Land Use Approval	Required for construction, erection, alteration of any structure or new use of land.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 1-2 months	TBD	According to the City's Zoning Map, the Project Area is located Single Family Residential (R-75 and R-50) and Industrial Zoning Districts. Portions of the Project are located in the FAA Airport Exclusion Zone and Comm and PO Conduit Use Overlay Districts. According to the Zoning Regulations, Public utility (central) substations are considered a permitted use in the Residential and Industrial Zoning Districts, subject to Planning Board approval. Additional permitting and construction considerations may need to be made with regards to the FAA Airport Exclusion Zone and Comm/PO Conduit Use Overlay Districts. Consultation with City Officials is recommended early in the planning phase to determine what considerations, if any, need to be made with regards to Project design and permitting requirements.
	Building Permit	Building Permits are needed only if alterations are required to the building or space to be occupied.	Low	No Issue	Lead: 2-3 weeks; Processing: 10 days	TBD, based on size of project	It is unlikely that Project development will trigger the need for a Building Permit. Project development will likely be allowed via the Zoning Permit / Land Use Approval.
	Site Plan Review	Required for issuance of zoning and construction permits.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	The proposed Project will require approval of a Site Plan Review prior to submittal of the Zoning and Construction Permit. Site Plan Review Procedures are detailed in Section 300-36 of the City Code of Ordinances. The Planning Board will review the Application for conformity to City Ordinances.
Camden County, NJ	Site Plan Review	Any site plans that abut a County road or County drainage structure will require Ocean County approval in addition to local municipal approvals.	High	No Issue	Lead: 2-3 weeks; Processing: 30 days	$500	Camden County planning process concerns itself primarily with a review of factors that directly impact county facilities such as county owned roads and stormwater management systems. Since Project development will likely impact a County-owned roadway, a Site Plan Review will likely be required. Follow the Camden County Planning Board Application Submission Requirements Checklist for the review submittal.
	Road Opening Permit	Required excavation of any County street, sidewalk, curb, gutter roadway or any portion of a County right of way.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Project development crosses a County Roadway and may require a County Road Opening Permit should any excavations be proposed. Consultant recommends reviewing Project design plans to determine the need for a County Road Opening Permit Application.

Camden County Soil Conservation District (CCSCD)	Soil Erosion and Sediment Control (SESC) Plan Approval/Certification	Construction activities resulting in one or more acres of earth disturbance require SESC Plan Approval from the local soil conservation district. Any commercial, industrial, linear projects, land grading or single lots disturbing 5,000 square feet or more and all multi lot subdivisions need to apply for certification.	High	No Issue	Lead: 1 month; Processing: 30 days	TBD, based on acres of disturbances	Permittees are required to submit their applications and payment electronically online utilizing the NJDEP's Stormwater Construction Activity E-Permitting System, or via paper application to the NJDEP's Bureau of Permits Management. Soil Erosion and Sediment Control Plan applications must still be submitted to the local district offices for certification. However, for those projects requiring a NJPDES Stormwater Construction Activity permit, the district shall issue a SCD Certification Code to the permittee verifying that the 251 Plan has been approved. This code is necessary to complete either the online E-Permitting or paper RFA process. Project development may require SESC Plan Approval from CSSCD prior to receiving NJDEP Approval for 5G3 - Construction Activity Stormwater General Permit. Submit a SESC Plan following the Standards for Soil Erosion and Sediment Control in New Jersey document (Appendix A2). Note that a 48 hour advance notice of soil disturbance is required by CSSCD.
Winslow Township, Camden County, NJ	Zoning Permit	Zoning Permits are required prior to commencement of a use or the erection, construction, reconstruction, alternation, conversion or installation of a structure or building.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 1 month	$25	According to the Township's Zoning Map, the Project Area is located is across numerous Pinelands Agricultural (PA), Recreation and Conservation (PRC), and Rural Residential (PR-1) Zoning Districts. According to the Land Use Regulations for the Pinelands Area, public service infrastructure intended to primarily serve the needs of the Pinelands is considered a permitted use across the identified zoning districts. Project development will likely be allowed via approval of a Zoning Permit; however, Consultant recommends consultation with City officials to ensure the appropriate permitting process for construction of a transmission line.
	Site Plan Application	Required for a change of land use.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	$300 fee, $1,500 escrow	A Site Plan Application for review of Project design plans may be required. Consultation with the Township is recommended to determine the need for a Site Plan Application approval,
	Construction Permit	Required to construct, enlarge, alter or demolish a structure.	High	No Issue	Lead: 2-3 weeks; Processing: Estimated 2-4 weeks	TBD	Applications for a Construction Permit shall be made in accordance with the requirements of the New Jersey State Uniform Construction Code.
	Road Opening Permit	Required for road opening construction activities.	TBD	No Issue	Lead: 1-2 weeks; Processing: Estimated 2-4 weeks	TBD	Project development crosses a County Roadway and may require a County Road Opening Permit should any excavations be proposed. Consultant recommends reviewing Project design plans to determine the need for a County Road Opening Permit Application.

PSEG Proposal 683 Permit Tables

Table 18. **NJDEP Division of Land Resources Protection Special Areas (On-shore only)**

Special Area	Presence	Facility Involved	Comment
Atlantic City	No	-	-
Beaches	Yes	Larrabee to Landfall	Sea Girt Beach
Canals	No	-	-
Coastal bluffs	Not Likely	-	Based on review of aerial imagery
Coastal high hazard areas	Yes	Larrabee to Landfall Deans to Landfall	VE floodplain/Atlantic Ocean VE Floodplain/Raritan River/Bay
Critical wildlife habitats	Unknown		Until maps are publicly available, sites must be considered on a case-by-case basis by the NJDEP’s Division of Fish and Wildlife.
Dredged material management areas	Yes	Sewaren to Landfall	Keasbey/Bayshore Public Processing Facility
Dry borrow pits	Not Likely	-	Based on review of aerial imagery
Dunes	Yes	Larrabee to Landfall	Dunes adjacent to Sea Girt Beach
Endangered or threatened wildlife or plant species habitat	Yes	All Facilities	14 Natural Heritage Priority Grids crossed by components
Erosion hazard areas	Not Likely	-	Based on review of aerial imagery
Excluded federal lands	No	-	-
Existing lagoon edges	Not Likely	-	Based on review of aerial imagery
Farmland conservation areas	Yes	Deans to Landfall	Giamarese Farm & Orchards, William Warren Farms (adjacent)
Filled water’s edge	Yes	Larrabee to Landfall Larrabee Tie Line Deans to Landfall Sewaren to Landfall	18 areas crossed by components where historic fill data overlaps mapped wetlands or streams
Finfish migratory pathways	Yes	Larrabee to Landfall Deans to Landfall	North Branch Metedeconk River-Alewife South River-Alewife
Flood hazard areas	Yes	Larrabee to Landfall Larrabee Tie Line Deans to Landfall Deans Tie Line Sewaren to Landfall Sewaren Converter	Floodplain Types Present: A, AE
Geodetic control reference marks	Yes	Larrabee to Landfall Deans to Landfall Sewaren to Landfall	6 marks within component ROWs
Hackensack Meadowlands District	No	-	-

Special Area	Presence	Facility Involved	Comment
Historic and archaeological resources	Yes	Larrabee to Landfall Deans to Landfall Deans Tie Line Sewaren to Landfall Sewaren Converter	Historic Districts: Sewaren Generating Station Historic District, Perth Amboy and Elizabethport Branch of the Central Railroad of NJ Historic District, New York and Long Branch Railroad Historic District, Garden State Parkway Historic District, Camden and Amboy Railroad Main Line Historic District, Raritan River Railroad Historic District, Herrmann-Aukam Company Historic District, Metuchen to Burlington Transmission Line Historic District, Manasquan Main Street Historic District Historic Properties: Overhead Contact System, Pennsylvania Railroad Company historic property, Garden State Parkway-Driscoll Bridge historic property, Allenwood-Lakewood Road Bridge historic property Archeological Site Grids: 5 eligible grids and 4 Identified grids crossed by components
Hudson River Waterfront Area	No	-	-
Intermittent stream corridors	Yes	All Facilities	Judas Creek, Manasquan River, North Branch Metedeconk River, North Branch Metedeconk River UNTs, South River, South River UNTs, Sawmill Brook UNT, Beaverdam Brook, Ireland Brook, Lawrence Brook UNTs, Raritan River, Raritan River UNTs, Wood Bridge Creek, Smith Creek, Uncoded Tributaries
Lands and waters subject to public trust rights	Yes	Larrabee to Landfall Deans to Landfall Sewaren to Landfall	Atlantic Ocean Raritan Bay South River Raritan River
Overwash areas	Not Likely	-	Based on review of aerial imagery
Pinelands National Reserve and Pinelands Protection Area	No	-	-
Public open space	Yes	Larrabee to Landfall Deans to Landfall Sewaren to Landfall	Sewaren Marina Park, Buffer Strip Park, Perth Amboy City Bicycle and Pedestrian Trail, Bordentown Avenue Park, Kennedy Park, Burkes Park, Millers Corner Park, Fitzpatrick Field, Tamarack Hollow, Ireland Brook Conservation Area, Turkey Swamp Park, Brook Road Park, Metedeconk River Recreation Area, 3 municipal open spaces, Ramtown Manor Park, Allaire State Park, Manasquan River Wildlife Management Area, Brice Park, Edgar Felix Bike Path, Dolan Field
Riparian zones	Yes	All Facilities	Judas Creek, Manasquan River, North Branch Metedeconk River, North Branch Metedeconk River UNTs, South River, South River UNTs, Sawmill Brook UNT, Beaverdam Brook, Ireland Brook, Lawrence Brook UNTs, Raritan River, Raritan River UNTs, Wood Bridge Creek, Smith Creek, Uncoded Tributaries
Shellfish habitat	Yes	Larrabee to Landfall Deans to Landfall Sewaren to Landfall	Atlantic Ocean Raritan Bay Raritan River

Special Area	Presence	Facility Involved	Comment
Special hazard areas	Yes	Larrabee to Landfall Deans to Landfall Sewaren to Landfall Larrabee Tie Line	Hazardous Waste Disposal Facilities: Bayshore Recycling Corporation, Resource Engineering LLC Hurricane Evacuation Routes: CR-611, NJ-440, Garden State Parkway, NJ-71, NJ-34
Special urban areas	Yes	Larrabee Tie Line Larrabee to Landfall Larrabee Converter Sewaren to Landfall	Woodbridge Township Perth Amboy City Brick Township Lakewood Township
Specimen trees	No	-	-
Submerged vegetation habitat	No	-	-
Wet borrow pits	Not Likely	-	Based on review of aerial imagery
Wetland buffers	Yes	All Facilities	See wetlands below
Wetlands	Yes	All Facilities	Types Present: Modified wetlands Deciduous Wooded wetlands Mixed Wooded wetlands Deciduous Scrub/Shrub wetlands Saline Marsh (Low Marsh) wetlands Vegetated Dune Communities wetlands
Wild and scenic river corridors	No	-	-

Table 19. **Federally- and State-Listed Threatened and Endangered Species**

Common Name	Species Name	Status
Federal[1]		
Northern Long-Eared Bat	Myotis septentrionalis	Threatened
Bog Turtle	Glyptemys muhlenbergii	Threatened
Piping Plover	Charadrius melodus	Threatened
Red Knot	Calidris canutus rufa	Threatened
Monarch Butterfly	Danaus plexippus	Candidate
Seabeach Amaranth	Amaranthus pumilus	Threatened
American Chaffseed	Schwalbea americana	Endangered
Knieskern's Beaked-rush	Rhynchospora knieskernii	Threatened
Swamp Pink	Helonias bullata	Threatened
State-Listed[2]		
Atlantic Sturgeon	Acipenser ocyrinchus	Endangered
Triangle Floater	Alasmidonta undulata	Threatened
Brook Floater	Alasmidonta varicose	Endangered
Henslow's Sparrow	Ammodramus henslowii	Endangered
Grasshopper Sparrow	Ammodramus savannarum	Threatened
Short-eared Owl	Asio flammeus	Endangered
Long-eared Owl	Asio otus	Threatened
Fin Whale	Balaenoptera physalus	Endangered
Upland Sandpiper	Bartramia longicauda	Endangered
American Bittern	Botaurus lentiginosus	Endangered
Silver-bordered Fritillary	Boloria selene myrina	Threatened
Cattle Egret	Bubulcus ibis	Threatened
Red-shouldered Hawk	Bueto lineatus	Endangered
Red Knot	Calidris canutus	Endangered
Loggerhead Sea Turtle	Caretta	Endangered
Piping Plover	Charadrius melodus	Endangered
Northern Harrier	Circus hudsonius	Endangered
Timber Rattlesnake	Crotalus horridus	Endangered
Bobolink	Dolichonyx oryzivorus	Threatened
Horned Lark	Eremophila alpestris	Threatened
North Atlantic Right Whale	Eubalaena glacialis	Endangered
Peregrine Falcon	Falco peregrinus	Endangered
American Kestrel	Falco sparverius	Threatened
Wood Turtle	Glyptemys insculpta	Threatened
Bog Turtle	Glyptemys muhlenbergii	Endangered

Common Name	Species Name	Status
Bald Eagle	Haliaeetus leucocephalus	Threatened
Pine Barrens Treefrog	Hyla andersonii	Threatened
Southern Gray Treefrog	Hyla chrysocelis	Endangered
Eastern Lampmussel	Lampsilis radiata	Threatened
Loggerhead Shrike	Lanius ludovicianus	Endangered
Green Floater	Lasmigona subvirdis	Endangered
Eastern Pondmussel	Ligumia nasuta	Threatened
Bobcat	Lynx rufus	Endangered
Humpback Whale	Megaptera novaeangliae	Endangered
Red-headed Woodpecker	Melanerpes erythrocephalus	Threatened
Yellow-crowned Night-Heron	Nyctanassa violaces	Threatened
Black-Crowned Night-Heron	Nycticorax nycticorax	Threatened
Osprey	Pandion haliaetus	Threatened
Savannah Sparrow	Passerculus sandwichensis	Threatened
Northern Pinesnake	Pituophis melanoleucus	Threatened
Pied-billed Grebe	Podilymbus podiceps	Endangered
Vesper Sparrow	Pooecetes gramineus	Endangered
Black Skimmer	Rynchops niger	Endangered
Least Tern	Sternula antillarum	Endangered
Barred Owl	Strix varia	Threatened
Seabeach Amaranth	Amaranthus pumilus	Endangered
Puttyroot	Aplecturm hyemale	Endangered
Pawpaw	Asimina triloba	Endangered
Eaton's Beggarticks	Bidens eatonii	Endangered
Pickering's Reedgrass	Calamagrostis pickeringii	Endangered
Buttonbush Dodder	Cuscuta cephalanthi	Endangered
Lancaster Flat Sedge	Cyperus lancasteriensis	Endangered
Squirrel-corn	Dicentra canadensis	Endangered
Pine Barrens Boneset	Eupatorium resinosum	Endangered
Swamp Pink	Helonias bullata	Endangered
Featherfoil	Hottonia inflata	Endangered
Goldenseal	Hydrastis canadensis	Endangered
Floating Marsh-pennywort	Hydrocotyle ranunculoides	Endangered
NJ rush	Juncus caesariensis	Endangered
Torrey's Rush	Juncus torreyi	Endangered
Hairy Woodrush	Luzula acuminata var. acuminata	Endangered
Slender Water-milfoil	Myriophyllum tenellum	Endangered

Common Name	Species Name	Status
Wild Blue Phlox	Phlox divarica ssp. Divaricate	Endangered
Dwarf Plantain	Plantago pusilla	Endangered
Seabeach Knotweek	Polygonum glaucum	Endangered
Torrey’s Mountainmint	Pycnanthemum torrei	Endangered
Knieskern’s Beaksedge	Rhynchospora pallida	Endangered
Southern Arrowhead	Sagittaria australis	Endangered
Saltmarsh Bulrush	Schoenoplectus maritimus	Endangered
Beaked Cornsalad	Valerianella radiata	Endangered
Deathcamas	Zigadenus leimanthoides	Endangered

Notes:
[3] Species listed are according to the USFWS Information for Planning and Consultation (IPaC) Online Tool.
[4] According to the NatureServe Biodiversity Report.

Table 20. **Preliminary Permits, Authorizations, and Clearances (On-shore Only)**

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Federal			
Section 10 Permit Authorization	USACE – New York District	3 Months	Required when spanning or impacting a navigable waterway. Not anticipated for on-shore portion of project
Nationwide Permit 57 or Individual Permit	USACE New York District	3 Months	Sewaren Converter Station is proposed to be located within 1000 feet of tidally influenced waters.
Endangered Species Act of 1973 Consultation	USFWS	6-12 Months	Required if proposed activities have potential effect on federally listed species.
Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act		2-4 Months	Required if activities have the potential to effect migratory birds or protected eagles.
State of NJ			
Certificate of Public Convenience and Necessity	NJ Board of Public Utilities	12-18 Months	
Freshwater Wetlands General/Individual Permit	NJDEP DLRP	12-18 Months	May be required if aboveground structures, access roads or facilities are proposed in freshwater wetlands or transition areas.
Coastal Wetlands General/Individual Permit	NJDEP DLRP	6-12 Months	NJDEP Coastal Wetland Maps will need to be referenced to determine if impacts to regulated coastal wetlands are proposed.
CAFRA Permit/ Individual Permit	NJDEP DLRP		The Larrabee to Landfall HVDC and Larrabee Converter Station are proposed to cross the CAFRA zone. Converter station may require an individual CAFRA permit
Waterfront Development General/Individual Permit	NJDEP DLRP	3-9 Months	
Federal Coastal Zone Consistency Determination	NJDEP DLRP	-	
Flood Hazard Area- General/Individual Permit	NJDEP DLRP	6-12 Months	The Larrabee to Landfall component of the Project crosses multiple C-1 waters
State Species Consultation	NJDEP DLRP	N/A	To be included with the DLRP permits
Air Quality Pre-Construction Permit	NJDEP Bureau of Stationary Sources	3-6 Months	For converter station backup generators, additional permits may be required for temporary equipment
Tidelands License	NJ Tidelands Council-NJDEP Bureau of Tidelands Management	3-9 Months	All components of the project cross tidelands

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
NJPDES General Construction Stormwater Permit (5G3)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	To be filed prior to construction	Coordination may be required with the local Soil Conservation District
NJPDES Basic Industrial Stormwater Permit (5G2)	NJDEP Department of Water Quality Bureau of Stormwater Permitting	6 Months	
Access permits	NJ Department of Transportation Division of Right of Way and Access Management	12-18 Months	Joint Federal Highway Administration approval for crossing of interstate highway
License to cross	NJ Turnpike Authority	TBD	The NJ Turnpike Authority manages the NJ Turnpike and Garden State Parkway and encourages submittal of a License to Cross as soon as possible in Project development
Middlesex, Monmouth and Ocean Counties			
Consultation on NJDEP permits (air, waste, noise, water)	County Environmental Health Division	-	
Road Permit (potential, for work on county roads)	Office of Public Works	1-3 months	
Site plan application (potential, for work on county roads)	Office of Planning	3-6 Months	
Municipal			
Excavation Street Opening Permit	The Cities of South Amboy and Perth Amboy, East Brunswick, South Brunswick, Lakewood Wall Howell, and Brick Townships, South River, Sayreville, Sea Girt and Manasquen Boroughs	-	Local submittals to follow NJ applications
Construction Permit	The city of South Amboy, South Brunswick, Sea Girt, Woodbridge, Lakewood Townships	-	

Permit/Approval	Regulatory Agency	Agency Review Timeframe	Comments
Floodplain Permit	The Cities of South Amboy and Perth Amboy, East Brunswick, South Brunswick, Lakewood Wall Howell, and Brick Townships, South River, Sayreville, Sea Girt and Manasquen Boroughs	-	
Street Opening Permit	The Cities of South Amboy and Perth Amboy, East Brunswick, South Brunswick, Lakewood Wall Howell, and Brick Townships, South River, Sayreville, Sea Girt and Manasquen Boroughs	1-3 Months	Additional local approvals and authorizations could be required for structures and permanent land alterations
Site Plan Approval (Underground cables as well as Larrabee, Deans, and Seawaren converter stations)	South Brunswick, Woodbridge, and Lakewood Townships	3-9 Months	NJ Board of Public Utilities may be able to override local regulatory approvals Additional approvals from local authorities could be required for structures and permanent land activities
Variance/Rezoning	South Brunswick, Woodbridge and Lakewood Townships	3-12 Months	Assuming only aboveground structures will be associated with the proposed converter stations
Zoning Permit	South Brunswick, Woodbridge and Lakewood Townships	-	Proposed converter station parcels may require rezoning
Building Permit	South Brunswick, Woodbridge and Lakewood Townships	1-3 Months	
Private			
Railroad Permit	Consolidated Rail Corporation (Conrail), NJ Transit Authority	TBD	

Appendix B – Option 2 & 3 Constructability Matrices

PJM Constructability Risk Assessment Approach

- PJM conducted its constructability evaluation of the project data submitted by proposers, and engaged expert consultants to evaluate the constructability and permitting risks of the projects.
- PJM held discussions with the NJ BPU, and the NJ Department of Environmental Protection (NJDEP), who also reviewed these projects, and our findings are consistent with that of the NJDEP regarding permitting in New Jersey.
- The constructability risk assessment is not intended as a pass/fail test, but rather as qualitative information on potential risks for NJ BPU to take into consideration in its independent evaluation. All proposals were found to be constructible as a result of PJM's constructability review and remained under consideration.
- PJM's constructability risk assessment scale is provided as follows:
  - A Low (Green) risk assessment is an indication that there are relatively minor potential risks to cost and schedule of the project identified by the constructability evaluation.
  - Medium (Yellow) and Medium-High (Orange) risk assessments are indications that there are moderate to significant potential risks identified in the evaluation, which if encountered would introduce significant delays or cost increases for the project. Neither of these are indications that a project is not viable as proposed, but a relative assessment of potential risks to a project that should be considered for a project if not properly mitigated.
  - A High (Red) risk assessment represents a severe potential risk identified by the evaluation, and is reserved for projects that may threaten the feasibility of the project as proposed, if left unmitigated.

For the constructability risk assessment matrices that follow, please also note the following about PJM's conservative approach:

- PJM's assessments are based on the routing/siting of the project and the potential issues that the entities may encounter in constructing the project.
- In some cases, the findings may be appropriately mitigated, either by an entity's experience and planning, or by an entity's use of existing 'pre-disturbed' ROW. However, there is still a possibility of encountering issues during construction, especially if expansion beyond the existing ROW is required, and the fact that protected resources may have moved in since the initial disturbance of the ROW, potentially resulting in additional permitting. This is a key point stressed by the NJDEP during our discussions, and factors into PJM's conservative stance in identifying potential risks.
- An entity's experience and their mitigation plans for the potential constructability risks, however, were part of the information requested as part of the NJ OSW SAA proposal window, and are important factors in the NJ BPU's evaluation and decision process.

Option 2 & 3 Proposals - Overview

Proposing Entity	Proposals	Description of Project	Injections (MW)	Landing Pt	Cost	Offshore Cables	Option 3	OSW Gen Connection
Anbaric - Boardwalk Power	831, 841, 574	1-1400 MW, 400kV DC circuits to Deans	Deans	Keyport (Deans)	$2B	400kV DC	(400kV DC) NC	66kV
Anbaric - Boardwalk Power	944, 802, 183, 131	1-1400 MW, 400kV DC circuits to Sewaren	Sewaren	Perth Amboy/ alt Buckeye Port Reading	$1.9-2B	400kV DC	(400kV DC) NC	66kV
Anbaric - Boardwalk Power	921, 285	1-1400 MW, 400kV DC circuits to Larrabee	Larrabee	Bay Head (Larrabee)	$1.9B	400kV DC	(400kV DC) NC	66kV
Anbaric - Boardwalk Power	145, 882, 568	1-1148 MW, 400kV DC circuits to Deans (OW2), 1-1510 MW, 400kV DC to Deans (AS1)	Deans	Bay Head (Larrabee) Perth Amboy (Sewaren)	$2.0-2.3B	400kV DC	(400kV DC) NC	66kV
Atlantic Power Transmission (Blackstone)	210, 172, 769	Three lines 320kV DC, 1200MWs each, converter station outside of Deans.	Deans 1200+ 1200+1200=3600	Raritan Bay, South Amboy adjacent to former Werner generating station	$2B (210) single ckt $1.6B (172) second ckt $1.5B (769) third ckt	320kV DC	future	66kV
Con Ed Clean Link New Jersey	990	Base case - 2-1200 MW, 320kV HVDC lines, in UG ducts 1 ckt to Larrabee and 1 ckt to Smithburg with ability to substitute one of both circuits to Deans.	Larrabee(1200MW), Smithburg (1200MW) and Deans optional (1200 or 2400MW)	Sea Girt (Larrabee)	$2.75B Larrabee and Smithburg Alt 1 Ckt $1.86B Deans Alt $3.14B Larr and Deans Alt $3.32B Smithburg and Deans Alt $3.7B 2 Ckts at Deans	320kV DC	66 kV AC ties	66kV
LSP Central Transmission (Option 2 only) Clean Energy Gateway	594	Two (2) 345kV offshore substations and eight (8) 345kV submarine cables that connect to the LSP onshore station.	Alt POI Lighthouse near Sea Girt	Sea Girt National Guard Training Ctr (Larrabee)	594 ($2B)	345kV AC/alt 275kV AC	none	345kV
MAOD (EDFR,Shell)	431, 551, 321	3 proposals for 2, 3 or 4 1200MW, 320kV DC circuits to Larrabee converter station. Larrabee converter station is included in MAOD proposal. Include 1 platform per circuit.	Smith 1200, Larrabee 1200, Atlantic 1200, Smith +1200	Sea Girt National (Larrabee/ Atlantic/ Smithburg)	$3B (431) Prop1 $4.4B (551) Prop2 $5.7B (321) Prop3 $2.4M per mile addl sub cable	320kV DC	320 kV HVDC ties (NO)	66kV
Next Era (Options 1b/2-3)	461, 860, 250 (Deans)	2-1500MW, 400kV DC circuits to Deans, alternate for 3 or 4 circuits to achieve 4500 MW or 6000 MW. One offshore platform for each circuit.	Alt POI Fresh Ponds near Deans 3000, 4500, 6000	Raritan Bay (Deans),	$3.6 B (461), $5.2B (860), $7.1B (250), $738M (359)	400kV DC	230kV AC ties (NO)	66kV
Next Era (Options 1b/2-3)	27, 298, 15 (Oceanview)	1 or 2-1500MW, 400kV DC circuits to Oceanview or 2-1200MW circuits. One offshore platform for each circuit.	Alt POI Neptune near Ocean View 1500, 2400, 3000	Asbury Park (Oceanview)	$1.5B (27), $2.7 (298), $3.0B (15), $738M (359)	400kV DC	230kV AC ties (NO)	66kV
Next Era (Options 1b/2-3)	604(Cardiff)	1-1500MW, 400kV DC circuit and 1-1200MW, 400kV DC circuit to Cardiff.	Alt POI Reega near Cardiff 2700	Absecon Bay (Cardiff)	$3.0B (604) $738M (359)	400kV DC	230kV AC ties (NO)	66kV
PSEGRT Coastal Wind Link	397, 214, 613, 230	1-1200 MW, 320 kV or 1-1400MW, 400 kV DC circuit from offshore platform, to either Sewaren or Larrabee.	Sewaren 1200/1400, Larrabee1200/1400	Sea Girt (Larrabee),South Amboy (Deans),Keasbey (Sewaren)	Sewaren $2.3B (397)/$2.4B (214) Larrabee $2.2B (613)/$2.3B (230)	320 or 400kV DC	N/A	275kV
PSEGRT Coastal Wind Link	208, 871	2-1400MW, 400kV DC circuits from offshore platforms, to Sewaren and Larrabee or Sewaren and Deans.	Sewaren 1400, Larrabee 1400 Deans 1400	Sea Girt (Larrabee),South Amboy (Deans),Keasbey (Sewaren)	$4.7B (208) $4.8B (871)	320 or 400kV DC	275 kV HVAC ties (NC)	275kV
PSEGRT Coastal Wind Link	683	3-1400MW, 400kV DC circuits from offshore platforms, to Sewaren, Larrabee and Deans.	Sewaren 1400, Larrabee 1400 Deans 1400	Sea Girt (Larrabee),South Amboy (Deans), Keasbey (Sewaren)	$7.2B (683)	320 or 400kV DC	275 kV HVAC ties (NC)	275kV

Option 2 & 3 Proposals - Environmental Risk Assessment

Proposal IDs	Proposing Entity	Project Title	Offshore Permitting/Routing/Siting	Onshore Permitting/Routing/Siting	Onshore ROW/Land Acquisition	Landfall Risks	Independent Evaluation Notes
568	Anbaric	Deans to Atlantic Shores 1	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route
574	Anbaric	Deans to Atlantic Shores 3	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route
841	Anbaric	Deans to Hudson South 1	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route
831	Anbaric	Deans to Hudson South 2	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route
882, 145	Anbaric	Deans to Ocean Wind 2	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route
921, 285	Anbaric	Larrabee to Atlantic Shores 2	Medium	Low	Low	Low	BOEM Permits required
183, 131	Anbaric	Sewaren to Atlantic Shores 3	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route
944, 802	Anbaric	Sewaren to Hudson South 2	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route
137	Anbaric	Atlantic Shores 2 to Atlantic Shores 1 Interlink	Medium	N/A	N/A	N/A	BOEM Permits required
896	Anbaric	Atlantic Shores 2 to Atlantic Shores 3 Interlink	Medium	N/A	N/A	N/A	BOEM Permits required
243	Anbaric	Atlantic Shores 2 to Ocean Wind 2 Interlink	Medium	N/A	N/A	N/A	BOEM Permits required
889	Anbaric	Hudson South 1 to Atlantic Shores 3 Interlink	Medium	N/A	N/A	N/A	BOEM Permits required
428	Anbaric	Hudson South 1 to Hudson South 2 Interlink	Medium	N/A	N/A	N/A	BOEM Permits required
748	Anbaric	Hudson South 2 to Atlantic Shores 2 Interlink	Medium	N/A	N/A	N/A	BOEM Permits required
248	Anbaric	Ocean Wind 2 to Atlantic Shores 1 Interlink	Medium	N/A	N/A	N/A	BOEM Permits required
210	APT	APT First 1200MW	Medium	Medium	Medium	Medium	BOEM Permits required, Green Acres onshore, Railroad ROW required, Congested Raritan Bay route
172	APT	APT Second 1200MW	Medium	Medium	Medium	Medium	BOEM Permits required, Green Acres onshore, Railroad ROW required, Congested Raritan Bay route
769	APT	APT Third 1200MW	Medium	Medium	Medium	Medium	BOEM Permits required, Green Acres onshore, Railroad ROW required, Congested Raritan Bay route
990	CONED	Clean Link New Jersey	Medium	Medium	Low	Low	BOEM Permits required, Green Acres onshore
594	LSPG	Clean Energy Gateway - Offshore	Medium	N/A	N/A	Low	BOEM Permits required
431	MAOD	Option 2 MAOD Proposal 1	Medium	Medium	Low	Low	BOEM Permits required, Green Acres onshore
551	MAOD	Option 2 MAOD Proposal 2	Medium	Medium	Low	Low	BOEM Permits required, Green Acres onshore
321	MAOD	Option 2 MAOD Proposal 3	Medium	Medium	Low	Low	BOEM Permits required, Green Acres onshore
359	NEETMH	Platform Connections	Medium	N/A	N/A	N/A	BOEM Permits required
604	NEETMH	Cardiff 2,700 MW DC Injection	Medium	Medium-High	Low	Low	BOEM Permits required, Green Acres onshore, Pinelands permit required
250, 461, 860	NEETMH	Deans 6,000 MW DC Injection	Medium	High	Low	Medium	BOEM Permits required, Onshore Converter parcel located on State Park, Congested Raritan Bay route
15, 27, 298	NEETMH	Oceanview 3,000 MW DC Injection	Medium	Medium	Medium	Medium	BOEM Permits required, Green Acres onshore, Asbury Park Beach Landfall, Public ROW easements require
683, 397, 214, 613,230, 871, 208	PSEG/Orsted	Sewaren/Deans/Larrabee Tri Collector	Medium	Medium	Low	Medium	BOEM Permits required, Green Acres onshore, Congested Raritan Bay route

Option 2 & 3 Proposals – Engineering & Construction Risk Assessment

Proposal ID	Proposing Entity	Project Title	Onshore Engineering	Offshore Engineering	Onshore Construction	Offshore Construction	Materials & Equipment	Independent Evaluation Notes
568	Anbaric	Deans to Atlantic Shores 1	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
574	Anbaric	Deans to Atlantic Shores 3	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
841	Anbaric	Deans to Hudson South 1	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
831	Anbaric	Deans to Hudson South 2	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
882, 145	Anbaric	Deans to Ocean Wind 2	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
921, 285	Anbaric	Larrabee to Atlantic Shores 2	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
183, 131	Anbaric	Sewaren to Atlantic Shores 3	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
944, 802	Anbaric	Sewaren to Hudson South 2	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
137	Anbaric	Atlantic Shores 2 to Atlantic Shores 1 Interlink	N/A	Low	N/A	Medium	Low	Offshore HVDC construction;
896	Anbaric	Atlantic Shores 2 to Atlantic Shores 3 Interlink	N/A	Low	N/A	Medium	Low	Offshore HVDC construction
243	Anbaric	Atlantic Shores 2 to Ocean Wind 2 Interlink	N/A	Low	N/A	Medium	Low	Offshore HVDC construction
889	Anbaric	Hudson South 1 to Atlantic Shores 3 Interlink	N/A	Low	N/A	Medium	Low	Offshore HVDC construction
428	Anbaric	Hudson South 1 to Hudson South 2 Interlink	N/A	Low	N/A	Medium	Low	Offshore HVDC construction
748	Anbaric	Hudson South 2 to Atlantic Shores 2 Interlink	N/A	Low	N/A	Medium	Low	Offshore HVDC construction
248	Anbaric	Ocean Wind 2 to Atlantic Shores 1 Interlink	N/A	Low	N/A	Medium	Low	Offshore HVDC construction
210	APT	APT First 1200MW	Low	Low	Medium	Medium	Medium	Construction in RR ROW & utility crossings, Offshore HVDC construction & materials
172	APT	APT Second 1200MW	Low	Low	Medium	Medium	Medium	Construction in RR ROW & utility crossings, Offshore HVDC construction & materials
769	APT	APT Third 1200MW	Low	Low	Medium	Medium	Medium	Construction in RR ROW & utility crossings, Offshore HVDC construction & materials
990	CONED	Clean Link New Jersey	Low	Low	Medium	Medium	Medium	Offshore HVDC construction & materials, onshore UG cable construction
594	LSPG	Clean Energy Gateway - Offshore	N/A	Medium	N/A	Low	Low	Reactive compensation concerns, No transformation for offshore wind gen
431	MAOD	Option 2 MAOD Proposal 1	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
551	MAOD	Option 2 MAOD Proposal 2	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
321	MAOD	Option 2 MAOD Proposal 3	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
359	NEETMH	Platform Connections	N/A	Low	N/A	Low	Low	
604	NEETMH	Cardiff 2,700 MW DC Injection	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
250, 461, 860	NEETMH	Deans 6,000 MW DC Injection	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns
15, 27, 298	NEETMH	Oceanview 3,000 MW DC Injection	Low	Low	Medium	Medium	Medium	Offshore HVDC construction, Public ROW conflicts; 400 kV HVDC system supply concerns
683, 397, 214, 613,230, 871, 208	PSEG/Orsted	Sewaren/Deans/Larrabee Tri Collector	Low	Low	Low	Medium	Medium	Offshore HVDC construction; 400 kV HVDC system supply concerns

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