COASTAL WIND*link*
A PSEG and Ørsted project

Response to request for additional information

Newark, NJ
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Pursuant to the New Jersey Board of Public Utility notice issued May 9, 2022 in Docket No. Q020100630, PSEG and Orsted provide the following additional information. Specifically, PSEG and Orsted are responding to all of the transmission developer questions that the BPU has posed on behalf of the to-be-formed Coastal Wind Link (CWL) project. Additionally, PSEG and Orsted are responding to selected generation developer questions, reflecting Orsted's world-leading offshore wind generation developer experience and expertise and PSEG's ownership in Orsted's BPU-awarded Ocean Wind 1 project.

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Transmission developer questions

1. How should the Board ensure that projects are completed on schedule given upcoming OSW generation projects' timelines? Please explain how changes in a future OSW generation project schedule may affect a selected SAA project, if at all.

CWL encourages the Board to select bidders with a proven track record and achievable schedules. We recognize the Board understands the complexities and timing requirements associated with moving from site investigation, through permitting, and ultimately into procurement and construction, and can determine which proposals are informed, and which are merely hopeful. CWL has developed a comprehensive schedule based on the combined experience of PSEG and Orsted in completing large, complex projects on time and on budget, incorporating best practices and lessons learned for design, permitting, construction, and commissioning. The schedule has also been informed by detailed discussions with key suppliers including cable manufacturers, HVDC equipment manufacturers, and offshore survey companies; as well as discussions with state and federal permitting agencies and other key stakeholders in the communities we serve.

One of the important features of the CWL schedule is that it is independent of the offshore wind generation developer and is not beholden to specific award to proceed with aspects of the project critical to delivering the system on time. The offshore platforms have been located so they can service the Hudson South, Central Bight, Hudson North, and Atlantic Shores lease areas (the ability to service Ocean Wind 2 is under investigation). Based on our design CWL would be considered an independent utility, where CWL is a single and complete project constructed independently and absent the construction of other projects in the area. CWL's design uses 275kV cable to connect to the offshore wind farm, rather than 66kV array cable, allowing the platform locations to be determined today which enables CWL to start offshore surveying, design, permitting, and procurement activities even before the OSW generation developer is known or has selected the voltage of their equipment. In addition, utilizing 275kV is one aspect that helps "future proof" the CWL proposal as it eliminates potential future design changes, and schedule impacts that can result, as the wind turbine generator voltage increases above 66kV. CWL's 275kV design minimizes the required interactions between CWL and the OSW developer while allowing the developer to optimize their design before interconnecting to the CWL platform. This unique approach allows CWL to be independent of the lease areas it will service, removing the likelihood of a National Environmental Policy Act (NEPA) connected project which could lengthen the overall permitting duration for projects servicing a specific lease area or placed within a BOEM designated lease area.

The main interdependency with OSW generation is with respect to commissioning. CWL's schedule supports an offshore wind developer achieving first power by December 2029, and going into full commercial operation in 2030; which aligns with a Phase 3 OSW generation COD estimate of 2030. [redacted] CWL will work with the OSW developer to achieve its preferred timeline. CWL has a flexible solution and can accommodate schedule changes. CWL proposals can start design and construction independent of the offshore wind developer and are not affected if the offshore wind farm goes in service later.

CWL encourages the Board to carefully evaluate schedule guarantees offered by bidders. The Board should prioritize selecting bidders that have an incentive to finish on time. [redacted] ther developers have included 6-month grace periods or only small basis point reduction to their ROEs, translating into far less significant impacts.

Lastly, the upcoming New York state offshore wind solicitations will create more competition for the available lease areas and put more demand on the supply chain and BOEM. The Board should prioritize awarding SAA transmission projects and phase 3 generation projects according to the current schedule (in 2022 and 2023 respectively), ahead of New York. This will help New Jersey projects order equipment earlier, and be ahead of potential supply chain constraints. For a detailed discussion of the supply chain please see the response to question 6.

2. Please outline any anticipated changes in tax policy and any federal sources of money transmissions developers might seek for a selected SAA project —or that New Jersey could seek.

PSEG directly and through its membership in Edison Electric Institute (“EEI”) actively seek to encourage Congress to enact favorable tax policy that would support the construction of offshore wind and the associated transmission projects. EEI is an association that represents all U.S. investor-owned electric companies. Its members provide electricity for 220 million Americans, operate in 50 states and the District of Columbia, and directly employ more than one million workers. PSEG’s VP of Tax is a member of the governing board of EEI’s tax section.

Currently, transmission projects are not entitled to an investment tax credit. However, the Build Back Better Act which was passed in the House in 2021 but stalled in the Senate included a 30% investment tax credit for qualified transmission lines and the related transmission property. A qualifying electric transmission line is defined as an electric transmission line that has a transmission capacity of at least 500 megawatts and is capable of transmitting electricity at a voltage of not less than 275 kilovolts. In certain instances, a qualifying electric transmission line may be a replacement, or upgrade to an existing electric transmission line. Related transmission property refers to any ancillary facilities and equipment necessary to operate a transmission line. PSEG and EEI are working to enact such legislation in Congress.

In addition to working on the enactment of favorable tax legislation, CWL is exploring other potential sources of federal and/or state cash tax benefits. Two examples include: 1) exploring the possibility of an offshore transmission project qualifying under current tax law for a research and development tax credit. This tax credit may apply on both the federal and state levels and 2) examining the possibility of discussing with the State a reduction or exemption from sales and use taxes that might be charged on the purchase of transmission related equipment.

Federal funding sources outside of the tax credit are outlined in our response to question 4.

3. Other than an act of Congress amending the current Federal Investment Tax Credit ("ITC"), might there be an innovative way (such as in collaboration with OSW generation developers) for Option 1b, Option 2, or Option 3 projects that support OSW to qualify for the ITC?

CWL continues to work with the Treasury Department and Congress to ensure that Federal incentives, such as the investment tax credit (ITC) reflect the commitment that has already been made by the federal government for offshore wind. We believe there are innovative approaches regarding the application of the existing ITC law to transmission projects. For example, under current tax law only qualifying generation property is eligible for a 30% investment tax credit. CWL will be working with Treasury to expand the definition of qualifying generation property to include the associated transmission lines. As we continue to explore this and other potential opportunities, the project team will endeavor to maximize the socialization of the economic benefits with New Jersey consumers.

4. How might transmission developers explore the availability of federal funding opportunities that may be available to support transmission projects? How would receipt of such funding be incorporated into bids or financing arrangements? How might the Board coordinate on applying for such opportunities?

Orsted is a member of a coalition of more than 30 companies and organizations committed to building America's clean energy future. The coalition recently requested that the U.S. Department of Energy's (DOE's) fiscal year 2023 budget include robust funding for high-voltage transmission deployment and research. Specifically, coalition participants seek enhanced funding for high-voltage transmission deployment and research through the DOE's Grid Deployment Office, Loan Programs Office, and Office of Electricity. The coalition encouraged members on the Energy and Water Development Subcommittees in both chambers of Congress to consider additional funding for the Transmission Facilitation Program; for deploying technologies to enhance grid flexibility; grants for enhancing grid resilience; and for loan guarantees, converter stations, national transmission planning needs and long-term planning studies, and transmission planning technical assistance for states. Investments via the FY 2023 Energy and Water Appropriations Bill in grid infrastructure will be critical moving forward.

CWL (CWL) is closely monitoring federal funding opportunities that support transmission projects and grid development. The DOE is spearheading many of these opportunities, either through provisions of the Infrastructure Investment and Jobs Act (IIJA) or previously enacted authorities and funding.

In a January 2022 Notice of Intent[1], the DOE announced its new Building a Better Grid Initiative focused on catalyzing nationwide development of new and upgraded high-capacity transmission lines. Under the Building a Better Grid Initiative, DOE will identify critical national transmission needs and support the buildout of long-distance, high-voltage transmission facilities that meet those needs through transmission planning, innovative financing mechanisms, coordinated permitting, and transmission related research and development.

As outlined in the Building a Better Grid Initiative, the IIJA contains several financial incentives to address financial risk from large scale transmission projects. While the decision to apply to any federal funding opportunity is subject to additional legal and commercial review by CWL, the following potential opportunities appear the most promising:

<u>Transmission facilitation program (sec. 40106)</u>: This provision created a $2.5 billion loan fund; eligible projects include new high-capacity transmission lines and increasing capacity of existing lines. While details are still forthcoming, DOE will prioritize projects that improve resilience and reliability of the grid, facilitate inter-regional transfer of electricity, lower electric sector greenhouse gas emissions, and use advanced technology. CWL thus should meet several prioritization criteria.

DOE has three tools to facilitate investment. First, DOE can serve as an "anchor-tenant," buying up to 50% of a new transmission line's capacity over a term of up to 40 years. Second, DOE can issue loans to eligible projects. Lastly, DOE can enter into public private partnerships with eligible transmission projects. Under these partnerships, DOE can participate in designing, developing, constructing, operating, maintaining, or owning an eligible project. Program implementation guidance is still to be determined. As these proposals largely entail forms of government financing, the project team will evaluate the efficiency of these mechanisms relative to our proposal and work with the BPU to develop the most efficient financing structure for customers.

<u>Preventing outages and enhancing the resilience of the electric grid (Sec. 40101)</u>: This provision appropriated $5 billion to support activities that reduce the likelihood and consequence of impacts to the electric grid due extreme weather, wildfire, and natural disaster. Eligible projects will supplement existing hardening efforts, enhance the resilience of a system to future events, or reduce disruption. Eligible entities include an electric grid operator; an electricity storage operator; an electricity generator; a

[1] https://www.govinfo.gov/content/pkg/FR-2022-01-19/pdf/2022-00883.pdf

transmission owner or operator; a distribution provider; a fuel supplier; and any other relevant entity, as determined by the Secretary of Energy—thus potentially encompassing NJ BPU and/or CWL.

The program is split between $2.5B of formula grants that will be awarded to eligible applicants (states and tribes), which can then be passed through as subawards to eligible entities (including utilities, a generator, and transmission owner/operator,), and $2.5B of competitive grants with open eligibility to include public and private sector entities. The NOI for this portion of the funding is expected to be released in summer 2022. The application for this program is expected to open in the fourth quarter of 2022.

Each State and Indian Tribe is required to match 15 percent of the amount of each grant provided to the State or Indian Tribe under the Program. Further, an eligible entity that receives a subaward under this program is required to match 100 percent of the amount of the subaward. (However, if the eligible entity sells not more than 4,000,000 megawatt hours of electricity per year, the required match will be one-third of the amount of the subaward.)

Timing for the release of the Formula Grants[2] depends on the release of the Administrative and Legal Requirements Document (ALRD), which will effectively serve as the Funding Opportunity Announcement. DOE anticipates issuing the ALRD[3] in late June/early July 2022, and Applicants will then have 60 days to submit an application.

The state will be allocated its portion of the funds, and should consider a mechanism to allocate them directly to utility infrastructure projects to reduce customer costs." (Only one entity within each State can apply for, receive, and administer the formula-based award.) The timing of the competitive grants is yet to be determined, but the associated Notice/Request for Information will be released in summer 2022.

- Electric grid reliability and resilience research, development, and demonstration (Sec. 40103): This provision appropriates $5 billion to coordinate electric sector owners and operators to demonstrate innovative approaches to transmission, storage, and distribution infrastructure and new approaches to enhance regional grid resilience (on a cost-shared basis). This provision also requires DOE, the Department of Homeland Security, FERC, and Nuclear Energy Regulatory Commission to develop a framework to assess the resilience of energy infrastructure. Eligible projects include the siting or upgrading of transmission and distribution lines. The timing is yet to be determined, but the Notice/Request for Information is expected to be released in summer 2022. The application for the Rural or Remote Areas program is expected to open in fall of 2022, and the Grid Resilience Demonstration Program's Notice/Request for Information will be posted in summer 2022. Based on the list of eligible entities, BPU would likely qualify for this funding.

  Eligible entities include a state, a combination of two or more states, a Native American tribe, a unit of local government, or a public utility commission. CWL expects this aspect of the program may take longer to implement, but we believe innovative aspects of our design would allow our proposals to qualify and we would support NJ BPU in utilizing this program once guidelines have been established

- Deployment of technologies to enhance grid flexibility (Sec. 40107): This provision appropriates $3 billion for the Smart Grid Investment Matching Program and also includes efforts to address storage and voltage balancing needs associated with greater deployment and utilization of intermittent sources of power. Industry must match investments in this competitive solicitation. Utilities are eligible, applications for this program are expected to be open by the end of 2022. The timing of the Notice/Request for Information is expected to be released in summer 2022. Funding for any

[2] An RFI on the Formula Grant Program is open with comments due by June 2, 2022: https://netl.doe.gov/sites/default/files/2022-05/IIJA%2040101d%20-%20Federal%20Register%20RFI.pdf
[3] The DRAFT ALRD can be found here: https://netl.doe.gov/sites/default/files/netl-file/IIJA%2040101d%20-%20DRAFT%20ALRD.pdf

transmission investments must be related to enabling Smart Grid functions, so CWL will be closely following any issued guidance. CWL believes that its HVDC solutions coupled with the meshed grid concept and closed interlink system would support a compelling application and we would work the BPU to pursue the best option for NJ, once this window opens.

- State energy program (Sec. 40109): This provision appropriates $500 million for FY22-26 for the State Energy Program for State, local, and Tribal governments to support transmission and distribution planning, including feasibility studies of line routes and alternatives, preparation of necessary project designs and permits, and outreach to affected stakeholders. This provision provides support for developing state energy hazard/risk mitigation plans[4].

Once awarded CWL would welcome coordination with NJ BPU on some or all of the funding opportunities outlined above. Because details on eligibility and financial terms are still being developed for most of these federal incentives, CWL cannot yet estimate the impact of these incentives on the project's finances or their ultimate desirability. As more details are expected in summer 2022, CWL would suggest a more detailed workshop or discussion with NJ BPU after this information becomes available. The purpose of this discussion would be to confirm funding programs and develop a strategy for application, either by CWL or BPU.

Currently grants received from the government are taxable to the recipient. For every $100 of grant received, $30 is paid in federal and state income tax, leaving only $70 of the $100 received to be used for its intended purpose. PSEG is working through an industry group to have the grant monies received not be taxable which would provide even more benefit to NJ customers.

[4] States are eligible (with 20% match), and specific guidance about formula program and allocation process can be found here: https://www.energy.gov/eere/wipo/state-energy-program-guidance#2022guidance

5. How might transmission developers explore the availability of federally-backed loans for loan guarantees that may be available to support transmission projects? How should developers and the Board coordinate on applying for such opportunities? How would receipt of such loans or loan guarantees be incorporated into bids or financing arrangements?

The Orsted and PSEG partnership behind CWL brings a unique funding capability. Both Orsted and PSEG are large energy utilities with investment grade ratings from leading rating agencies (Orsted: BBB+/Baa1 by S&P/Fitch and Moody's and PSEG: BBB+ by S&P/Fitch and Baa2 by Moody's) with strong track records for raising financing in the capital markets at highly competitive rates. All seven CWL proposals are eligible for competitive rates in the debt market to provide the best financing option for NJ consumers.

PSEG and Orsted continuously monitor the debt market for opportunities, including federal-backed loans. CWL will consider a federal-backed loan if it offers competitive and attractive financing terms compared to available alternatives including what the capital market can offer.

The team has identified the opportunity to finance the project using the Title 17 Innovative Energy Loan Program Office (LPO) for transmission projects. CWL qualifies for an LPO loan because it uses innovative technology such as HVDC and for the purpose of connecting offshore wind which avoids and reduces sequester greenhouse gas and air pollutant emissions. LPO supports transmission projects like CWL with up to a total of $3 billion in aggregate guarantee loans. This opportunity will be monitored.

6. How might a selected SAA project manage and mitigate material and equipment supply chain risks and any associated costs, particularly as they might related to HVDC?

A selected SAA project must first understand the complexities of the supply chain incorporating the learnings of not only past and current projects, but also of on-going maintenance needs of assets in-service. Those projects that have access to the experience of consistently accessing the supply chain for new projects and maintenance of existing assets will benefit. The CWL project has unrivalled access to the supply chain; with PSEG's experience procuring, constructing, and maintaining onshore transmission networks, and Orsted's experience with offshore construction and maintenance, material and equipment supply risk will be minimized beyond what any other competitor is able to offer.

[redacted]

The HVDC supply chain is in heavy demand, and suppliers will look to extract costly premiums from smaller customers. In this environment, NJ customers would benefit from selecting a developer with a broad enough portfolio interest to effectively negotiate supply arrangements for SAA systems. Since [redacted]

[redacted]

[redacted]

The CWL proposals are informed by the experience and portfolio learning of Orsted and PSEG, who will leverage these learnings to manage and mitigate the supply chain risk and provide protection to the rate payer. As an active participant in offshore development, CWL recognizes the complexities that currently face the industry and impact these projects. [redacted]

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7. How might a selected SAA project manage financial risk, including, but not limited to, market and interest rate dynamics, labor costs, raw material and supply chain costs, land procurement costs, and insurance?

A selected SAA project must have the demonstrated experience to manage such risks as well as appropriate mitigation measures in place. CWL will bring PSEG's and Orsed's unparalleled experience which has already been incorporated into the proposals as described below.

Raw material and supply chain

CWL has strong relationships with both the onshore and offshore supply chain and plans to secure equipment and material early to lock in pricing and reduce risk. [redacted]

CWL has strong site control with direct ownership of Sewaren and purchase option agreements in place for most parcels, providing cost certainty. Though real estate makes up a modest percentage of the total project cost, site control is critical to insure that routes are identified and the schedule is not adversely impacted.

The upcoming New York state offshore wind solicitations will create more competition for the available lease areas; thus, stressing the already overburdened supply chain. To get ahead of competition, NJ BPU should push to award transmission projects according to the current schedule by October 2022, ahead of New York offshore wind procurement. This will ensure New Jersey awarded projects are positioned to order equipment earlier than New York projects, and hence reduce supply chain risks.

Insurance

CWL's proposals included insurance costs for construction and the ongoing operations and maintenance costs include ongoing insurance once the project is in operation. The costs were based on quotes received from insurance providers and include comprehensive coverage to protect New Jersey customers.

Labor

PSEG has strong relationships with the local union workforce and works with the top civil and electrica contractors regularly. [redacted] Additionally, North America's Building Trades Unions (NABTU) and Orsted have announced a Project Labor Agreement (PLA) to construct the company's US offshore wind farms with an American union workforce. The National Offshore Wind Agreement (NOWA) is a first-of-its-kind agreement in the US which "sets the bar for working conditions and equity, injects hundreds of millions of dollars in middle-class wages into the American economy, creates apprenticeship and career opportunities for communities most impacted by environmental injustice, and ensures projects will be built with the safest and best-trained workers in America."[5]

Financial risks

In crafting its cost containment mechanism, CWL took an aggressive approach to protecting customers from cost over-runs, and other risks best controlled by project developers. This led to cost containment proposal with very few exceptions, all of which are related to costs outside the control of CWL.

[redacted]

Inflation risk

Coast Wind Link recognizes inflation will impact the overall cost of the project. The project team did not include any risk premium to compensate the uncertainties in the market instead a trans arent ad ustment of the cost ca will secure the best value for NJ consumers. [redacted]

[5] https://www.offshorewind.biz/2022/05/06/orsted-and-nabtu-sign-historic-project-labor-agreement-for-us-offshore-wind/

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8. If an Option 2 or Option 3 proposal is selected, please detail the potential reliability and economic benefits.

CWL believes that selecting a proposal that includes Options 2 and 3 would bring significant reliability and economic benefits to NJ consumers. Different from radial transmission CWL offers an option 3 which can be an innovative approach to offshore wind offerings; a win-win solution to solve offshore wind injection, reliability, and system congestion issues. CWL's design is based on those three challenges and provides the most efficient solution to tackle all of them. CWL's interlinks offer several benefits especially if backed by an HVDC system offering power flow control once two or more platforms are interconnected. Interlinks also provide reliability in case of a cable failure or outage, positioning the offshore wind generation away from the single point of failure.

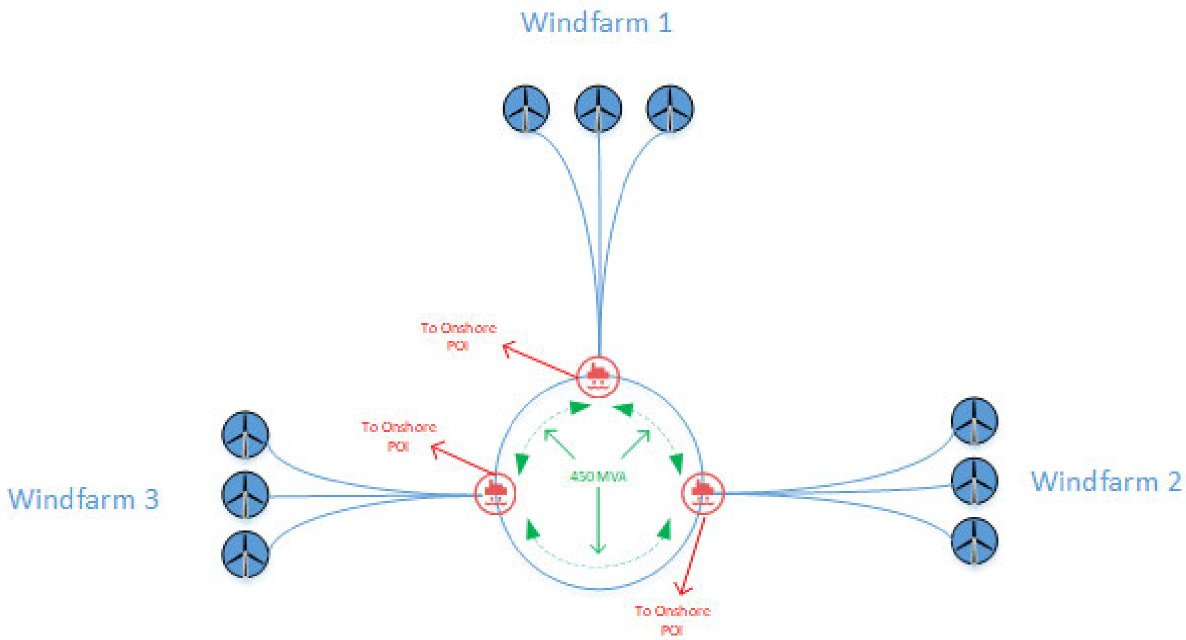

Figure 1: CWL Meshed Grid Design

CWL is the only HVDC project that has analysed the offshore meshed grid holistically and without bias. CWL's approach starts at enabling fair and equitable competition among future round 3-5 offshore wind participants. CWL designed a platform that connects to export cable rated at 275kV; thus, minimizing the number of conductors routed to the centralized location. More importantly, CWL engineered its interlinks with the continuous ability to operate providing a true meshed grid solution. The design is cost effective, reduces generation losses and curtailment and improves availability and congestion significantly.

NYSERDA, which has been evaluating the cost-effective way to implement meshed grid offshore, has indicated AC interlinks should be utilized as the best path forward.[6] They considered the optimal capacity for interlink power transfer based on wind farm capacity factor, and have determined the optimal size for interlink transfer capacity is 300MW.[7] CWL performed similar studies and arrived to a similar conclusion hence each interlink is rated for 450MVA. When the three CWL platforms are interlinked in a ring, each platform can transfer approximately 450 MWs, creating a total transfer capability through the interlinks of over 800MW.

[6] Appendix G: Technical Requirements for Meshed Ready, https://www.nyserda.ny.gov/offshore-wind-2022-solicitation
[7] Appendix G: Technical Requirements for Meshed Ready, https://www.nyserda.ny.gov/offshore-wind-2022-solicitation

Another differentiator from other HVDC projects is that CWL will have higher availability than any HVDC system using HVDC interlinks. Unlike AC systems, HVDC requires annual or bi-annual maintenance with schedule ranging from 5 to 10 days. During this time the system is unavailable, the use of HVDC interlinks would not be feasible or possible with the HVDC system in an outage; by contrast, with an HVAC interlink, power can still move between platforms even during times of HVDC system maintenance. Furthermore, because PJM has required a 1500MW single largest contingency. HVDC interlinks, absent of HVDC breakers, could not be used during grid congestion because it would connect two HVDC systems together and a single fault would constitute a violation of the 1500MW single largest contingency. In addition, CWL is the only proposal that has the ability to reduce onshore grid congestion by shifting load from one POI to another via AC interlink without violating the single largest contingency imposed by PJM.

Furthermore, as many wind farm developers have requested to reduce uncertainty around schedule, prescriptive guidance should be provided for how generation, transmission, and interconnections scopes will be integrated into a SAA award. CWL offered an approach that is independent of generation awards, to facilitate the siting and permitting process, insuring each project will be delivered on time.. Our project is also the only project in a position to provide the prescriptive guidance to the future offshore wind solicitation participants on technical requirements, facility interconnection guidance, and operational requirements. CWL's offshore platform is the only platform that has its scope fully defined and has the ability to begin engineering and fabrication without input from the wind farm developers. Because our competitors utilize 66kV as the point of interconnection, each outbound circuit requires its own revenue metering equipment, and the transmission developer also will be required to house all of the wind farm developers wind turbine control system. These are inputs that are provided to the OEM at the time of tender. Because all this information is not available until after the offshore wind solicitation award, the transmission developers using 66kV can't fully define RFPs until after agreements and arrangements are made with wind farm developers. Based on this alone, our competitors can expect schedule delays, and scope changes that will lead to higher costs. It should be considered that cost caps don't include scope changes for all of the competitors.

In summary, CWL's design offers the best power transfer capability and availability when interconnected with one or more platforms, [redacted] CWL's offshore meshed grid will ensure that wind farm developers will get the highest availability possible as compared to a radial system or competitor's proposals making it the most reliable system offshore, and providing the greatest economic benefit of any other system by increasing the energy delivered to the heart of the grid.

[8] Proposal 683, Appendix T

Offshore wind developer questions

6. How should the Board consider the optimal locations for Option 2 substations? Should such determinations occur at the time of the Board's SAA decision or following the Board's OSW generation solicitations? If the location is determined after the generation solicitations, what type of coordination between generation and transmission developers would be required?

One key advantage of the SAA is that, if the chosen solution is planned correctly, the transmission portion of the projects can proceed mostly independently of the offshore wind generation awards. This allows permitting to get a "head start" while the HVDC substation and cable design proceed, thereby minimizing the risk of delays, including those related to supply chain constraints. CWL recommends that the Board place a great deal of weight on proposals that allow substation locations to be finalized at the time of the SAA award so that permitting process can begin immediately. These locations should be outside the lease areas to mitigate the risk of a NEPA connected project, which would couple the transmission projects to the generation projects and therefore increase the risk of a prolonged permitting process. In addition, CWL recommends that the Board focus on proposals that allow the transmission design to proceed without knowing who and where the offshore generation will come from.

To explain further, offshore collector platform (OCP) location determination post-award offers a different risk profile for an offshore wind developer than a pre-award determination. A post-award determination means that the offshore wind developer must make a series of assumptions about how their project will interconnect with the SAA transmission developer. Generally, this means that a developer risk premium is included in the business case to mitigate assumption uncertainty.

Furthermore, a post-award substation location determination could likely end in a complicated design loop between generation developers and SAA transmission developers. For example, selecting the wind turbine generator (WTG) is a critical part of the generator's optimization process. WTG selection, positions, and array cable layout may vary until the end of the tender process, thereby delaying their permitting and design work. This puts the transmission timeline at risk, with negative implications for all stakeholders.

The risks mentioned above are mitigated when the substation is positioned outside the lease area, pre-award, since the transmission developer can advance its design and permitting process ahead of generation. By contrast, when a substation is positioned inside the lease area, post-award, the complexity and interface risk both increase due to the commercial agreements required to locate the transmission asset in the lease area.

CWL decreases these risks via two key design features:

- The locations of the offshore substations are already determined and are outside the lease areas. This allows the routes to be finalized and the design and permitting to proceed while also mitigating the risk of a NEPA connected project in the permitting process.
- The voltage used to connect to the offshore wind generation creates flexibility and future-proofing, allowing the design to be finalized for the transmission project and mitigating project risks for both the transmission and generation developers. The proposals utilize collector platforms at 275kV to connect the offshore wind generation, which offers maximum flexibility for the generation developer to decide the best utilization of the offshore lease area, providing the maximum efficiency within the lease area, and driving more competitive OREC offerings.

7. Describe if and how the primary transmission line technology used for the Option 2 proposal, HVAC or HVDC, affects the development – timing, sizing, locational considerations and costs –of new OSW projects.

Transmission line technology has a significant impact on the schedule, size, location, cost, and risk profile of new OSW projects. For very long (greater than 40 miles) offshore transmission routes, HVDC becomes the natural choice due to the following:

- There are no reactive power concerns in relation to the export cable(s). Only active power is transmitted which allows for optimal utilization of the cable conductor when compared to AC cables.
- It has lower transmission losses.
- It allows for de-coupling of the wind farm HVAC system from the onshore HVAC grid, which improves overall system stability and operability.

[redacted]

Figure 2: DC and AC Cable Characteristics[9]

De-coupling the wind farm HVAC system from the onshore AC grid reduces the curtailment risk during low short circuit or weak grid conditions, mitigating the impacts to WTGs. HVDC transmission technology for offshore wind has the ability to ensure stable operation even under very low short circuit strength. However, connecting the AC onshore grid with HVAC export cables would reduce the short circuit strength further, and hence can adversely impact stable operation of the offshore WTGs. This will be a risk for OSW developers and there may be a need to mitigate this by bringing in rotating equipment like synchronous condensers that will increase capital costs, permitting, and O&M risk for OSW developers.

The schedule, size, location, cost, and risk factors are described in detail below.

Timing

Although the engineering and fabrication timeline for HVAC is shorter than for HVDC, it comes with certain constraints. For example, engineering, procurement, and fabrication of long underground AC systems can only begin once all system parameters are known. To define such system parameters, the wind farm design must have already progressed beyond the preliminary engineer stage to a point where significant detail has been determined to enable the HVAC design

Furthermore, HVAC systems are not isolated from the grid, and any disturbance in voltage, frequency, or current could potentially be transferred to the WTGs. On the other hand, HVDC naturally provides the WTG with protection against voltage, frequency, and current disturbances on the onshore grid and can

[9] NKT cable manufacturer

therefore be engineered and fabricated without being dependent on the same wind farm parameters that HVAC requires. In other words, HVDC systems can adapt to different wind farm configurations while HVAC designs cannot.

At the time of installation, HVAC cables will also take three times as long as HVDC to be installed. This is due to the number of cable kilometres which need to be installed, along with any applicable seasonal restrictions defined through the permitting process. Similarly, the installation of onshore HVAC cables requires wider easements and more cables compared to HVDC cables.

[redacted]

Figure 3: 1400 MW HVDC and HVAC Cable System Cross-Section[10]

Sizing

In terms of sizing, depending on the export cable interconnection voltage, transfer capability can range from 75MVA-150MVA for 66kV, 150-300MVA for 230kV, 300-450MVA for 275kV, 450-550MVA for 345kV, 1200MW for ±320kV and 1400MW for ±400kV . As shown in Figure 4 below, for AC cable systems, power transfer capability increases with voltage, but is constrained by distance due to charging current, and AC cables will experience higher losses. On the other hand, HVDC cables are not limited by distance and for the same size conductor they can carry up to three times the power.

[redacted]

Figure 4: HVAC Cable Capacity

[10] NKT cable manufacturer

For a wind farm developer optimizing inter-array cable design is a critical component of the project costs. The generation developer will look to minimize the overall length of the array cable to minimize the initial installation costs as well as the operational costs due to losses. Projects that offer 66kV inter-array cable connection to the converter platform and are located outside the lease area will have significant additional cost and losses as compared to projects such as CWL. The CWL design does not overburden the wind farm developer with sub-optimal inter-array cable design. Instead, it allows the wind farm developer to best optimize its system. CWL analysis showed that installing additional platforms that allow wind farm developers to optimize the wind farm and inter-array cable layout is more cost effective than running cables directly from wind turbines to collector stations outside the lease area. Our studies showed unless the platform is located inside the lease area, using 275kV export cable is the best way to interconnect wind farms to converter stations outside the lease area. This maximizes efficiency, and transfer capacity, reduces losses, and provides wind farm developers a clear and prescriptive way to interconnect.

Location

Determining the most optimal solution is not a simple decision of AC or DC but needs careful consideration. AC may be best suited for short distance connection where DC will cost prohibitive; but because most of the BOEM offshore wind lease areas are located in the Hudson South and Hudson North region which is relatively far from shore, the most effective way to transmit power at those distances is utilizing HVDC which as mentioned in the previous section will increase performance and reduce losses. Also, location is one of the most critical and important factors that will determine the risk level placed on a wind farm developer. First, clarity into how and where the offshore wind developer will need to interconnect is critical as this will guide the developer’s capital costs, operating costs, permitting plan, and COD schedule certainty. Ambiguity in any of the aspects will lead to a higher OREC price to account for the risk of the unknown. A common location offers a level playing field for offshore wind developers to compete for BPU’s future solicitation awards. This can only be achieved at export cable voltage 230kV and above; implementing this concept with 66kV cable connections would burden developers even more. Also, for solutions that locate the OCP inside the lease area, rather than providing a benefit, it increases permitting risks, adds schedule uncertainty, and the potential for higher costs due to changes in equipment, location, and design from both the transmission and generation developers.

Orsted and PSEG have been the only entities in the SAA actively requesting inclusivity for offshore wind projects in the PJM interconnection Tariff currently being revised. In fact, PSEG, Orsted, and Dominion recently successfully pursued a friendly amendment to ensure offshore wind is not hindered in the revised interconnection process due to technicalities. This is the same team that is diligently working on CWL project proposals.

Costs

All of the aforementioned will have an impact on the costs offshore wind developers will incur if uncertainty around schedule, capacity, and location is not removed. A pure HVAC solution will have the highest operational costs due to losses and capacity limitations that the ratepayer will have to bear. Overall costs of the HVAC connection to onshore AC substation must also include the cost of reactive power compensation needed to regulate the voltage at the offshore and onshore end of the HVAC cable, the cost of dynamic reactive power support at the onshore AC substation (to meet NERC VAR requirements), and the cost of including synchronous condenser capability to improve short circuit strength at the offshore end. A system that appears simple can quickly become complex, and in some instances cost prohibitive to both wind developers and ratepayers.

Risks

Schedule uncertainty, interconnection uncertainty, technology uncertainty, and location uncertainty will amplify the risk for offshore wind developers. The only way to maximize benefit to rate payers and lower OREC pricing is by either removing or minimizing such uncertainty. CWL provides a clear path for offshore wind developers to execute their permitting plan independently from the SAA awardee(s), price their system based on a known OCP location, have a clear picture of the interconnection requirements and prescriptive guidance to meet their schedule, and be assured CWL will deliver the system by the date committed in the proposal. PSEG and Orsted's experience in the interconnection and stakeholder engagement processes, combined with a robust technical solution, offers the lowest risk profile to wind farm developers to interconnect.

9. Describe how risks of cable outages are managed with HVAC versus HVDC technology, particularly where using large single HVDC lines for any offshore segment.

Managing cable outages in HVAC vs HVDC can be very different. In general, HVAC cables will experience greater electrical stress than HVDC cables. The main reason is that HVAC cables can experience voltage disturbances, fluctuations, surges, and faults due to the fact they are part of the grid and are not isolated from it, and weak sources can contribute and enhance these disturbances. This generally translates to higher HVAC cable outages.

On the other hand, HVDC cable is isolated from grid disturbances and is therefore more stable. For this reason, although not installed in the same numbers as HVAC, HVDC tends to experience reduced cable outages. Also, for the same MW transfer capability, HVAC requires 3 times more circuits than HVDC to service a large windfarm, creating a corresponding increase in the probability of an outage on a given path.[11]

CWL has considered low probability and high impact risks, which is key to ensuring a reliable transmission system. To mitigate the risk of an HVDC cable failure, CWL has included an AC mesh grid where power can be safely transferred to the adjacent collector platforms in the event of a fault, thereby minimizing the risk of stranded generation.

For HVAC applications a single export cable failure typically reduces the export capability by some 400-500MW (maximum capacity of one export cable circuits). A Wind Farm will require several of these circuits to deliver its output, and the loss of single one may be less impactful on overall wind farm output.

For HVDC applications, the current state-of-the-art export cable design for very large wind farms (1000-1500MW) is to use a single cable circuit (2 poles). This reduces the overall number of cable-kilometers (compared to the HVAC case with several export cables) and therefore the overall risk of cable failure. The less cable that is installed, the less risk there is that the cable will be damaged or fail. In a system without a meshed grid, the whole wind farm would be isolated and no power export would be possible during the export cable repair. However, CWL's meshed grid design allows power to be re-routed while the cable is repaired.

CWL believes that the risk of outages is driven less by a technology choice and more by the offshore radial transmission model. A cable failure in a radial transmission system will result in the whole wind farm being isolated, with no power export during the cable repair process. For increased reliability, interlinking the OCPs can be implemented, and power can be re-routed after a cable fault, minimizing the loss of energy transfer. NYSERDA's draft RFP for its third offshore wind solicitation, which includes requirements for HVAC interlinks.[12]

Lastly, the industry's statistics[13] on cable failures indicates that DC export cables at ±320kV DC or higher comes with fewer failures per cable-km/year, compared to the 100-275kV AC export cables applied so far for offshore wind grid connections. Anchor dragging is a low likelihood event that can physically damage the cables, and is a risk to both HVAC and HVDC technology. Although HVAC has more cables, the fact that the cables are run parallel to each other in a narrow corridor means an anchor strike can affect multiple cables.

[11] The MWs associated with single line outage will be smaller, as each circuit is only carrying a third of the total load of the wind farm

[12] [12] Appendix G: Technical Requirements for Meshed Ready, https://www.nyserda.ny.gov/offshore-wind-2022-solicitation

[13] Failure Rates of Offshore Wind Transmission Systems, Failure Rates of Offshore Wind Transmission Systems

10. For an Option 2 or Option 3 scenario, please address whether an HVAC or HVDC would better integrate into a multi-state or multi-regional offshore wind transmission grid? Should coordination or future computability opportunities affect the Board's evaluation of proposals?

Power control is a critical aspect of a multiregional offshore grid expansion given the large distances between the different ISOs/RTOs. HVDC has multiple economic advantages compared to HVAC when considering long cable lengths and large amount of generated power, but power control truly differentiates HVDC as a technology.

The Board is planning a system that will go into service at the end of the decade, and operate 50 years into the future, making it prudent to consider inter-regional opportunities and technology advancements in its evaluation. In a future scenario with an offshore grid along the East Coast, some of the longest interconnection between platforms will be in HVDC. In this case the HVDC multi terminal technology for interlinks checks all boxes, but it requires HVDC breakers to function properly. The breakers have a similar functionality to an HVAC breaker, however because the DC signal is not oscillating there is a need to dissipate a large amount of heat during the operation of the breaker. With current technology, after operation DC breakers would need to be reconditioned extending the time required to bring the system back online. Unfortunately, this technology is in the final stage of development but not commercially available. To be open to such future opportunities, CWL offers a multi-terminal ready configuration to expand the system to accommodate future developments in HVDC technology. Alternatively, HVAC interlinks can be utilized to interconnect platforms of other ISOs/RTOs if those other platforms are located nearby those awarded in the NJ SAA process.