Summary Report for the NJBPU Selected Project

2021 SAA Proposal Window to Support NJ OSW

November 15, 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 the NJBPU'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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EXECUTIVE SUMMARY

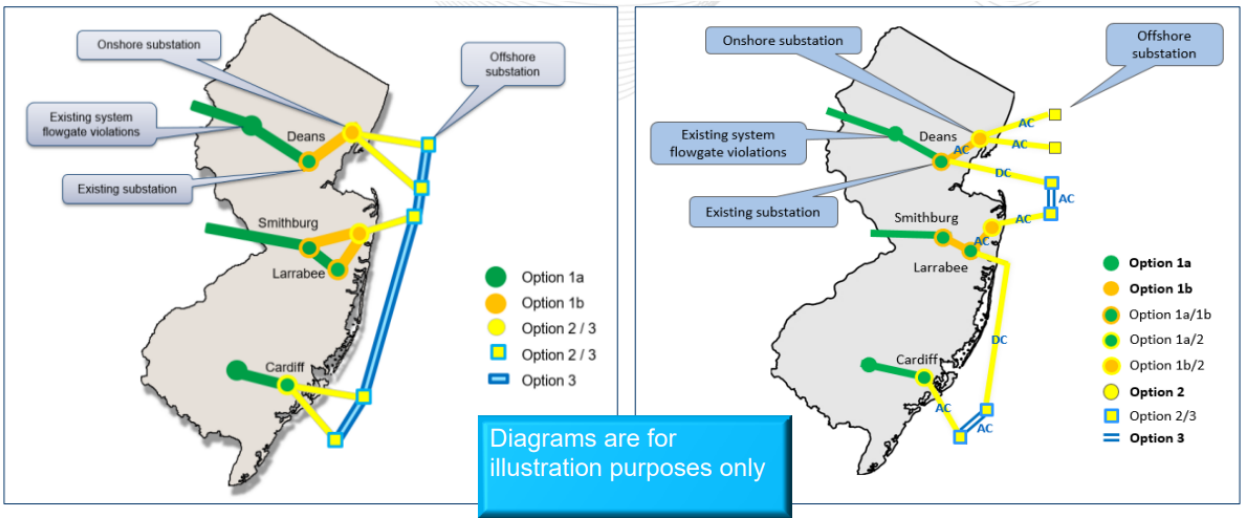
Background

On Nov. 18, 2020, the New Jersey Board of Public Utilities (NJBPU) issued an order formally requesting that PJM open a competitive proposal window to solicit project proposals to identify a transmission project that addresses the state's public policy goals for 7,500 MW of offshore wind (OSW) by 2035.

Working with the NJBPU, PJM opened its first public policy window in April 2021 and closed it in September 2021. As part of the 2021 State Agreement Approach (SAA) Proposal Window to support New Jersey offshore wind, PJM received proposals to meet the state's goal of interconnecting up to 7,500 MW of offshore wind by 2035. The proposals were categorized into four options according to the function and location of the proposal (see **Figure 1**). Altogether, PJM received a diverse set of 80 proposals.

- **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, ReliabilityFirst 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 New Jersey 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.

Objective

The objective of the PJM analysis was to evaluate the technical performance of the submitted proposals to ensure that they satisfy PJM reliability requirements and New Jersey's public policy requirements to achieve 7,500 MW of offshore wind by 2035. The findings of each body of analysis were provided to the NJBPU for its consideration and as input to its independent evaluation of the proposals and decision on which project, if any, it would select.

Overview of Evaluation Approach

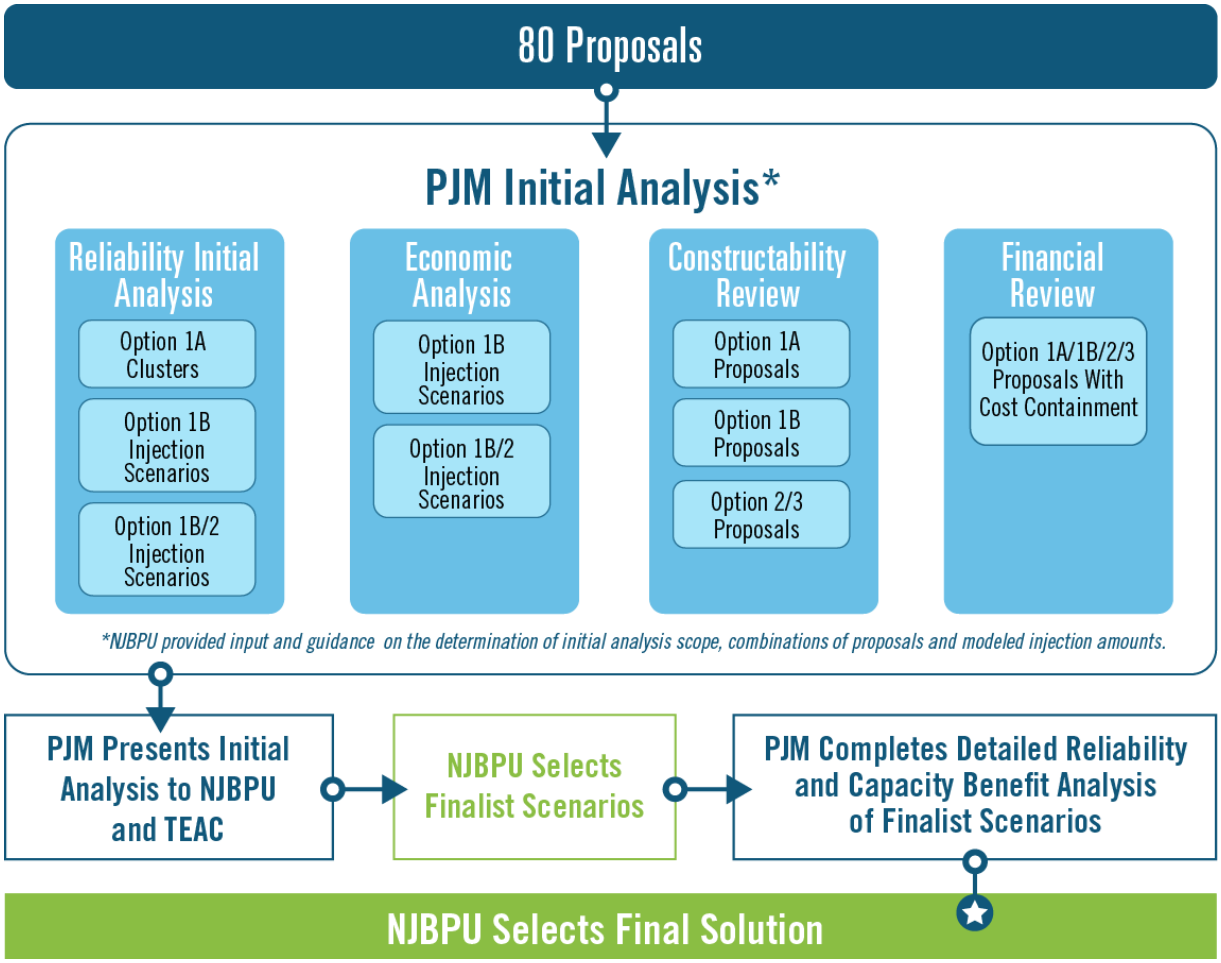
Following the submittal of proposals in a competitive planning solicitation, PJM performs technical analysis as needed to assess the performance of proposed solutions to meet the identified system need(s). As described in PJM Manual 14F, the approach to technical analysis typically involves an initial screening followed by a more detailed analysis phase as may be required to evaluate solutions in a window with multiple competitive proposals and/or complex system needs. For a window driven by public policy, where the project selection is by the sponsoring state, PJM and the NJBPU jointly determined the analysis that PJM would perform to assess the performance of the proposals, which would then be shared with the NJBPU as an input into their independent evaluation and decision to pursue project selection. The analysis included reliability, economic, constructability, financial and legal review.

The evaluation of the proposals in the 2021 New Jersey OSW SAA competitive window presented a number of unique challenges in the approach to analysis. The requirements as specified by the NJBPU and as posted by PJM permitted proposing entities to submit solutions to address any one or more of the posted options. The window requirements also permitted and invited these entities to offer solutions for different injection amounts that varied from the OSW target amount, as well as alternative points of injection (POIs) that might differ from those identified as the default POI. The window was further complicated by the incorporation of the outcome of New Jersey's second offshore wind generation procurement, which was concluded during PJM's open window.

In response to PJM competitive transmission solicitation, PJM received 80 proposals from 13 different entities for onshore upgrades, onshore greenfield facilities to extend the grid to the shore, offshore transmission proposals to extend the grid to access OSW lease areas and offshore backbone transmission to intertie future OSW platforms.

In a cooperative effort, PJM performed its initial analysis of the proposals as depicted in **Figure 2**. The NJBPU provided its input and guidance to the initial analysis scope, which informed the combinations of proposals and modeled injection amounts. Additionally, the NJBPU separately convened several public meetings for stakeholder input on various topics concerning the development of transmission for offshore wind. This information was also made available to PJM in its analysis.

Figure 2. Evaluation Process Overview



In order to perform the range of analysis, PJM grouped the project proposals into three main groups for conducting the initial analysis:

1. **Option 1a proposals:** Proposals to resolve identified violations of the existing facilities due to injections at the default POIs

2. **Option 1b-only proposals:** Proposals to extend the existing grid toward the shore to accommodate future interconnection of offshore wind projects to be constructed at a future time

3. **Option 1b/2/3 proposals:** Proposals to extend the transmission grid to offshore platforms such that future OSW generator developers could interconnect their projects to the platforms

The initial reliability screening analysis of the proposals was performed for the purpose of determining what upgrades would be needed to the existing system in combination with Option 1b/2 proposals to satisfy both reliability criteria and the OSW requirements. The analysis consisted of a range of injection scenarios to consider the various proposed POIs and concepts offered by each of the proposing entities. Each injection scenario incorporated the consideration of NJBPU solicitation #2 projects. Given the number of proposals and associated scenarios, it was impractical to perform the full complement of reliability tests for all of the scenarios. For this initial

reliability analysis, the scope of the technical studies was limited to those tests that were deemed mostly likely to stress the system and provide a reasonable test of proposed Option 1a onshore system upgrades. The balance of complete reliability analysis was conducted for the four finalist scenarios selected by the NJBPU.

Similar to the reliability analysis, economic analysis was performed for the injection scenarios that included projections of energy market and capacity market benefits. The scope of the economic analysis was developed jointly with the NJBPU for the purpose of identifying potential economic benefits that might differentiate the performance of the transmission proposals.

The energy market benefits simulations were performed in conjunction with the initial reliability analysis and consisted of estimated load locational marginal prices (LMPs) and gross load payments for Load Serving Entities, generation LMPs and energy market value of New Jersey's OSW generation, simulated OSW unit energy and curtailments of New Jersey's OSW generation to the state's estimated emissions.

The capacity market benefits simulations were conducted for the three finalists' scenarios (scenarios 18 and 18a are equivalent for market analysis simulations) and consisted of simulating capacity market prices for the four New Jersey load zones (Atlantic City Electric, Jersey Central Power & Light, Public Service Electric & Gas Company, Rockland Electric) and adjacent load zones (Baltimore Gas & Electric, PECO).

Detailed constructability evaluation of all Option 1a, 1b and 2/3 proposals was performed in parallel with the initial screening analysis to assess the feasibility of constructing the proposed solutions. The detailed constructability analysis consisted of an in-depth review of the project scope, project cost, project complexity and constructability factors that could impact the cost and/or schedule, including ability to acquire rights-of-way and land, ability to site and permit the project, equipment technical feasibility, and the overall project schedule.

Detailed financial analysis of the proposals that included a cost commitment was performed during the initial analysis. The financial analysis consisted of simulating the cost of the project over the lifetime under a base scenario as well as several stress scenarios. The lifetime cost was calculated as the net present value revenue requirement (NPVRR) for the projects based on the proposed financial parameters and a representative cost of service revenue model. The NPVRR was then calculated for several scenarios that included variations of return on equity, capital cost, debt cost, equity percentage, and operation and maintenance costs. The purpose of the scenario simulations was to test the overall effectiveness of the proposed cost commitments.

In conjunction with the financial analysis, PJM performed a legal review of the cost commitment language that consisted of a qualitative assessment of the risks associated with the cost commitment provisions. The assessment considered such factors that might lead to delays in finalizing of the Designated Entity Agreement (DEA) or potential risks to acceptance of filed DEA and subsequent rate filing.

After completion of the initial analysis work, PJM presented its findings to the NJBPU and to PJM's Transmission Expansion Advisory Committee (TEAC) on July 18, 2022. The findings of the initial analysis are detailed in separate reports and are posted with TEAC materials.

The NJBPU then selected four finalist scenarios for the balance of reliability analysis, and PJM provided the results of the final comprehensive reliability analysis to the NJBPU. The NJBPU completed its independent evaluation of the proposals and selected the project, inclusive of all necessary components, that it will sponsor as a public policy project.

New Jersey's Selected Project

On Oct. 26, 2022, the NJBPU issued an order notifying PJM of its selection of the transmission project, inclusive of all components, that it will sponsor to achieve its stated public policy goals of injecting 7,500 MW of offshore wind into New Jersey by 2035.

The NJBPU has selected the solution identified as the "Larrabee Tri-Collector Solution" or "MAOD-JCP&L Option 1b Solution," which includes elements of the Jersey Central Power & Light (JCP&L) Option 1b proposal, as well as scaled-down elements of Mid-Atlantic Offshore Development's (MAOD's) Option 2 proposal, and the necessary Option 1a upgrades to create the SAA Capability[1] associated with the SAA scenario evaluating the Larrabee Tri-Collector Solution. The total cost for the selected solution is estimated to be $1.08 billion.

The primary component of the MAOD portion of Larrabee Tri-Collector Solution is a new substation to be constructed adjacent to the existing JCP&L Larrabee 230 kV substation, which is identified as the Larrabee Collector station (LCS). MAOD will construct the alternating current (AC) portion of the new Larrabee Collector station to accommodate three future high-voltage direct current (HVDC) circuits, which would be constructed by the future OSW generator developers. The proposal also includes sufficient land for the future installation of up to four DC converter stations. The HVDC cables delivering the output of future OSW generators will interconnect at the new Larrabee Collector station.

The JCP&L Option 1b (proposal #453) portion of the Larrabee Tri-Collector Solution includes transmission upgrades to the grid to create three paths from the LCS to the three points of injection: Larrabee 230 kV, Atlantic 230 kV and Smithburg 500 kV.

The primary components include:

- Smithburg substation 500 kV expansion to a four-breaker ring
- Atlantic 230 kV substation conversion to double-breaker double-bus
- New Larrabee Collector station-Smithburg No. 1 500 kV line
- G1021 Atlantic-Smithburg 230 kV line rebuild between the Larrabee and Smithburg substations as a double circuit 500 kV/230 kV line
- D2004 Larrabee-Smithburg 230kV rebuild to 1590 ACSS
- New Larrabee Collector station-Atlantic 230 kV line
- New Larrabee Collector station-Larrabee 230 kV line

[1] SAA Capability has the meaning set forth in Paragraph 1 of the State Agreement Approach Agreement by and among PJM Interconnection, L.L.C. and New Jersey Board of Public Utilities, designated as Rate Schedule FERC No. 49, as filed at and accepted by FERC in Docket No. ER22-902-000. *See PJM Interconnection, L.L.C.,* 179 FERC ¶ 61,024 (2022), *reh'g denied* 179 FERC ¶ 62,131 (2022). Specifically, SAA Capability is defined to include:

> all transmission capability created by a SAA Project(s), including but not limited to the capability to integrate resources injecting energy up to the Maximum Facility Output ("MFO"), capability which may become CIRs through the PJM interconnection process, and any other capability or rights under the PJM Tariff, and consistent with the reliability study criteria applied to the evaluation of a SAA Project(s) as set forth in Paragraph 6 below. For the avoidance of doubt, SAA Capability shall also include any incremental transmission capability that is created by a SAA Project(s) and is determined to provide Incremental Auction Revenue Rights ("IARRs") or Incremental Capacity Transfer Rights ("ICTRs") associated with Incremental Rights-Eligible Required Transmission Enhancements, pursuant to Tariff, Schedule 12-A.

The selected solution also requires a number of Option 1a upgrades to reinforce the existing grid to accommodate the OSW injections. The primary components include:

- Rebuild the underground portion of Richmond-Waneeta 230 kV.
- Rebuild Clarksville-Lawrence 230 kV.
- Reconductor Kilmer I-Lake Nelson I 230 kV.
- Rebuild Larrabee-Smithburg No. 1 230 kV.
- Reconductor Red Oak A-Raritan River 230 kV (b3737.33).
- Reconductor Red Oak B-Raritan River 230 kV (b3737.34).
- Reconductor small section of Raritan River-Kilmer I 230 kV (b3737.35).
- Add a third set of submarine cables for the Silver Run-Hope Creek 230 kV line.
- Linden subproject: Install a new 345/230 kV transformer at the Linden 345 kV switching station and relocate the Linden-Tosco 230 kV line from the Linden 230 kV to the existing 345/230 kV transformer at Linden 345 kV.
- Build a new greenfield North Delta station with two 500/230 kV 1500 MVA transformers and nine 63 kA breakers.
- Build a new North Delta-Graceton 230 kV line by rebuilding 6.07 miles of the existing Cooper-Graceton 230 kV line. Upgrade to Graceton-Cooper 230 kV.

The complete list of components that make up the Larrabee Tri-Collector Solution are provided in **Appendix** A: Summary of Larrabee Tri-Collector Solution**A**.

SAA Capability

The selected SAA project will result in creating SAA Capability as follows:

Table 1. Point of Interconnection & Associated Injected Amounts

Location	State	Transmission Owner	SAA Capability	MFO	MW Energy	MW Capacity
Larrabee Collector station 230 kV – Larrabee	NJ	MAOD	1,200	1,200	1,200	360
Larrabee Collector station 230 kV – Atlantic	NJ	MAOD	1,200	1,200	1,200	360
Larrabee Collector station 230 kV – Smithburg	NJ	MAOD	1,342	1,342	1,342	402.6
Smithburg 500 kV	NJ	JCPL	1,148	1,148	1,148	327

OVERVIEW OF PROPOSALS

Of the 80 project proposals received from the 13 applicants, there were 27 Option 1a solutions, 11 Option 1b solutions, 34 Option 2 solutions, and eight Option 3 solutions. The proposals represented a mixture of competitive onshore and offshore transmission solutions to support New Jersey's offshore wind needs.

In addition to the competitive proposals submitted in the window, transmission upgrades were provided by the incumbent Transmission Owners (TOs) to address new violations that were identified as a result of the reliability analysis and were not previously identified as part of the posted problem statement for the default points of injection.

Summary level project information and a geographical map for each of the 80 project proposals as well as the transmission upgrades provided by the incumbent TOs are provided in the 2021 NJ OSW SAA Window Map Book.

Option 1a Proposals

PJM received 27 Option 1a proposals as part of this window. A number of the Option 1a proposals addressed similar sets of reliability violations and were grouped into one of three competitive proposal clusters in order to compare the proposals:

- Pennsylvania/Maryland Border Proposal Cluster
- Central New Jersey Proposal Cluster
- Southern New Jersey Proposal Cluster

The remaining Option 1a proposals each addressed a unique set of reliability violations and were analyzed to demonstrate that they met PJM standards for an acceptable reliability solution and were selected as part of the set of reliability solutions used for scenario evaluations.

The proposals for addressing the Option 1a violations included both conventional transmission solutions, such as the rebuild or reconductoring of an existing transmission line as well as installation of power flow controlling devices. While power flow controlling devices can be a solution that mitigates certain violations, such solutions do not increase transmission capability on the system and require additional active control in operations. Where there are acceptable conventional solutions and where the additional transmission capacity offered by conventional solutions are extensive compared to cost savings of adopting power flow control devices, PJM will generally prioritize consideration of the conventional solutions. Power flow controlling devices, such as phase angle regulators and SmartWire devices, were proposed in this window. Such devices are generally not preferred solutions but may be considered when there is no other transmission solution within an order of magnitude cost of the power flow controlling device.

For any upgrades to an existing transmission facility, only incumbent TOs can be designated. For these TO upgrades, PJM contacted the incumbent TO to request a reliability solution and a corresponding project cost estimate.

Tables 3 through 9 in the Reliability Analysis Report provide a brief description, location and cost estimate of each of the 27 Option 1a proposals.

Option 1b Only Proposals

PJM received 11 Option 1b proposals, submitted by four entities in this window. Each of these proposals represented onshore-only projects with all necessary upgrades and/or greenfield solutions for transferring the offshore wind generation from new onshore substations to default or alternative POIs.

The Option 1b proposals are summarized in the following table.

Table 2. Option 1b Proposals

PJM Proposal ID	Proposing Entity	Proposal Cost Estimate	Project Description
797	Atlantic City Electric Company	**$233 M**	Onshore 275 kV AC system that facilitates 1,200 MW of offshore wind injection into Cardiff via new transition vault near shore at Great Egg Harbor
453	Jersey Central Power & Light Company	**$620 M**	Onshore 230/500 kV AC systems and expansions to existing JCPL stations to enable offshore wind injections of 2,490 MW at Smithburg, 1,200 MW at Larrabee, and 1,200 MW at Atlantic via new onshore Larrabee Collector AC substation to be constructed by MAOD
72	LS Power Grid Mid-Atlantic, LLC	**$1.601 B**	Five onshore HVAC scenarios to accommodate offshore wind injections of up to 6,000 MW via new Lighthouse shore AC substation
294	LS Power Grid Mid-Atlantic, LLC	**$1.545 B**	
627	LS Power Grid Mid-Atlantic, LLC	**$1.474 B**	
629	LS Power Grid Mid-Atlantic, LLC	**$1.568 B**	
781	LS Power Grid Mid-Atlantic, LLC	**$1.772 B**	
171	Rise Light & Power/Outerbridge Renewable Connector	**$109 M**	One or two onshore HVDC systems to enable offshore wind injections of 1,200/2,400 MW via Outerbridge shore AC station at Werner to new Half Acre HVDC converter station that ties into Deans-E. Windsor 500 kV; two options to directly inject an additional 400/800 MW of offshore wind at Werner 230 kV AC substation
376	Rise Light & Power/Outerbridge Renewable Connector	**$67 M**	
490	Rise Light & Power/Outerbridge Renewable Connector	**$1.732 B**	
582	Rise Light & Power/Outerbridge Renewable Connector	**$1.035 B**	

Additional details on these Option 1b proposals can be found in the NJ OSW Constructability Reports for Option 1b proposals.

Option 2 and 3 Proposals

PJM received 34 Option 2 proposals, submitted by seven entities in this window. Each of these proposals included new offshore substation(s), and all necessary greenfield solutions connecting the new offshore substation to an onshore substation proposed as part of an Option 1b project, or to a default or alternative point of injection (POI) where onshore substations are not needed.

The Option 2 proposals are summarized in the following table.

Table 3. Option 2 Proposals

PJM Proposal ID	Proposing Entity	Proposal Cost Estimate	Project Description
131	Anbaric Development Partners, LLC	$1.648 B	Twelve offshore scenarios for injecting offshore wind into Deans, Sewaren and Larrabee POIs, using single 1,200, 1,400, or 1,510 MW HVDC systems
145	Anbaric Development Partners, LLC	$1.905 B	
183	Anbaric Development Partners, LLC	$1.682 B	
285	Anbaric Development Partners, LLC	$1.580 B	
568	Anbaric Development Partners, LLC	$1.978 B	
574	Anbaric Development Partners, LLC	$1.810 B	
802	Anbaric Development Partners, LLC	$1.715 B	
831	Anbaric Development Partners, LLC	$1.877 B	
841	Anbaric Development Partners, LLC	$1.794 B	
882	Anbaric Development Partners, LLC	$1.776 B	
921	Anbaric Development Partners, LLC	$1.545 B	
944	Anbaric Development Partners, LLC	$1.748 B	
172	Atlantic Power Transmission LLC	$1.601 B	Offshore scenarios to inject up to 3,600 MW offshore wind into Deans POI using one, two or three 1,200 MW HVDC systems
210	Atlantic Power Transmission LLC	$2.024 B	
769	Atlantic Power Transmission LLC	$1.478 B	
990	Con Edison Transmission	$2.747 B	Offshore scenarios to inject 2,400 MW offshore wind into Deans, Larrabee or Smithburg POIs using two 1,200 MW HVDC systems
594	LS Power Grid Mid-Atlantic, LLC	$1.968 B	Offshore scenario to inject 4,000 MW offshore wind into new Lighthouse shore station using eight 345 kV HVAC cables
321	Mid-Atlantic Offshore Development	$5.726 B	Three offshore scenarios for up to 4,800 MW offshore wind injections into Smithburg, Atlantic and Larrabee via new Larrabee Collector AC substation, using two, three or four 1,200 MW HVDC systems (works with JCP&L Option 1b onshore project)
431	Mid-Atlantic Offshore Development	$2.957 B	
551	Mid-Atlantic Offshore Development	$4.411 B	
15	NextEra (NEETMH)	$3.023 B	Offshore scenarios for varying MW levels of offshore wind injections into Oceanview (up to 3,000 MW), Deans (up to 6,000 MW), and Cardiff (2,700 MW) via new Neptune, Fresh Ponds and Reega onshore
27	NextEra (NEETMH)	$1.477 B	
250	NextEra (NEETMH)	$7.029 B	

PJM Proposal ID	Proposing Entity	Proposal Cost Estimate	Project Description
298	NextEra (NEETMH)	**$2.662 B**	Converter stations, using combinations of 1,200 and 1,500 MW HVDC systems
461	NextEra (NEETMH)	**$3.608 B**	
604	NextEra (NEETMH)	**$2.943 B**	
860	NextEra (NEETMH)	**$5.285 B**	
208	PSEG/Orsted	**$4.719 B**	Seven offshore scenarios for varying MW levels (up to 4,200 MW) of offshore wind injections into Sewaren, Larrabee and Deans POIs, using combinations of 1,200 and 1,400 MW HVDC systems
214	PSEG/Orsted	**$2.445 B**	
230	PSEG/Orsted	**$2.328 B**	
397	PSEG/Orsted	**$2.295 B**	
613	PSEG/Orsted	**$2.151 B**	
683	PSEG/Orsted	**$7.181 B**	
871	PSEG/Orsted	**$4.843 B**	

PJM received eight Option 3 proposals, submitted by two entities in this window. Each of these involved greenfield transmission solutions connecting the new offshore substations (platforms) proposed as part of an Option 2 project.

The Option 3 proposals are summarized in the following table.

Table 4. Option 3 Proposals

PJM Proposal ID	Proposing Entity	Proposal Cost Estimate	Project Description
137	Anbaric Development Partners, LLC	**$60 M**	Seven 400 kV 700 MW HVDC cable links between offshore substation platforms proposed in Anbaric Option 2 solutions
243	Anbaric Development Partners, LLC	**$96 M**	
248	Anbaric Development Partners, LLC	**$80 M**	
428	Anbaric Development Partners, LLC	**$81 M**	
748	Anbaric Development Partners, LLC	**$67 M**	
889	Anbaric Development Partners, LLC	**$72 M**	
896	Anbaric Development Partners, LLC	**$65 M**	
359	NextEra Energy Transmission MidAtlantic Holdings, LLC	**$739 M**	Four 230 kV 800 MW AC cable links between the six offshore substation platforms proposed in NEETMH Option 2 solutions

In addition to the eight Option 3 proposals listed above, a number of entities also included Option 3 offshore links as part of their Option 2 proposals. This was the case for the Con Edison Transmission, Mid-Atlantic Offshore Development and PSEG/Orsted Option 2 proposals.

Additional details on the Option 2 and 3 proposals can be found in the NJ OSW Constructability Reports for Option 2 and 3 Proposals.

RELIABILITY ANALYSIS

Approach Overview

PJM first performed an initial reliability analysis screening of 28 offshore wind scenarios using PJM's generator deliverability procedures. Generator deliverability analysis is the primary reliability test used in PJM's generator interconnection studies to identify reliability violations caused by new generators and, by itself, typically identifies the majority, if not all, of the upgrades needed to reliably interconnect new generation to the PJM system. As part of the generator deliverability analysis, summer, winter and light power flow models were developed for each scenario for the year 2028 without including any Option 1a proposals. Single- and common-mode contingencies were examined to identify the reliability violations caused by the offshore wind scenarios.

Once the reliability violations without any Option 1a proposals were identified, PJM consulted with the NJBPU to select an initial single set of Option 1a proposals from among the competitive Option 1a proposal clusters, described above, to evaluate further.

Each offshore wind scenario resulted in a unique set of onshore reliability violations. A number of the reliability violations were identified as a result of alternate POIs submitted by proposers that the submitted Option 1a proposals did not address. PJM consulted with the affected TOs to identify the appropriate upgrades and provide the associated cost estimates to address the newly identified reliability violations.

After this initial reliability analysis screening, the NJBPU selected four scenarios for PJM to investigate more rigorously. PJM performed a comprehensive reliability analysis on these four finalist scenarios, as discussed further below, to ensure the final transmission buildout satisfied all PJM reliability criteria.

Offshore Wind Injection Scenarios

PJM worked with the NJBPU to create 28 offshore wind-injection scenarios involving various combinations of the submitted Option 1b and Option 2 proposals. Each scenario contains the awarded solicitation #1 for 1,100 MW and solicitation #2 for 2,658 MW. While the scope for the submission of proposals did not allow alternative POIs for solicitation #1, it did allow alternative POIs for solicitation #2. As a result, each scenario contains identical considerations for solicitation #1, and the scenario creation focused on selecting combinations of submitted Option 1b and Option 2 proposals that together enable the transmission system to reliably deliver approximately 6,400 MW of additional offshore wind. Table 55 and 6 illustrate the POI locations and megawatt injection amounts for each scenario considered. Appendix B of the Reliability Analysis report provides a detailed description of each scenario.

Table 5. POI Onshore Scenarios – Option 1b Only

						Alt POI	Default POI	Alt POI	Alt POI	Default POI	Alt POI	Default POI	Alt POI
Scenario ID	**Total (MW)**	**Proposing Entities**	**Option 1b Proposal IDs**	**Option 2 Proposal IDs**	**Excess Capacity (MW)**	**New Freedom 500 kV (MW)**	**Cardiff 230 kV (MW)**	**Half Acre 500 kV (MW)**	**Lighthouse 500 kV (MW)**	**Smithburg 500 kV (MW)**	**Atlantic 230 kV (MW)**	**Larrabee 230 kV (MW)**	**Werner 230 kV (MW)**
2a	6,258	AE, JCPL	797 929.9 453.1-18,24,28-29	None	0		1,510 1,148			1,200	1,200	1,200	
3	6,458	AE, RILPOW, JCPL	797 127.8,9 490 376 453.9-11,16-17	None	200	1148	1,510	2,200				1,200	400
12	6,400	CNTLM	781	None	1110		1,510		4,890				
13	6,400	CNTLM	629	None	710		1,510		4,890				
14	6,400	RILPOW, JCPL	490 171 453.18-27,29	None	710		1,510	2,400		1,690			800
18	6,400	JCPL	453	None	0		1,510			2,490	1,200	1,200	
18a	6,400	JCPL, MAOD	453.1-18,24,26-29	551 (partial)	0		1,510			1,342 1,148	1,200	1,200	

Note 1: All POI Scenarios include Solicitation #1 (1,100 MW), which has been subtracted from the total MW.
Note 2: All MW assumed to be injected at the offshore platform for Option 2 proposals.
Note 3: Excess capacity represents additional transmission capability to the POI beyond the amounts being studied.
Note 4: Transmission interconnection facilities for POI MWs in black font are assumed to be supplied outside this SAA window.

LEGEND

Alt POI = Alternative POI

Table 6. POI Onshore/Offshore Scenarios – Option 1b/2

						Alt POI	Default POI	Alt POI	Default POI	Alt POI	Default POI	Alt POI	Default POI	Alt POI	Alt POI
Scenario ID	Total (MW)	Proposing Entities	Option 1b Proposal IDs	Option 2 Proposal IDs	Excess Capacity (MW)	Reega 230 kV (MW)	Cardiff 230 kV (MW)	Fresh Ponds 500 kV (MW)	Deans 500 kV (MW)	Lighthouse 500 kV (MW)	Smithburg 500 kV (MW)	Atlantic 230 kV (MW)	Larrabee 230 kV (MW)	Neptune 230 kV (MW)	Sewaren 230 kV (MW)
1.1	6,310	COEDTR, ANBARD	None	990 574 831	400		1,510		2,400		1,200		1,200		
1.2	6,310	COEDTR, PSEGRT	None	990 613	0		1,510		1,200		1,200 1,148		1,200		
1.2a	6,400	COEDTR, ANBARD	None	990 574	58		1,510		1,342		1,200 1,148		1,200		
1.2b	6,400	COEDTR, ATLPWR	None	990 210 172	1058		1,510		1,342		1,200 1,148		1,200		
1.2c	6,400	JCPL MAOD, ANBARD	453.9-11, 16-18,24,29	431 574	58		1,510		1,342		1,200 1,148		1,200		
2c	6,258	AE, JCPL, MAOD	797 929.9 453.1-18,24,28-29	551	0		1,510 1,148				1,200	1,200	1,200		
4	6,010	NEETMH	None	461 27	0		1,510	3,000						1,500	
4a	6,400	NEETMH	None	461 27	758		1,510	2,242			1,148			1,500	
5	6,310	JCPL, MAOD	453	321	0		1,510				2,400	1,200	1,200		
6	6,400	CNTLM	781	594	110		1,510			4,890					
7	6,400	CNTLM	629	594	110		1,510			4,890					
10	6,400	ANDBARD	None	882 841	258		1,510		2,290				1,200		1,400

						Alt POI	Default POI	Alt POI	Default POI	Alt POI	Default POI	Alt POI	Default POI	Alt POI	Alt POI
Scenario ID	Total (MW)	Proposing Entities	Option 1b Proposal IDs	Option 2 Proposal IDs	Excess Capacity (MW)	Reega 230 kV (MW)	Cardiff 230 kV (MW)	Fresh Ponds 500 kV (MW)	Deans 500 kV (MW)	Lighthouse 500 kV (MW)	Smithburg 500 kV (MW)	Atlantic 230 kV (MW)	Larrabee 230 kV (MW)	Neptune 230 kV (MW)	Sewaren 230 kV (MW)
				921 131											
11	6,399	PSEGRT	None	683	459		1,510		1,247		1,148		1,247		1,247
15	6,400	NEETMH	None	250	1,110		1,510	4,890							
16	6,400	NEETMH	None	604 860	758	2,658		3,742							
16a	6,400	NEETMH	None	860	758		1,510	3,742			1,148				
17	6,400	ATLPWR, NEETMH	None	210 172 15	510		1,510		1,890					3,000	
19	6,258	ATLPWR	None	210 172 769	0		1,510		3,600		1,148				
20	6,400	NEETMH	None	298 461	158		1,510	1,342			1,148			2,400	
20a	6,400	NEETMH, ANBARD	None	298 574	58		1,510		1,342		1,148			2,400	
20b	6,400	NEETMH, ATLPWR	None	298 210 172	1,058		1,510		1,342		1,148			2,400	

Note 1: All POI Scenarios include Solicitation #1 (1,100 MW), which has been subtracted from the total MW.
Note 2: All MW assumed to be injected at the offshore platform for Option 2 proposals.
Note 3: Excess capacity represents additional transmission capability to the POI beyond the amounts being studied.
Note 4: Transmission interconnection facilities for POI MWs in black font are assumed to be supplied outside this SAA window.

LEGEND

Alt POI = Alternative POI

Initial Reliability Analysis

Table 7 through **Table 9** below summarize the cost estimates for the Option 1b, Option 2 and Option 1a proposals selected for each scenario. Note that the Option 1a cost estimates include both the selected Option 1a proposals and any incumbent TO-identified onshore upgrades required to resolve reliability violations for the scenario that were not resolved by a submitted Option 1a proposal.

The SAA megawatts are the POI injections associated with an Option 1b or Option 2 proposal, i.e., the sum of the POI megawatts for the scenario in **Table 5** and **Table 6** that are not in black font.

Table 7. POI Onshore Scenarios – Option 1b Only

Scenario ID	Total (MW)	SAA (MW)	Proposing Entities	Option 1b		Option 2		Option 1a	TOTAL	
				Proposal IDs	Cost Estimate ($M)	Proposal IDs	Cost Estimate ($M)	Cost Estimate ($M)	Cost Estimate ($M)	Cost Estimate ($M/SAA MW)
2a	6,258	4,748	AE, JCPL	797 929.9 453.1-18,24,28-29	$233 $70 $377	None	$0	$856	$1,536	$0.32
3	6,458	4,948	AE, RILPOW, JCPL	797 127.8,9 490 376 453.9-11,16-17	$233 $225 $1,732 $68 $17	None	$0	$385	$2,660	$0.54
12	6,400	4,890	CNTLM	781	$1,772	None	$0	$271	$2,043	$0.42
13	6,400	4,890	CNTLM	629	$1,568	None	$0	$283	$1,851	$0.38
14	6,400	4,890	RILPOW, JCPL	490 171 453.18-27,29	$1,732 $109 $519	None	$0	$422	$2,782	$0.57
18 *(finalist)*	6,400	4,890	JCPL	453	$620	None	$0	$515	$1,135	$0.23
18a *(finalist)**	6,400	3,742	JCPL, MAOD	453.1-18,24,26-29	$428	551 (partial)	$121	$515	$1,064	$0.28

* Costs updated to reflect latest information included in the Nov. 4 TEAC presentation. The correction reflects moving Larrabee-Smithburg 230 kV rebuild from Option 1a components into Option 1b components, as it is component 26 of Proposal #453.

Table 8. POI Onshore/Offshore Scenarios – Option 1b/2

Scenario ID	Total (MW)	SAA (MW)	Proposing Entities	Option 1b		Option 2		Option 1a	TOTAL	
				Proposal IDs	Cost Estimate ($M)	Proposal IDs	Cost Estimate ($M)	Cost Estimate ($M)	Cost Estimate ($M)	Cost Estimate ($M/SAA MW)
1.1	6,310	4,800	COEDTR, ANBARD	None	$0	990 574 831	$2,747 $1,810 $1,877	$327	$6,761	$1.41
1.2	6,310	3,652	COEDTR, PSEGRT	None	$0	990 613	$3,317 $2,151	$352	$5,820	$1.59
1.2a	6,400	3,742	COEDTR, ANBARD	None	$0	990 574	$2,747 $1,810	$352	$4,909	$1.31
1.2b	6,400	3,742	COEDTR, ATLPWR	None	$0	990 210 172	$2,747 $2,024 $1,601	$352	$5,823	$1.56
1.2c *(finalist)*	6,400	3,742	JCPL, MAOD, ANBARD	453.9-11,16-18,24,29	$293	431 574	$2,957 $1,810	$381	$5,441	$1.45
2c	6,258	4,748	AE, JCPL, MAOD	797 929.9 453.1-18,24,28-29	$233 $70 $377	551	$4,411	$670	$5,761	$1.21
4	6,010	4,500	NEETMH	None	$0	461 27	$3,608 $1,477	$390	$5,475	$1.22
4a	6,400	3,742	NEETMH	None	$0	461 27	$3,608 $1,477	$387	$5,461	$1.46
5	6,310	4,800	JCPL, MAOD	453	$620	321	$5,726	$561	$6,907	$1.44
6	6,400	4,890	CNTLM	781	$1,772	594	$2,460	$271	$4,503	$0.92
7	6,400	4,890	CNTLM	629	$1,568	594	$2,460	$283	$4,311	$0.88

Table 9. POI Onshore/Offshore Scenarios – Option 1b/2

Scenario ID	Total (MW)	SAA (MW)	Proposing Entities	Option 1b		Option 2		Option 1a	TOTAL	
				Proposal IDs	Cost Estimate ($M)	Proposal IDs	Cost Estimate ($M)	Cost Estimate ($M)	Cost Estimate ($M)	Cost Estimate ($M/SAA MW)
10	6,400	4,890	ANDBARD	None	$0	882 841 921 131	$1,776 $1,794 $1,545 $1,648	$406	$7,169	$1.47
11	6,399	3,741	PSEGRT	None	$0	683	$7,181	$402	$7,583	$2.03
15	6,400	4,890	NEETMH	None	$0	250	$7,029	$311	$7,340	$1.50
16	6,400	6,400	NEETMH	None	$0	604 860	$2,943 $5,285	$519	$8,747	$1.37
16a ***(finalist)***	6,400	3,742	NEETMH	None	$0	860	$5,285	$327	$5,612	$1.50
17	6,400	4,890	ATLPWR, NEETMH	None	$0	210 172 15	$2,024 $1,601 $3,023	$772	$7,420	$1.52
19	6,258	3,600	ATLPWR	None	$0	210 172 769	$2,024 $1,601 $1,478	$324	$5,427	$1.51
20	6,400	3,742	NEETMH	None	$0	298 461	$2,662 $3,608	$586	$6,856	$1.83
20a	6,400	3,742	NEETMH, ANBARD	None	$0	298 574	$2,662 $1,810	$578	$5,050	$1.35
20b	6,400	3,742	NEETMH, ATLPWR	None	$0	298 210 172	$2,662 $2,024 $1,601	$578	$6,865	$1.83

Finalist Scenarios

The completion of the initial reliability analysis screening and identification of an initial set of onshore upgrades for each scenario was necessary to provide the NJBPU with a comparative framework of preliminary transmission cost estimates for the scenarios under evaluation that consider both the offshore and onshore transmission needs. The NJBPU used this information to select four scenarios for a final, comprehensive reliability evaluation that included both a further review of the competitive Option 1a proposal clusters as necessary and a full set of reliability studies. The four finalist scenarios were

- Scenario 1.2c
- Scenario 16a
- Scenario 18
- Scenario 18a

PJM performed a comprehensive reliability analysis on these four finalist scenarios, as discussed further below, to ensure the final transmission buildout satisfied all PJM reliability criteria.

Balance of Reliability Analysis for Finalist Scenarios

A complete list of the reliability criteria that was applied by PJM during the final evaluation of proposals in this proposal window – along with the associated analytical procedures, study material and terminology used to define the criteria violations – is described in Appendix A of the Reliability Analysis Report.

This comprehensive reliability analysis only identified an additional five over-dutied breakers for each of the four finalist scenarios. Tables 3 through 5 contain these additional breaker costs in the cost estimates developed for the four finalist scenarios.

SAA Project Selection

After the comprehensive reliability analysis and all other evaluations were complete, the NJBPU selected Scenario 18a as the State Agreement Approach Project. The description, required in-service date and cost estimate for each of the components of Scenario 18a, which is called the Larrabee Tri-Collector Solution, is provided in the Appendix to this report.

ECONOMIC ANALYSIS

Overview of Economic Analysis Approach

As part of the initial screening, PJM undertook 2028 energy market simulations for the New Jersey Offshore Wind Study to estimate the impact of selected OSW scenarios on key New Jersey market metrics.

The PJM energy market analysis utilized a production cost simulation tool, PROMOD by Hitachi Energy, which incorporates extensive electric market modeling details. The PROMOD “base case” used by PJM as the starting

point for this analysis included the best available topology (2025 RTEP) and the forecast 2028 market conditions as used for the PJM 2020/21 Long-Term Window.

PJM created a "Scenario" by adding the combination of a selected transmission package along with the corresponding OSW generation injection it supported.

Summary of Energy Market Findings

There are some differences between the four finalist scenarios, but they may not be, at a high level, significant. The largest difference in New Jersey load payments between the finalist scenarios is 0.29%. The largest difference in POI annual average LMP is 2.73%.

Scenarios 1.2c and 16a result in offshore wind curtailment. The highest scenario annual curtailment is 70,991 MWh, or 0.31% of total annual generation. Scenarios 18 and 18a have no wind curtailment.

Detailed energy market simulation outputs for the completed scenarios can be found in the NJ OSW Economic Analysis Report posted at the Nov. 4, 2022, TEAC meeting.

Summary of Capacity Market Findings

The Capacity Market Operations Team executed seven different Base Residual Auction scenario runs for this study. The base scenario assumed that no offshore wind or transmission upgrades would be constructed and resulted in an estimated 2028/2029 total capacity cost for the key Locational Deliverability Areas of $1.01 billion. The remaining six auction runs all included 7,500 MW (installed capacity) of installed offshore wind units, and each of the three scenarios was run with transmission upgrades completed and then again without those same upgrades. The average total capacity cost for scenarios run without upgrades was $626 million, while the average cost with transmission upgrades was $612.3 million.

CONSTRUCTABILITY EVALUATION

Overview of 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 New Jersey 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 noncompletion 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 New Jersey 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, using the following approach 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 that is defined for each project) can support the economical construction of the electric transmission and/or substation facilities.
    b) Identify those permits and agency consultations that are complex and require long lead times that could potentially significantly impact 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; and 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.
    c) Identify potential high-level risks and items that may require protracted permitting time frames 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 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 eight categories, as required: materials and equipment; engineering and design; construction and commissioning; permitting/routing/siting; 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.

Summary of Findings

Detailed findings from PJM's constructability reviews are provided in the following constructability reports, categorized by the NJ OSW problem statements they address (Options), have been publicly posted on the PJM Transmission Expansion Advisory Committee (TEAC) meeting page.

- Constructability Report: Option 1a Proposals 2021 SAA Proposal Window to Support NJ OSW
- Constructability Report: Option 1b Proposals 2021 SAA Proposal Window to Support NJ OSW
- Constructability Report: Option 2 & 3 Proposals 2021 SAA Proposal Window to Support NJ OSW

Each report provides the constructability findings for each reviewed proposal, which includes results from environmental and regulatory analysis, transmission line analysis, substation analysis, and cost and construction schedule reviews.

From the reviews, all 80 NJ OSW SAA proposals were found to be constructible as proposed and remained under consideration by the NJBPU for potential selection. Key takeaways from the constructability evaluations were incorporated into PJM's constructability risk assessments, which were provided to the NJBPU to take into consideration in its independent evaluation. Please see Appendix B of each NJ OSW Constructability Report for constructability matrices summarizing PJM's risk assessments of the projects.

NJBPU Selected Project

On Oct. 26, 2022, the NJBPU issued an order selecting the "Larrabee Tri-Collector Solution" or "MAOD-JCP&L Option 1b Solution," which includes elements of the Jersey Central Power & Light (JCP&L) Option 1b proposal as well as scaled-down elements of Mid-Atlantic Offshore Development's (MAOD's) Option 2 proposal, and the necessary Option 1a upgrades to create the SAA Capability associated with the SAA scenario evaluating the Larrabee Tri-Collector Solution.

The Larrabee Tri-Collector Solution comprises elements of the original Option 1a, Option 1b and Option 2 NJ OSW SAA proposals, for which PJM performed constructability evaluations, with results as summarized in the previous section.

The main elements of the Larrabee Tri-Collector Solution are discussed below.

1. **Larrabee Tri-Collector Station (LCS) – Mid-Atlantic Offshore Development (MAOD):**

   - This component represents a scaled-down version of MAOD Proposal #551, which is an Option 2 proposal for three HVDC systems that includes three new offshore platforms, three HVDC submarine and underground cable segments, a new onshore converter station for three HVDC systems, and a new 500/230 kV onshore AC substation, both located at a new site adjacent to JCP&L's existing Larrabee substation. In the scaled-down version selected, only the 500/230 kV onshore AC substation is included for construction by MAOD, along with procurement of sufficient land, and site preparation for future installation of an onshore converter station that accommodates up to four HVDC systems. HVDC cables delivering the output of future OSW generators will interconnect at the new Larrabee Collector station.
   - During the evaluation process, the NJBPU requested answers to Clarifying Questions submitted to MAOD, JCP&L and other proposing entities. Responses to these questions, which were provided to the NJBPU and PJM for review, provided clarifications on the ability of the proposing entities to construct scaled-down versions of the original proposals submitted to the NJ OSW SAA window that better aligned with the NJBPU's final selection criteria as laid out in the NJBPU order.

- The original scope of MAOD Option 2 Proposal #551 was estimated to cost $4.411 billion, with the bulk of the cost attributed to offshore HVDC transmission components. In comparison, the reduced scope in the scaled-down version of Proposal #551 results in a significantly lower revised cost estimate of $121.1 million, which excludes other owners costs, permitting, commercial and financial fees that will require further evaluation and refinement by MAOD. This revised cost estimate was provided in MAOD's responses to the NJBPU Clarifying Questions.

2. **Transmission Upgrades From LCS to Larrabee, Atlantic and Smithburg – JCP&L:**

- The JCP&L Option 1b (Proposal #453) portion of the Larrabee Tri-Collector Solution includes transmission upgrades to the grid to create three paths from the LCS to the three points of injection: Larrabee 230 kV, Atlantic 230 kV and Smithburg 500 kV. The specific components of the Proposal #453 selected include components 1–18, 24 and 26–29, with components 27 and 29 combined into a single scope for a Smithburg 500 kV four-breaker ring bus. A key difference between the original scope and the NJBPU selected scope of Proposal #453 is the exclusion of a second Larrabee Collector station to Smithburg 500 kV line.
- The original scope of JCP&L Option 1b Proposal #453 was estimated to cost $620 million. In comparison, the reduced scope in the selected version of Proposal #453 results in a lower revised cost estimate of $427.82 million.

FINANCIAL EVALUATION

Overview of Analysis Approach

Altogether, PJM received a diverse set of 80 proposals submitted by 13 different entities, and each proposal was reviewed for completeness and consistency of cost information. Ultimately, 36 proposals were selected for a more detailed cost analysis and are representative of the solutions being offered by the participating entities. PJM engaged an expert financial consultant for the financial evaluation of the selected proposals, which included a comparative evaluation of the proposals' net present value revenue requirements (NPVRRs) under base case and other scenarios. The results obtained are intended to illustrate the lifetime costs to ratepayers for the proposals and the effectiveness of their cost containment mechanisms.

Each proposal received by PJM was accompanied by a number of supporting documents, all of which PJM reviewed in detail. The key documents relevant to the financial analysis included:

- PJM Competitive Planner Proposal Form – This document contains general information about the proposal, including project title, proposal ID number, a brief project description and key dates (construction start, capital spend start and in-service).
- BPU Supplemental Document – The BPU supplemental document collects more in-depth data necessary to evaluate the proposal. The key section most relevant to the financial analysis is the Proposal Costs, Containment Provisions and Cost Recovery section. This section contains a detailed characterization of the cost containment mechanisms, project costs and key assumptions for the revenue requirement (such as ROE, capital structure, book life and tax assumptions).

- Project Financial Information Schedule – Developers completed the financial information schedule for each proposed project. The financial information schedule depicts annual capital spend by project element.
- Revenue Requirement Schedule – Developers completed the revenue requirement schedule for each proposed project. The revenue requirement schedule depicts the estimated annual revenue requirement for the project over its life. We used a consistent revenue requirement modeling process, described later in this report, to ensure comparability. However, the proposer's revenue requirement models were used to obtain model inputs, such as operations and maintenance (O&M), property taxes and working capital, if not provided elsewhere in their submitted proposal documents.

Additional documents submitted by some proposers included:

- Cost Containment Document – Developers proposing projects with cost-capping mechanisms submitted a separate document describing their cost containment in detail in addition to mentioning them in their BPU Supplemental Document.
- Project Schedule – Some developers submitted documents with more detailed construction schedules than what they provided in the BPU Supplemental document or the project Financial Information Schedule.

Using the above information, a common template covering all proposals was created to ensure consistency in the revenue requirement modeling and comparisons across proposals. The most important sections in this common template are:

- General Information – Consists of the project description and project components from the Proposal Form, as well as key dates (i.e., construction start, capital spend start and in-service date)
- Capital Costs – Contains proposer estimates for total capital expenditures as well as some checks for consistency between the various proposer documents
- Cost Containment – Contains various binary indicators based on whether the overall project and certain components are capped, dollar amounts for those caps, further descriptions of the capping mechanisms and separate cost containment summaries. Key cost containment information such as the project components and elements were included as well.
- Financial Inputs & Assumptions – Contains information about the proposal's capital structure, tax assumptions, depreciation schedule and O&M
- Interdependency – Describes any issues, benefits or requirements related to modularity and pairing with other proposals
- Risks & Mitigations – Describes any uncertainties in timeline or other disruptions in the project that arise from major risks, with special attention included to any impacts on cost projections

With the common template developed, PJM and its consultants then conducted a detailed cost analysis for the 36 modeled projects using the following key steps:

- Revenue Requirement Modeling – A comparison of project cost estimates was performed, and for a more detailed cost analysis, a revenue requirement model was developed to allow comparison of the lifetime cost to ratepayers for the 36 modeled proposals. The analysis model calculates a bottom-up revenue

requirement for each of the solutions utilizing the bidders' cost and financial assumptions, as well as a number of standardized model inputs. The NPVRR represents the discounted total cost of the proposed project over its lifetime.

- Review of Cost Containment Mechanisms – An evaluation of the various cost containment mechanisms offered by bidders was also performed. Particularly, for high-cost Option 1B and 2 proposals, a well-capped proposal could considerably lower-cost overrun risks, while a poorly capped or uncapped proposal could result in millions or even billions of extra ratepayer dollars over the lifetime of the project if actual project costs are higher than proposed.
- Scenario Analysis – In addition to the base case NPVRR comparison for the modeled proposals, PJM also modeled six scenarios that alter one or multiple model inputs. Five of the scenarios alter a single variable (setting the return on equity to 12%, increasing the cost of debt to 6%, increasing project costs by 25%, increasing O&M by 50%, and setting the capital structure at 50% debt and 50% equity). A sixth, referred to as "downside," combines the impacts of the five single variable scenarios. The use of the scenarios provided insight into the impact of potential cost increases as well as the effectiveness of the proposed cost containment mechanisms.

Summary of Findings

Detailed results from PJM and its consultant's financial analysis are provided in the Financial Analysis report, which has been publicly posted on the PJM Transmission Expansion Advisory Committee (TEAC) meeting page.

As detailed in Results & Key Observations section of the report, PJM compared base case and scenario NPVRR results for each option group, namely, Option 1A, Option 1B, Option 1B/2, and Option 3, to best provide like-for-like project cost-of-service comparisons. For each proposal, PJM measured the percentage and dollar increase in each of the six scenarios compared to the base case NPVRR, then compared the total cost of each scenario across the option group. While the percentage increase serves as a good indicator of the effectiveness of various cost caps, the dollar increase measure provides a more holistic picture that factors in the proposals' different base cost levels. Well-capped proposals may result in a higher dollar increase in certain scenarios due to their high base costs, whereas the opposite could be true for uncapped, lower base cost proposals. It was also noted that the number of different capping mechanisms does not necessarily increase overall effectiveness of cost containment.

The Financial Analysis was not intended to declare winners or losers, but rather to provide useful information about the expected cost impacts over time, and the related impact on customer rates, as well as the ability of the proposals' cost containment mechanisms to mitigate unexpected increases in costs.

Legal Review of Cost Containment Provisions

In addition to the Financial Analysis, PJM also performed a qualitative assessment of the risks associated with the cost commitment provisions submitted by the eight developers from a legal perspective. In performing the qualitative assessment, PJM reviewed the legal language submitted by the developers to determine:

- Whether any aspect of the language could lead to a delay in the negotiation of a Designated Entity Agreement (DEA), including, for instance, whether the developer submitted proposed legal language for inclusion in Schedule E of a DEA, and, if so, whether the proposal included any unclear or ambiguous language, or that would otherwise make the developer's commitment under the cost commitment language less firm;
- Potential risks associated with third-party challenges when the DEA is filed at FERC; and
- Potential risks associated with third-party challenges when the proposed cost of service rate is filed at FERC. Proposals that included clear legal language including firm commitments with respect to costs, ROE and capital structure tended to be considered low risk, whereas proposals that did not include legal language, or that did not include firm commitments with respect to costs, ROE and capital structure, tended to be considered medium risk.

Appendix C of the Financial Analysis report includes: (i) a summary of the cost commitment language included in the developers' proposals; (ii) issues that could, in PJM's view, lead to potential DEA negotiation delays or third-party challenges; and (iii) PJM's qualitative assessment of the relative risk related to DEA negotiation delays or third-party challenges.

APPENDIX A: SUMMARY OF LARRABEE TRI-COLLECTOR SOLUTION

Proposal IDs	Components	In-Service Date (ISD)	Cost ($M)
ACE			
Proposal ID 127	The following components of Proposal 127		
	10. Rebuild the underground portion of Reconductor Richmond-Waneeta 230 kV (1098SN/1247SE, 1150WN/1299WE MVA)	6/1/2029	$16.00
	1. Upgrade Cardiff-Lewis 138 kV by replacing 1590 kcmil strand bus inside Lewis substation (377SN/478SE, 451WN/478WE MVA)	4/30/2028	$0.10
	3. Upgrade Cardiff-New Freedom 230 kV by modifying the existing relay settings (650SN/804SE, 748WN/906WE MVA)	4/30/2028	$0.30
	2. Upgrade Lewis No. 2-Lewis No. 1 138 kV by replacing bus tie with 2000A circuit breaker (478SN/478SE, 478WN/478WE MVA)	4/30/2028	$0.50
MAOD			
Proposal ID 551	Construct the AC switchyard portion of MAOD Proposal 551, composed of a 230 kV 3 x breaker-and-a-half substation with a nominal current rating of 4000A and four single phase 500/230 kV 450 MVA autotransformers to step up the voltage for connection to the Smithburg substation. AC switchyard design and site preparation shall be suitable for expansion to a 230 kV 4 X 230 kV breaker-and-a-half substation and seven single phase 500/230 kV 450 MVA autotransformers to step up voltage for connection of two circuits to Smithburg substation.	ISD to be aligned with NJBPU solicitation schedule and related JCPL Proposal 453 project work	$121.10 Note: This cost represents a partial scope of MAOD proposal #551. It excludes other owners' costs, permitting, commercial and financial fees, and will require further evaluation to refine the estimate.
	Procure land adjacent to the MAOD AC switchyard, which is a portion of the MAOD Proposal 551, and prepare the site for construction of future AC to DC converters for future interconnection of DC circuits from offshore wind generation. Land should be suitable to accommodate installation of four individual converters to accommodate circuits with equivalent rating of 1400 MVA at 400 kV. MAOD will commit to work with NJBPU and staff, PJM, the relevant transmission owners, and all future developers to lease or otherwise make land access available for construction of converters by those future developers to support the integration of OSW generators to achieve the OSW goals of New Jersey.	ISD to be aligned with NJBPU solicitation schedule and related JCPL Proposal 453 project work	
JCP&L			
Proposal ID 453	The following components of Proposal 453:		
	1. Atlantic 230 kV substation – Convert to double-breaker double-bus	6/1/2030	$31.47
	2. Freneau substation – Update relay settings	6/1/2030	$0.03
	3. Smithburg substation – Update relay settings	6/1/2030	$0.03
	4. Oceanview substation – Update relay settings	6/1/2030	$0.04
	5. Red Bank substation – Update relay settings	6/1/2030	$0.04

Proposal IDs	Components	In-Service Date (ISD)	Cost ($M)
	6. South River substation – Update relay settings	6/1/2030	$0.03
	7. Larrabee substation – Update relay settings	6/1/2030	$0.03
	8. Atlantic substation – Install line terminal	6/1/2030	$4.95
	9. Larrabee substation – Reconfigure substation	6/1/2029	$4.24
	10. Larrabee substation: 230 kV equipment for direct connection	6/1/2029	$4.77
	11. Lakewood Gen substation – Update relay settings	6/1/2029	$0.03
	12. G1021 (Atlantic-Smithburg) 230 kV	6/1/2030	$9.68
	13. R1032 (Atlantic-Larrabee) 230 kV	6/1/2030	$14.50
	14. New Larrabee Converter-Atlantic 230 kV	6/1/2030	$17.07
	15. Larrabee-Oceanview 230 kV	6/1/2030	$6.00
	16. B54 Larrabee-South Lockwood 34.5 kV line transfer	6/1/2029	$0.31
	17. Larrabee Converter-Larrabee 230 kV new line	6/1/2029	$7.52
	18. Larrabee Converter-Smithburg No. 1 500 kV line (new asset)	12/31/2027	$150.35
	24. G1021 Atlantic-Smithburg 230 kV	12/31/2027	$62.85
	26. D2004 Larrabee-Smithburg No1 230 kV	12/31/2027	$44.77
	27. Smithburg substation 500 kV expansion	12/31/2027	$5.81
	28. Larrabee substation	6/1/2030	$0.86
	29. Smithburg substation 500 kV 3 breaker ring	12/31/2027	$62.44
Proposal ID 17	The following components of Proposal 17: Convert the six-wired East Windsor-Smithburg E2005 230 kV line (9.0 mi.) to two circuits. One a 500 kV line and the other a 230 kV line - Smithburg-East Windsor 500 kV (3678SN/4541SE, 4262WN/5503WE MVA) - Deans-Smithburg 500 kV (3215SN/3998SE, 3890WN/4334WE MVA)		
	4. East Windsor-Smithburg 500 kV line	12/31/2028	$104.21
	5. East Windsor-Smithburg 230 kV line	12/31/2028	$37.80
	6. East Windsor substation	12/31/2028	$32.10
	7. T5020 Smithburg-Deans 500 kV	12/31/2028	$13.24
	8. K137 Windsor-Twin Rivers-Wyckoff Street 34.5 kV	12/31/2028	$6.20
	9. X752 Jerseyville-Smithburg 34.5 kV	12/31/2028	$4.58
	10. B158 Gravel Hill Smithburg 34.5 kV	12/31/2028	$4.23
	11. Smithburg 230 kV substation	12/31/2028	$4.12
	18. Add third Smithburg 500/230 kV (1034SN/1287SE, 1036WN/1451WE MVA)	12/31/2027	$13.40

Proposal IDs	Components	In-Service Date (ISD)	Cost ($M)
	16. D1018 (Clarksville-Lawrence) 230kV: Rebuild approximately 0.8 miles of the D1018 (Clarksville-Lawrence) 230kV Line between Lawrence Substation (PSEG) and Structure #63 with double bundled 1590 kcmil 45/7 ACSR.	12/31/2029	$11.45
	19. Reconductor Kilmer I-Lake Nelson I 230 kV (1136SN/1311SE, 1139WN/1379WE MVA)	12/31/2029	$4.42
PJM Identified Upgrades	Proposal Email 12/30/21: Additional reconductoring required for Lake Nelson I- 1 – Middlesex I 230 kV (1114SN/1285SE, 1116WN/1352WE MVA)	6/1/2029	$3.30
	Proposal Email 2/11/22: Reconductor small section of Raritan River-Kilmer 1I 230 kV (n6201) (1156SN/1334SE, 1158WN/1403WE MVA)	6/1/2029	$0.20
	Proposal Email 2/11/22: Replace substation conductor at Kilmer & reconductor Raritan River-Kilmer W 230 kV (n6202) (1156SN/1334SE, 1158WN/1403WE MVA)	6/1/2029	$25.88
	Proposal Email 2/11/22: Reconductor Red Oak A-Raritan River 230 kV (n6203) (1156SN/1334SE, 1158WN/1403WE MVA)	6/1/2029	$11.05
	Proposal Email 2/11/22: Reconductor Red Oak B-Raritan River 230 kV (n6204) (1156SN/1334SE, 1158WN/1403WE MVA)	6/1/2029	$3.90
LS Power			
Proposal ID 229	One additional Hope Creek-Silver Run 230 kV submarine cable (1364SN/1614SE, 1364WN/1614WE MVA) and rerate plus upgrade line:	5/1/2028	
	1. Transmission line upgrade		$60.20
	2. Silver Run substation upgrade		$1.00
PSE&G			
Proposal ID 180	The following components of Proposal 180:	6/1/2029	
	3. Linden subproject (IP)		$16.36
	4. Linden subproject (OP)		$8.56
	5. Upgrade Lake Nelson W-Middlesex W-Greenbrook W 230 kV line drop and strain bus connections at Lake Nelson 230 kV (Lake Nelson W-Greenbrook W 230 kV: 934SN/1080SE, 999WN/1143WE MVA)(OP)	6/1/2029	$4.28
	6. Upgrade Lake Nelson W-Middlesex W-Greenbrook W 230 kV line drop and strain bus connections at Lake Nelson 230 kV (Lake Nelson W-Greenbrook W 230 kV: 934SN/1080SE, 999WN/1143WE MVA) (IP)		$1.49
	7. Bergen Subproject		$5.53
PJM Identified	Proposal PPT 3/11/22: Upgrade inside plant equipment at Lake Nelson I 230 kV (Kilmer I-Lake Nelson I 230 kV: 1378SN/1625SE, 1475WN/1723WE MVA)	6/1/2029	$3.80

Proposal IDs	Components	In-Service Date (ISD)	Cost ($M)
Upgrades	Proposal PPT 2/4/22: Upgrade Kilmer W-Lake Nelson W 230 kV line drop and strain bus connections at Lake Nelson 230 kV (Kilmer W-Lake Nelson W 230 kV: 934SN/1080SE, 999WN/1143WE MVA)		$0.16
	Proposal PPT 2/4/22: Upgrade Lake Nelson W-Middlesex W-Greenbrook W 230 kV line drop and strain bus connections at Lake Nelson 230 kV (Lake Nelson W-Greenbrook W 230 kV: 934SN/1080SE, 999WN/1143WE MVA)		$0.12
PPL			
Proposal ID 330	The following components of Proposal 330:	6/1/2029	
	1. Reconductor Gilbert-Springfield 230 kV		$0.38
Transource			
Proposal ID 63	North Delta Option A:	12/31/2028	
	1. Graceton station upgrade		$1.55
	2. North Delta station		$76.27
	3. Tline upgrade – Graceton-Cooper-Peach Bottom		$28.74
	4. Tline upgrade – North Delta-Cooper Cut-in Lines		$1.56
	5. Tline upgrade – Peach Bottom-Delta Cut-in Lines		$1.56
Peco			
PJM Identified Upgrades	Replace four 63 kA circuit breakers “205,” “235,” “225” and “255” at Peach Bottom 500 kV with 80 kA breakers	12/31/2028	$5.60
BGE			
PJM Identified Upgrades	Replace one 63 kA circuit breaker “B4” at Conastone 230 kV with 80 kA breaker	12/31/2028	$1.3

Document Revision History

11/15/2022 - V1: original version posted