Constructability & Financial Analysis Report

2022 RTEP Window 3

November 17, 2023

For Public Use

The information contained herein is based on information provided in project proposals submitted to PJM by third parties through its 2022 RTEP Window 3. PJM analyzed such information for the purpose of identifying potential solutions for the 2022 RTEP Window 3. 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.

This maps contained in this report are only intended to illustrate the general electrical connectivity of the projects and should not be relied upon for exact geographical substation locations or line routes.

Table of Contents

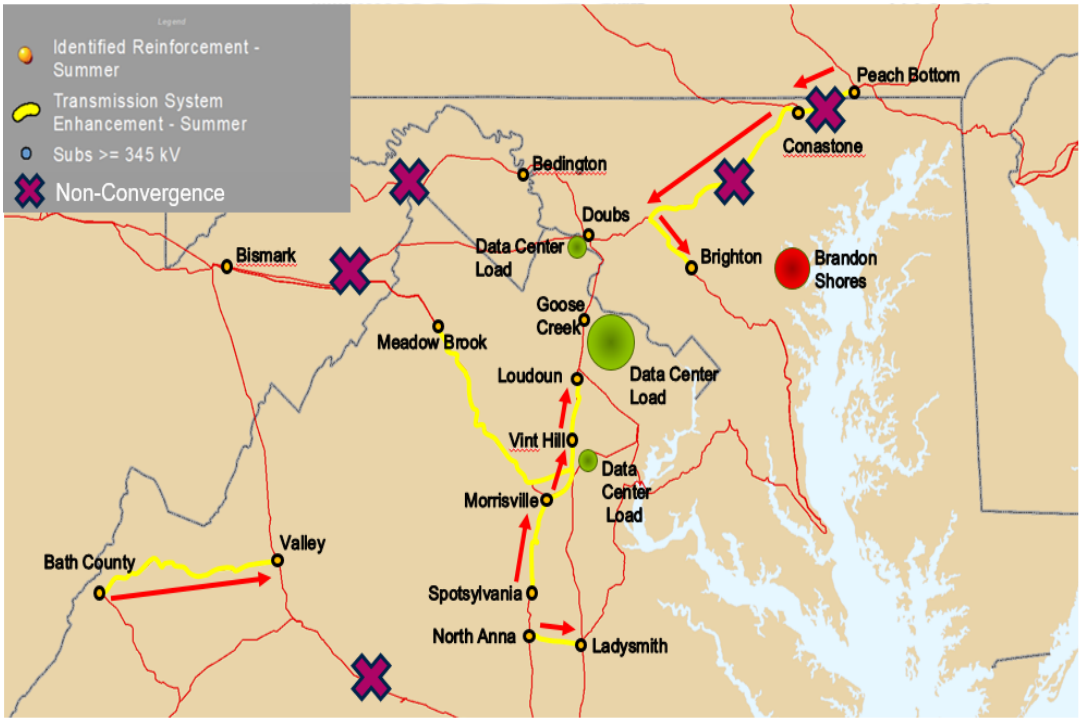
INTRODUCTION

Window Objective

The objective of the 2022 RTEP Window 3 is to develop robust, holistic and expandable solutions that address the 2027/28 baseline violations as illustrated in **Map 1** associated with:

- **Local Constraints:** Resulting from directly serving the data center loads in APS and Dominion zones through the respective 230 kV networks and into the points of delivery:
  - Goose Creek-Ashburn-Mars-Wishing Star and Brambleton
- **Regional Constraints:** Resulting from imports into load center areas (500 kV primarily):
  - Doubs-Goose Creek
  - Front Royal-Morrisville-Vint Hill-Loudoun/Mosby
  - Meadow Brook-Loudoun/Mosby
  - Morrisville-Bristers-Ox
  - Peach Bottom-Conastone-Brighton-Doubs
- **Reactive Power Needs:** Needed reactive power MVAR reinforcements, both static and dynamic as deemed necessary, to address the reactive power needs of the system for the 2027/28 baseline scenario
- **Cummulative Impact of Generation Changes and Deactivations**:
  - 11,100 MW of announced deactivations to the west and south of Conastone
  - Approximately 5,300 MW occurring after the 2022 RTEP 2027 case was created
  - The vast majority of the new generation with signed ISAs has been solar, which has low availability during the winter period.
  - The replacement generation is coming from the region to the east of Peach Bottom as well as west of Doubs to meet projected load growth.
  - PJM has implemented a new block dispatch procedure.
  - The old dispatch procedure in the past (including that implemented in the 2027 study cases) maintained historical intraregional transfers, dispatching most of the generators in the Dominion zone at 100%.
- **Adherance to All Applicable Criteria:** The recommended solution must adhere to all applicable planning criteria, including PJM, NERC, SERC, RFC and local Transmission Owner FERC 715 criteria.

Map 1. 2022 RTEP Window 3 Map of Regional/Local Needs



Proposals Submitted to PJM

PJM received 72 proposals from ten different entities as part of this window. Of the ten proposing entities, six were incumbent Transmission Owners (TOs) and four were non-incumbent entities. PJM received 22 proposals that involve upgrades to existing facilities, and 50 proposals that include new greenfield/brownfield facilities. The total cost of all proposals received, not all of which are required, add up to approximately $50.7 billion. The proposals include:

- 230 kV, 500 kV and 765 kV developments
- HVDC developments
- Underground 500 kV AC cable developments
- 500 kV GIS substations
- Double circuit 500 kV proposals

Proposal Clusters/Groupings

Map 2 below shows the regional nature of the proposals, concentrating in four clusters: West, South, East and Northern Virginia (VA) Data Center areas. Each cluster included proposals by different entities in the same need area and/or addressed the same local/regional needs.

Map 2. Regional Clusters

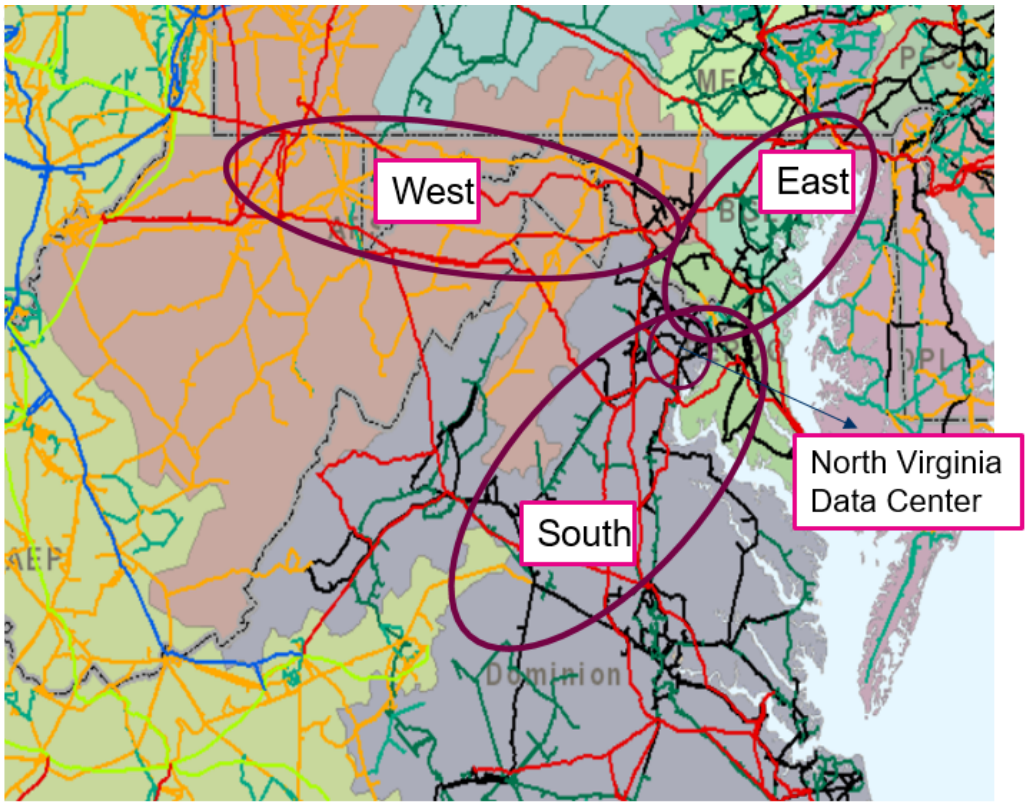


Table 1. 2022 RTEP Window 3 Submitted Proposals

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
1	9	AEP	Local AEP	Scottsville-Bremo Sag Study	$1.27
2	55			Boxwood-Scottsville 138 kV Rebuild	$104.88
3	181			Boxwood-Scottsville 138 kV Sag Study	$4.26
4	196			Glen Lyn-Peters Mountain Rebuild	$21.89
5	202			Cloverdale Transformer Addition	$57.29
6	234			Glen Lyn-Peters Mountain Sag Study	$0.80
7	410			Cloverdale Breaker Reconfiguration	$11.59
8	477			Fieldale-Franklin Rebuild	$74.89
9	524			Opossum Creek and New London Reactors	$8.86
10	537			Fieldale-Franklin Sag Study	$30.19
11	629			Scottsville-Bremo Rebuild	$31.31
12	856			Leesville-Altavista Rebuild	$28.85
13	487	Transource	Combo	Maryland & Pennsylvania Baseline Reliability Solution	$492.75
14	858		Northern VA	Stork-Flys 500 kV Greenfield Line and Substations	$510.44

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
15	904		Combo	Joshua Falls-Yeat 765 kV Greenfield Line and Substation	$1,048.10
16	977		South	Yeat 500/230 kV Greenfield Station	$232.14
17	30	Dominion	Local DOM	Charlottesville-Hollymead Line No. 2054 Rebuild	$159.87
18	74			Line No. 2090 (Ladysmith CT-Fredericksburg) Rebuild	$57.34
19	129		South	Dominion Aggregate 500 kV Proposal	$3,035.05
20	211		Local DOM	Hollymead-Gordonsville Line No. 2135 Rebuild	$54.85
21	231			Reactive Power VAR Reinforcements	$155.82
22	516		East	Interregional solution-Aspen-Doubs Second 500 kV Line	$61.72
23	671		Local DOM	Lines No. 541 (Front Royal to Morrisville) Rebuild	$299.03
24	692		Northern VA	Data Center Alley Local solution-New 500 kV/230 kV Aspen-Golden & Golden-Mars lines	$1,058.45
25	704		Local DOM	Hollymead-Gordonsville Line No. 2135 Rebuild	$36.89
26	711		South	Regional Solution-500 kV North Anna-Wishing Star Upgrades	$1,227.84
27	731		Local DOM	Locks Substation 230/115 kV Transformer Upgrade	$7.14
28	923		South	Second 500 kV line from Lexington to Dooms	$232.18
29	967		Local DOM	Charlottesville-Hollymead Line # 2054 Rebuild	$183.48
30	548	LS Power	Combo	RTEP Window 3 Solution	$2,404.48
31	28	NextEra	West	Hunterstown-Doubs-Goose Creek, Black Oak-Pike-Goose Creek, Pike SVC + Cap Banks	$884.05
32	116			Hunterstown-Doubs-Gant Solution	$478.87
33	175	NextEra	Combo	Combination of PEBO 215A + WOP 1F + SOP 8E	$6,265.95*
34	217		East	North Delta-Conastone Solution	$155.99
35	255		West	Hunterstown-Doubs-Gant Solution	$411.61
36	279		West	Black Oak-Woodside-Goose Creek, Woodside SVC + Cap Banks Solution	$429.18
37	347		West	Black Oak-Woodside-Gant, Woodside SVC + Cap Banks	$483.83
38	385		East	New 500/230 kV Bartholow substation, new 500/230 kV North Delta substation, new 230 kV Grisham switchyard, new 500/230 kV Goram substation	$1,140.73
39	419		West	Hunterstown-Doubs-Audobon-Goose Creek	$548.75
40	445		East	Muddy Creek/Delta-Conastone/Hunterstown-Doubs-Goose Creek Solution	$637.80
41	530		East	Muddy Creek/North Delta-Conastone Solution	$166.74
42	564		East	New 500/230 kV Bartholow substation, new 500/230 kV North Delta substation, new 230 kV Grisham switchyard, new 500/230 kV Goram substation	$876.88

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
43	577		South	Front Royal-Racefield, Warrenton-Wheeler, North Anna-Lady Smith	$258.38
44	598		Combo	Combination of PEBO 220 + WOP 1F + SOP 8E	$2,036.47
45	631		East	Muddy Creek/North Delta-Conastone Solution	$184.47
46	642		West	502 Junction-Black Oak-Woodside-Gant, Woodside SVC + Cap Banks, Gant-Farmwell, Cochran Tap-Round Table	$747.31
47	663		South	Front Royal-Racefield, Warrenton-Rixlew, Warrenton-Hourglass, Mars-Ocean Court-Davis Drive	$284.17
48	676		West	Black Oak-Stonewall-Gant, Stonewall SVC + Cap Banks, Gant-Farmwell, Cochran Tap-Round Table Solution	$552.49
49	685		West	Ft. Martin-Black Oak-Woodside, Woodside SVC + Cap Banks Solution	$609.78
50	719		West	Ft. Martin-Black Oak-Pike, Pike SVC + Cap Banks Solution	$600.90
51	728		West	Barnhart Substation, Bartholow Substation, Barnhart-Bartholow-Goose Creek solution	$385.36
52	766		South	Front Royal-Racefield, Warrenton-Wheeler	$239.59
53	846		West	Hunterstown-Doubs-Goose Creek, Black Oak-Woodside-Goose Creek, Stonewall SVC + Cap Banks	$892.94
54	853		West	502 Junction-Black Oak-Woodside-Gant, Woodside SVC + Cap Banks	$683.55
55	948		East	New 500/230 kV Bartholow substation, new 500/230 kV North Delta substation, new 230 kV Grisham switchyard, new 500/230 kV Goram substation, and Keeney to Waugh Chapel tie-in	$5,381.25*
56	951	**NextEra**	West	Black Oak-Gore-Goose Creek, Pike SVC + Cap Bank Solution	$419.86
57	344	**PECO**	East	PECO Expansion Plan for DOM Window 2023	$302.86
58	600		Local Other	Exelon Replacement Upgrades	$423.79
59	660	**PEPCO**	East	West Cooper BGE-PEPCO	$1,105.62
60	691			Mid-Atlantic Power Pathway (MAPP)	$1,990.28
61	23	**POTOED-FirstEnergy**	Combo	Data Center Reinforcement Proposal No. 2	$3,503.86
62	837			Data Center Reinforcement Proposal No. 1	$2,991.77
63	374	**PPL**	East	Otter Creek-Conastone 500 and 230 kV double circuit Line	$154.21
64	606		Local Other	Juniata-Lewistown 230 kV No. 2 line	$141.16
65	24	**PSEG**	East	Proposal A-North Delta-New Raphael-Waugh Chapel 500 kV	$739.40
66	125		Local Other	Proposal B-North Delta-Northeast 230 kV	$313.34
67	229		East	Proposal C-Hunterstown-New Green Valley 500 kV	$529.11
68	325		Combo	Proposal E-Brambleton-Hinsons Ford Rd 500 kV	$944.05

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
69	637		East	Proposal D-Conastone-Doubs 500 kV	$684.22
70	741			Proposal G-Peach Bottom-New Brandon Shores 500 kV; Peach Bottom-Doubs 500 kV	$1,065.32
71	808			Proposal F-Peach Bottom-New Raphael-Waugh Chapel 500 kV; Peach Bottom-Doubs 500 kV	$1,150.80
72	962			Proposal H-Peach Bottom-Doubs 500 kV (Circuits No. 1 and No. 2)	$977.71
				Total:	**$54,408.06**

**The NextEra proposal No. 175 cost was increased due to cost revision provided by proposing entity from approximately $1.6 billion to $5.4 billion.*

Overview of Evaluation Approach

Following the submittal of proposals in a competitive planning solicitation, PJM performs technical analysis 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 analysis and screening phase 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. The detailed analysis included reliability, constructability, financial and legal reviews.

As noted in the previous section, PJM received 72 proposals from ten different entities as part of this window – six incumbent Transmission Owners (TOs) and four non-incumbent entities.

PJM performed an initial analysis and screening of all proposals as depicted in **Figure 1**. This phase of analysis also included a minimum of two rounds of PJM meetings with the proposing entities. The first round of meetings was conducted between June and July 2023, with the discussions intended to clarify details of proposed developments, assumptions and rationale of proposed alternatives/variations. The second round of meetings was conducted between July and August, with the focus of these discussions on outage scheduling, routing, risk and an explanation of cost containment mechanisms proposed.

PJM's initial analysis and screening involved generator deliverability screening of proposals for a preliminary understanding of reliability performance, and to ascertain how each proposal and its components may be used as stand-alone solutions or combined with other proposals to address the identified system needs. To aid in this process, PJM organized the proposals into regional clusters (East, West, South and Northern VA Data Center), thereby enabling selection of proposals and their components from each cluster to form holistic scenarios that address the overall system needs.

A select group of proposals were identified for detailed constructability and financial analysis, based on their performance in the initial analysis and screening. These selected proposals were then used to create a number of holistic scenarios to address the overall system needs that were then subject to further evaluation.

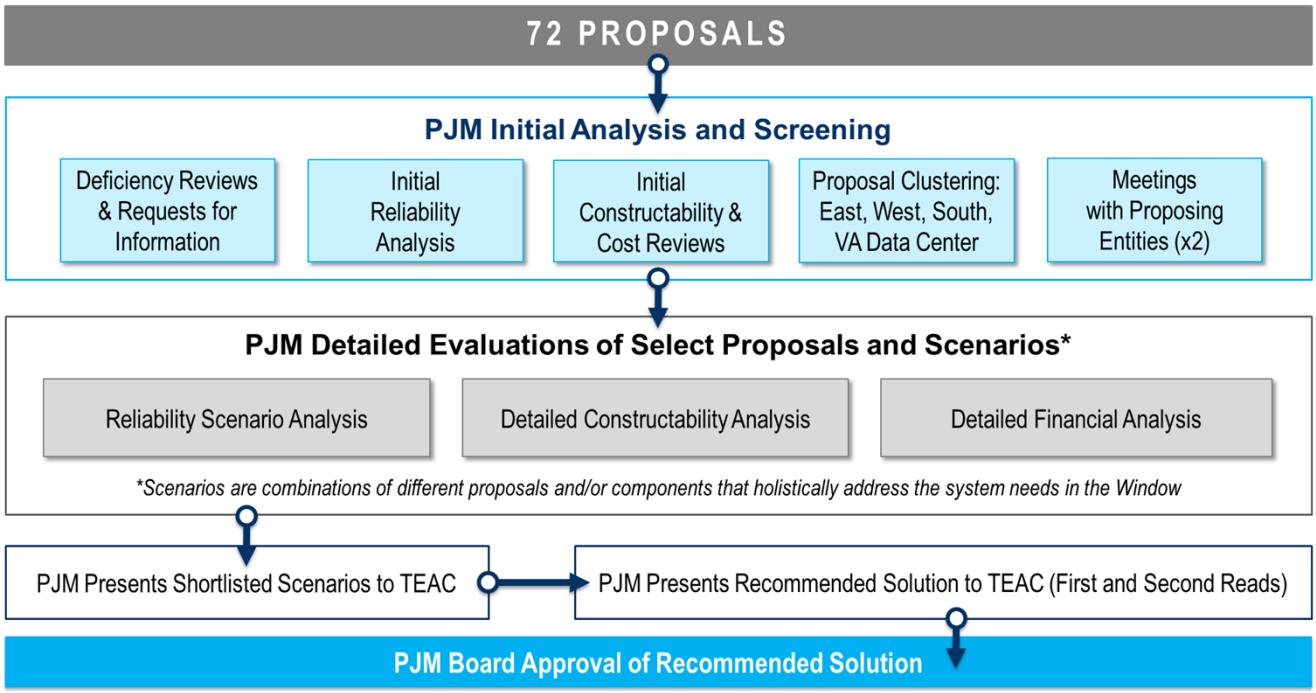
These scenarios, with their associated proposed developments, were evaluated based on the following principles:

- **Performance**
  - Meeting the system needs of 2027 and being flexible to address 2028 needs

- **Scalability**
  - Scenario/development longevity – system robustness and utilization
- **Impact**
  - Utilization of existing Right-of-Way (ROW) where possible and efficient.
- **Validated**
  - Cost evaluation using third-party benchmarking metrics
- **Risks**
  - Triggering additional costs:
    - Substation rebuilds due to extreme short-circuit levels
  - Avoid extended critical outages (Peach Bottom/Conastone rebuilds)
    - Imposing high permitting
    - Inability to meeting required in-service date
- **Efficiencies**
  - Avoidance of redundant capital investment including recognizing synergies with EOL facilities and overlaps of previously approved (or imminent) supplemental/baseline upgrades

The scenarios were developed and tested to first address the regional needs, then were refined through new scenarios to address local needs. Scenarios were further refined using more effective proposal components as demonstrated through their performance in the analysis.

Figure 1. Evaluation Process Overview



Proposals Selected for Detailed Evaluations

East Proposal Cluster

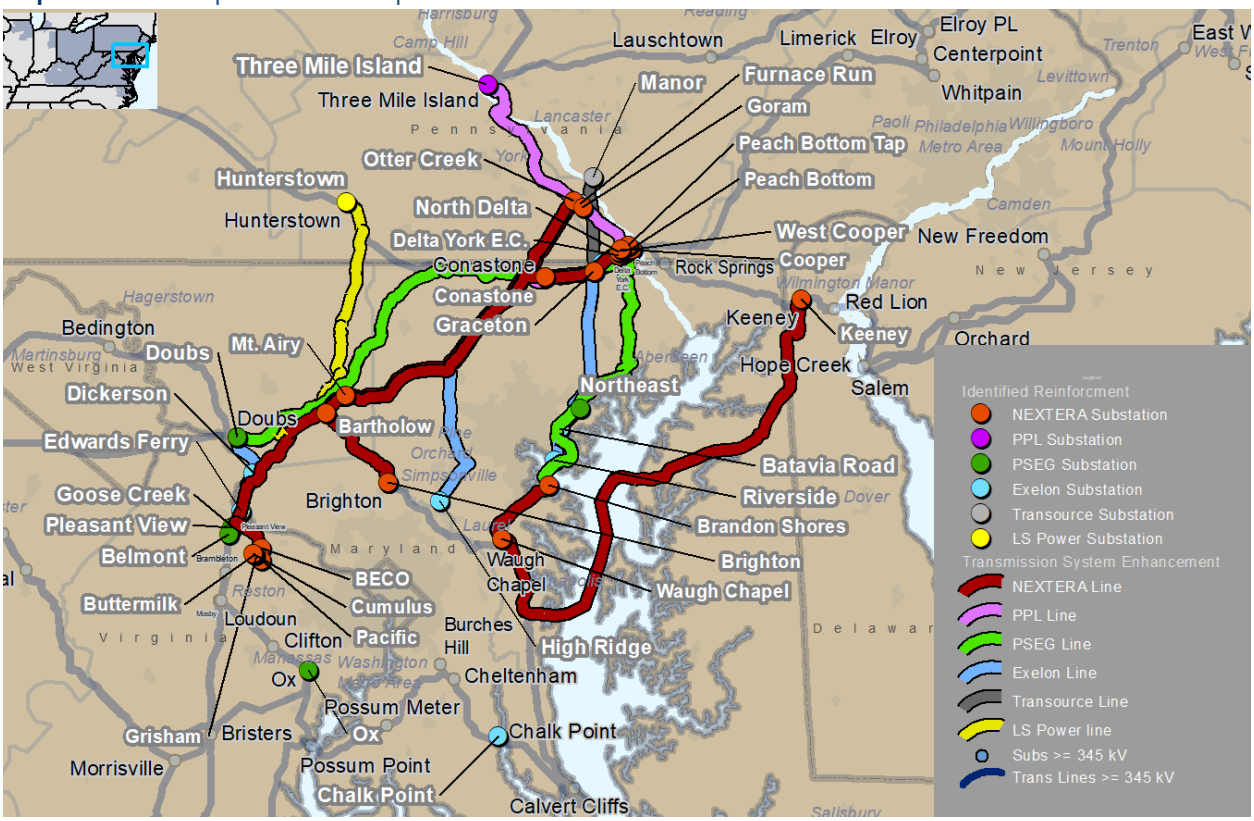
Seven entities submitted proposals to address the East cluster violations, and the selected proposals for detailed evaluations are provided in **Table 2** and **Map 3** below.

Table 2. East Proposal Cluster

PJM Proposal ID	Proposing Entity	Project Title	Component ID	Component Name
344	Exelon (PECO)	PECO Expansion Plan for DOM Window 2023	1	New 500 kV 4 Leg Breaker and a Half Substation (West Cooper): PECO
			2	New 230 kV Line from Cooper to West Cooper: PECO
			4	Peach Bottom North (PECO)-Graceton (BGE) New 500 kV Line: PECO Portion

PJM Proposal ID	Proposing Entity	Project Title	Component ID	Component Name
			5	West Cooper-Peach Bottom South New 500 kV Line: PECO
344 Cont.			6	Rebuild 5012 500 kV Line and Cut-in West Cooper (Peach Bottom South-West Cooper): PECO
			7	Rebuild 5012 500 kV Line and Cut-in West Cooper (Graceton-West Cooper): PECO Portion
			8	New Breaker and a Half Leg at Peach Bottom North: PECO
			10	West Cooper (PECO)-High Ridge (BGE) New 500 kV Line: PECO Portion
			14	Calpine-Peach Bottom South 500 kV Line Cut In: PECO
			15	Peach Bottom South Substation Bypass: PECO
660	Exelon (BGE-PEPCO)	West Cooper BGE-PEPCO	All	All
548 (East)	LS Power	RTEP Window 3 Solution-East Components	10	Conastone Substation Upgrade
			13	Hunterstown Substation Upgrade
			14	North Delta Substation Upgrade
			21	Peach Bottom Substation Upgrade
			23	Conastone-Peach Bottom Rebuild
			27	Hunterstown-Doubs Greenfield 500 kV Transmission Line
			32	Hunterstown-Doubs Greenfield 500 kV Transmission Line (Shared ROW)
			35	Conastone-North Delta Greenfield 500 kV Transmission line (Shared ROW)
			37	Peach Bottom-North Delta Reconductor
637	PSEG	Proposal D-Conastone-Doubs 500 kV	All	All
741	PSEG	Proposal G-Peach Bottom-New Brandon Shores 500 kV; Peach Bottom-Doubs 500 kV	All	All
487	Transource	Maryland & Pennsylvania Baseline Reliability Solution	All	All
374	PPL	Otter Creek-Conastone 500 and 230 kV double circuit Line	All	All
948	NextEra	New 500/230 kV Bartholow substation, new 500/230 kV North Delta substation, new 230 kV Grisham switchyard, new 500/230 kV Goram substation, and Keeney to Waugh Chapel tie-in.	All	All

Map 3. East Proposal Cluster Map



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

West Proposal Cluster

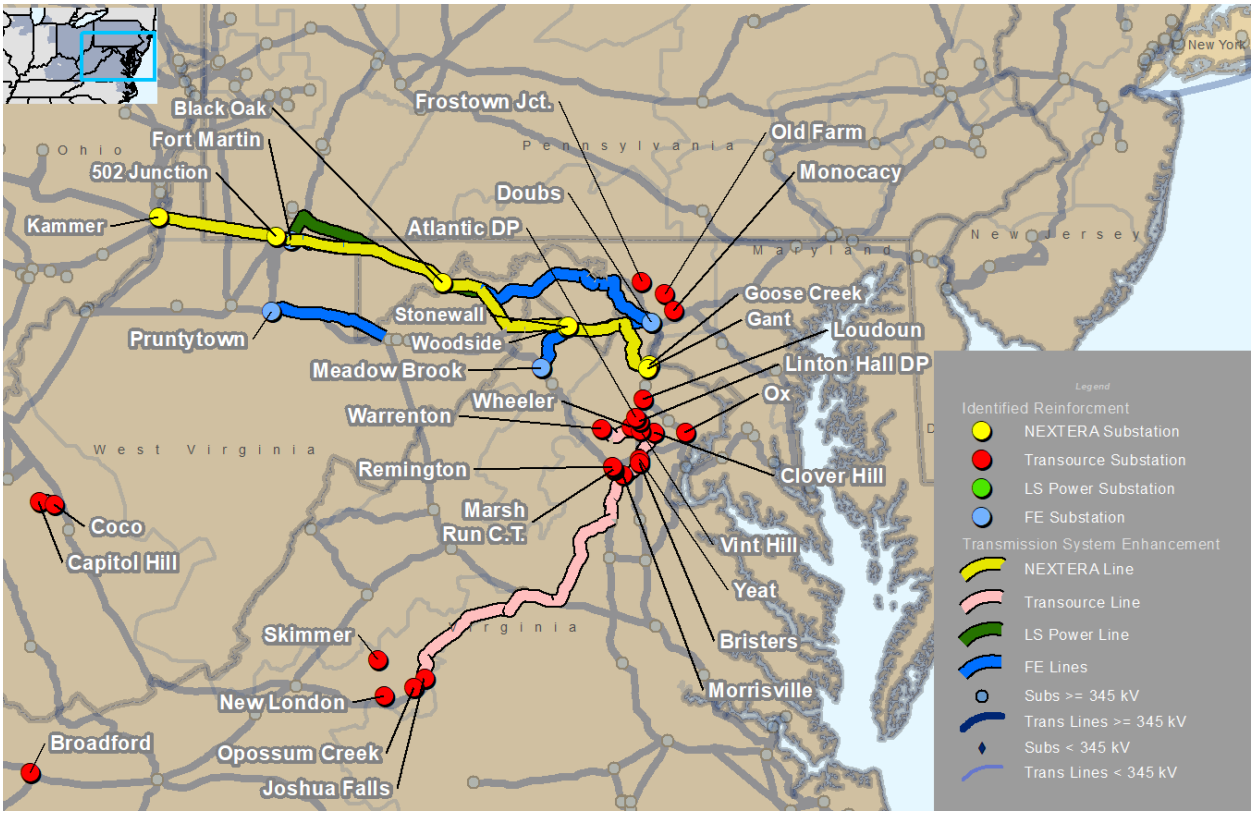
Four entities submitted proposals to address the West cluster violations, and the selected proposals for detailed evaluations are provided in **Table 3** and **Map 4** below.

Table 3. West Proposal Cluster

PJM Proposal ID	Proposing Entity	Project Title	Component ID	Component Name
837 (West)	POTOED – FirstEnergy	Data Center Reinforcement Proposal No. 1	1	Doubs Substation – Install 500 kV Breaker
			2	Doubs Substation – Expand 500 kV Switchyard
			3	Meadow Brook Substation - Expand 500 kV Switchyard
			4	Fort Martin Substation – Install 500 kV Breaker
			5	Pruntytown Substation – Expand 500 kV Switchyard
			6	Bedington Substation – Rebuild & Install 600 MVAR STATCOM
			7	Fort Martin-Doubs 500 kV No. 1 Line
			8	Meadow Brook-Doubs 500 kV Line

PJM Proposal ID	Proposing Entity	Project Title	Component ID	Component Name
			9	Meadow Brook-Pruntytown 500 kV Line
837 (West) Cont.			10-13	Relaying Upgrades – Various Stations
			14,15	Overduty Breaker Replacements – Doubs & Pruntytown
			18-30	Carroll-Hunterstown 230 kV Line
548 (West)	LS Power	RTEP Window 3 Solution – West Components	7	502 Junction Substation Upgrade
			9	Black Oak Substation Upgrade
			11	Doubs Substation Upgrade
			25	502 Junction-Black Oak 500 kV Transmission Line
			26	Black Oak-Doubs Greenfield 500 kV Transmission Line
			29	Black Oak-Doubs Greenfield 500 kV Transmission Line (Shared ROW)
853	NextEra	502 Junction-Black Oak-Woodside-Gant, Woodside SVC + Cap Banks	All	All
904	Transource	Joshua Falls-Yeat 765kV Greenfield Line and Substation	All	All

Map 4. West Proposal Cluster Map



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South Proposal Cluster

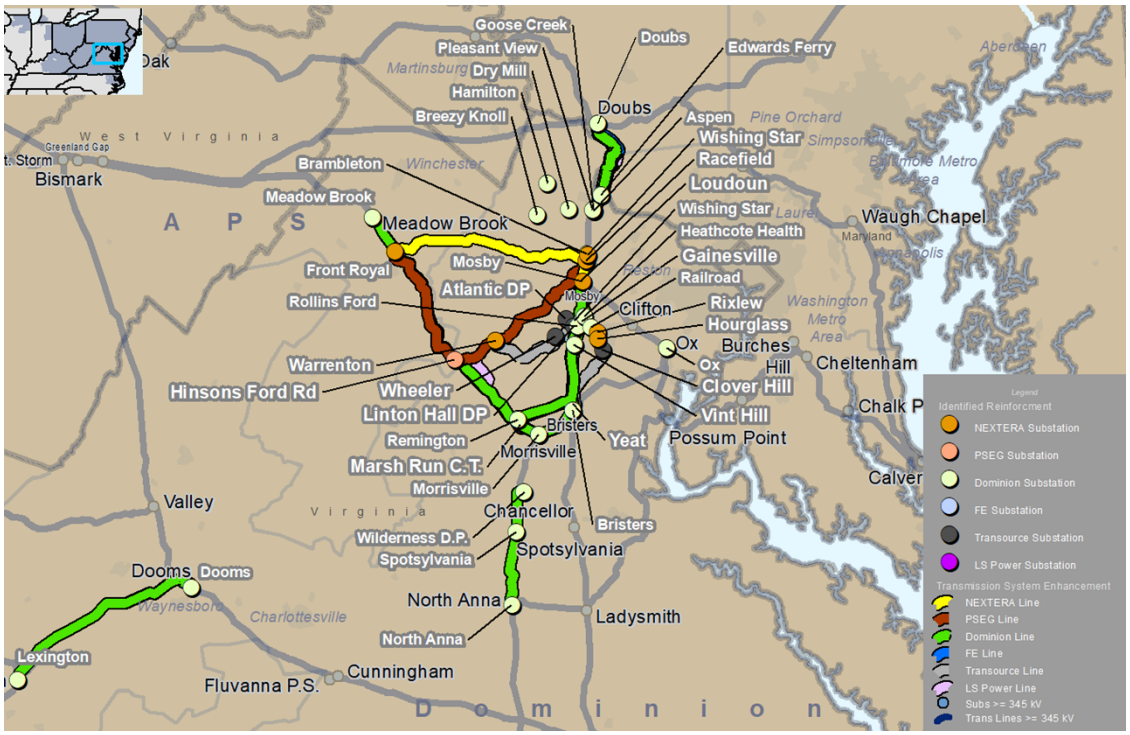
Five entities submitted proposals to address the South cluster violations, and the selected proposals for detailed evaluations are provided in **Table 4** and **Map 5** below.

Table 4. South Proposal Cluster

PJM proposal ID	Proposing Entity	Project Title	Component ID	Component Name
516	**Dominion**	Interregional solution-Aspen-Doubs Second 500 kV Line	**All**	All
711	**Dominion**	Regional Solution-500 kV North Anna-Wishing Star Upgrades	**All**	All
548 (South)	**LS Power**	RTEP Window 3 Solution	**12**	Goose Creek Substation Upgrade
			15	Vint Hill Substation Upgrade
			22	Vint Hill-Loudoun Reconductor

			28	Doubs-Goose Creek Greenfield 500 kV Transmission Line
			30	Front Royal Substation Upgrade
			33	Doubs-Goose Creek Greenfield 500 kV Transmission Line (Shared ROW)
			34	Front Royal-Vint Hill Greenfield 500 kV Transmission Line
325	**PSEG**	Proposal E-Brambleton-Hinsons Ford Rd 500 kV	**9**	New Brambleton to Hinsons Ford Rd 500 kV Line
			10	Reconductor Front Royal-Hinson Ford Rd 500 kV
			12	Hinsons Ford Rd 500 kV
837 (South)	**POTOED - FirstEnergy**	Data Center Reinforcement Proposal No. 1	**16**	Doubs-Goose Creek 500 kV Rebuild
			17	Doubs-Aspen 500 kV Line
663	**NextEra**	Front Royal-Racefield, Warrenton-Rixlew, Warrenton-Hourglass, Mars-Ocean Court-Davis Drive	**All**	All

Map 5. South Proposal Cluster Map



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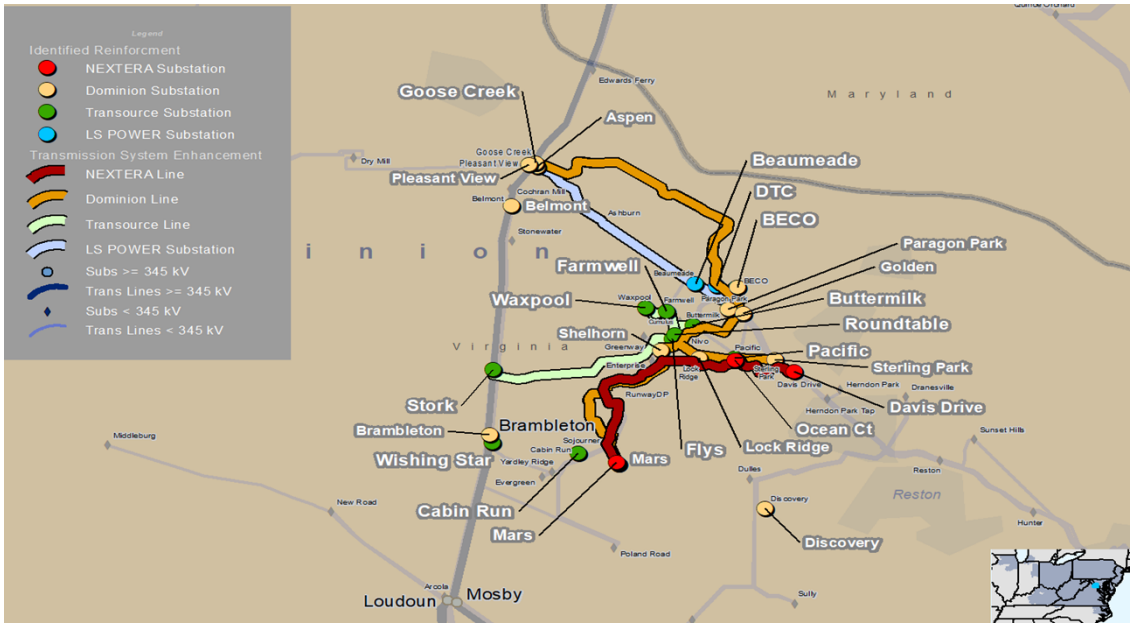
Northern VA Data Center Proposal Cluster

Three entities submitted proposals to address the Northern VA Data Center cluster violations, and the selected proposals for detailed evaluations are provided in **Table 5** and **Map 6** below.

Table 5. Northern VA Data Center Cluster

PJM Proposal ID	Proposing Entity	Project Title	Component ID	Component Name
692	Dominion	Data Center Alley Local solution – New 500 kV/230 kV Aspen-Golden & Golden-Mars lines	**All**	All
858	Transource	Stork-Flys 500 kV Greenfield Line and Substations	**All**	All
548 (Dominion)	LSPower	RTEP Window 3 Solution	**8**	Beaumeade Substation Upgrade
			16	DTC Substation Upgrade
			17	Mars Substation Upgrade
			24	Beaumeade-BECO-DTC 230 kV Transmission Line Upgrade
548 (Dominion) Cont.			**31**	BECO Substation Upgrade
			36	Goose Creek-Beaumeade Greenfield Underground 500 kV Double Circuit Transmission Line

Map 6. Northern VA Data Center Proposal Cluster Map



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CONSTRUCTABILITY ANALYSIS

Approach

The following is an outline of PJM and its consultant's approach for detailed constructability analysis of the selected 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.

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

- National Wetland Inventory mapping from United States Fish and Wildlife Service (USFWS), which will include counts and acreages of:
  - Total Wetlands
  - Non-Tidal (Non-Forested) Wetlands
  - Non-Tidal (Forested) Wetlands
  - Total Non-Tidal Wetlands
  - Wetlands of Special State Concern
  - Subaqueous Lands
- Mapping of specially designated wetlands, streams or rivers, which will include:
  - Non-Tidal Waterbodies (Count/Acres)
  - 100-Year Flood Plain (Acres)
  - Watershed Boundaries (Count)
  - Outstanding and Exceptional Waters (Count)
  - Wild and Scenic Rivers (Count
  - United States Geologic Survey Blue Line Streams (Count)
- United States Department of Agriculture(USDA)/The Natural Resources Conservation Service (NRCS) Land Cover mapping, which will include acreages of:
  - Sub-Aquatic Vegetation
  - Forested Uplands
  - Unforested Uplands
  - Agricultural Lands
- Land Use Mapping, which will include:
  - Residences within 100 feet (Count)
  - Residences within 250 feet (Count)
  - Land Zoned Conservation (Acres)
  - Rural Legacy (Acres)
  - Program Open Space (Acres)
  - Private Conservation Easements (Acres & Count)
  - Public Land (Acres & Count)
  - Parcels Crossed (Count)
  - Green Infrastructure/Green Acres program (Acres)
  - National Estuarine Research Reserve Project Areas (Acres & Count)
  - Natural Heritage Areas (Acres & Count)
  - Environmental Trust Easements (Acres & Count)
  - Forest Legacy Easements (Acres & Count)
  - Tidelands

- Public Lands Mapping Review, which will include the types, counts and acreages of the following:
  - State/National Forests
  - Natural Areas
  - Preserves
  - Game Lands
  - Recreation Areas
- Cultural Resources Mapping Review, including the count of previously identified resources, which will include the types, counts, and acreages of the following:
  - Listed and Eligible Historic Structures
  - Listed and Eligible Historic Districts
  - Listed and Eligible Archeological Sites
- Aquatic Resource Mapping, including the count of Submerged Historic Resources (if applicable)
- Online distribution data of rare, threatened and endangered species within a 0.5 mile radius of the study area
- Major utility and transportation (roads and rail lines) corridors

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

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

(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, ROWs 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 seven (8) categories, as required: materials and equipment; engineering and design; construction and commissioning; permitting/routing/siting; right of-way (ROW)/land acquisition; construction management; company overheads and other miscellaneous costs; and project contingency (30%).

Analysis Results

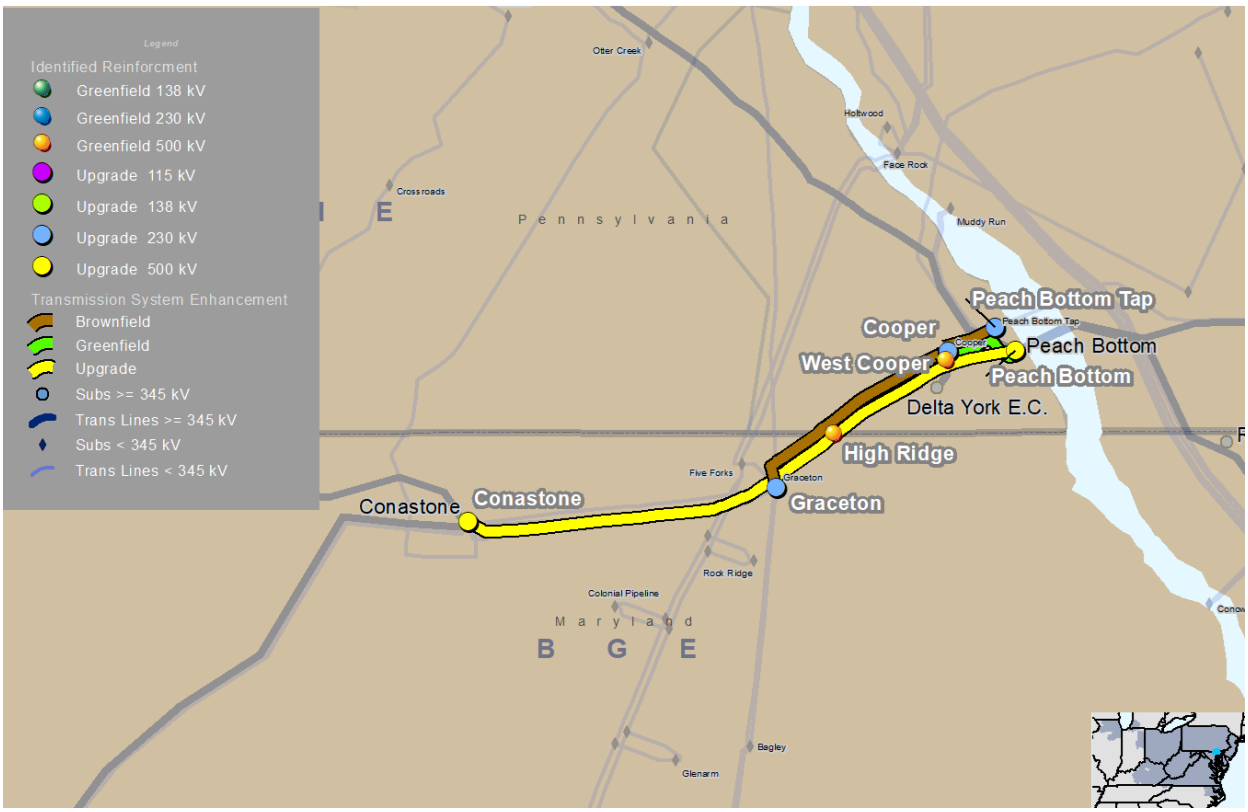
The following sections outline the results of PJM and its consultants' detailed constructability evaluations performed on select proposals and their components organized into the regional clusters defined by PJM. These results are also the basis for the Constructability Risk Assessment matrices that are included in **Appendix A** – Constructability Matrices of this report.

East Proposal Cluster

Proposal 344 – Exelon (PECO)

Proposal No. 344 (**Map 7**), described as PECO Expansion Plan for DOM Window 2023, is located within York, Lancaster and Chester counties, Pennsylvania, and includes the construction of several new lines and other distribution components. The majority of the components will be developed within existing ROWs. The proposed components will traverse within York County, Pennsylvania. Proposal No. 344 comprises the PECO portion of Exelon's West Cooper Max solution and is intended to be combined with Proposal No. 660, the BGE/PEPCO portion of Exelon's West Cooper Max solution.

Map 7. Proposal 344



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Proposal No. 344 includes seventeen components, representing two alternative solutions proposed by Exelon:

- The primary West Cooper Max solution, which involves building a new West Cooper 500/230 kV substation by cutting into and reconfiguring several 500 kV lines near Cooper substation, rebuilding the 5012 Peach Bottom-Conastone 500 kV, and building two new 500 kV lines from Peach Bottom to Graceton and the new West Cooper to High Ridge
- The alternative Peach Bottom Expansion solution, which involves expanding Peach Bottom substation to build two new 500 kV lines to Graceton (BGE) and High Ridge substation by retiring the 220-93 Cooper to Graceton to utilize the existing ROW, and also building new 230 kV substation to serve Cooper by cutting into existing 220-07 Muddy Run-Peach Bottom 230 kV line and building new line to Cooper, and rebuild of the 5012 Peach Bottom-Conastone 500 kV line

From Proposal 344, based on PJM's initial screening and analysis, only the 10 out of the 17 components associated with the West Cooper Max solution were selected for the detailed evaluations. These components are as follows:

- Component 1: New 500 kV 4 Leg breaker-and-a-half substation (West Cooper): PECO
- Component 2: New 230 kV line from Cooper to West Cooper: PECO

- Component 4: Peach Bottom North (PECO)-Graceton (BGE) new 500 kV line: PECO portion
- Component 5: West Cooper-Peach Bottom South new 500 kV line: PECO
- Component 6: Rebuild 5012 500 kV line and cut-in West Cooper (Peach Bottom South-West Cooper): PECO
- Component 7: Rebuild 5012 500 kV line and cut-in West Cooper (Graceton-West Cooper): PECO portion
- Component 8: New breaker-and-a-half leg at Peach Bottom North: PECO
- Component 10: West Cooper (PECO)-High Ridge (BGE) new 500 kV line: PECO portion
- Component 14: Calpine-Peach Bottom South 500 kV line cut in: PECO
- Component 15: Peach Bottom South substation bypass: PECO

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Peach Bottom North (PECO)-Graceton (BGE) New 500 kV Line: PECO Portion

This component of the proposal is for PECO's approximately 5.5-mile portion of greenfield 500 kV overhead transmission line from Peach Bottom North substation heading toward the Graceton substation. The line will travel through new ROW parallel to the existing Peach Bottom-Conastone 5012 500 kV line ROW for about 1.6 miles between Peach Bottom North and Cooper, transitioning to existing ROW from Cooper to Graceton by rebuilding Cooper to Graceton 230 kV line up to the Maryland/Pennsylvania state line. The line continues on to Graceton under BGE's portion of the line as part of Proposal 660.

West Cooper-Peach Bottom South New 500 kV Line: PECO

This component of the proposal is for an approximate 2.5-mile portion of 500 kV overhead transmission line from Peach Bottom South substation to the new West Cooper substation. The line will travel within new ROW between Peach Bottom South and West Cooper parallel to the existing Peach Bottom-Conastone 5012 500 kV line ROW. As proposed, the project will repurpose existing tie No. 1 transmission line between Peach Bottom North and Peach Bottom South; this is an additional feed line to West Cooper.

West Cooper (PECO)-High Ridge (BGE) New 500 kV Line: PECO Portion

This component of the proposal is for an approximate 4-mile portion of 500 kV greenfield overhead transmission line from the new West Cooper substation heading toward the expanded High Ridge substation. The line will travel on single circuit structures within existing ROW created by the demolition of Cooper to Graceton 230 kV and rebuild of Peach Bottom to Conastone 5012 500 kV line up to the Maryland/Pennsylvania state line. The line continues on to High Ridge under BGE's portion of the line as part of Proposal 660.

Overall, the ROW risk for components of this proposal is low, with extensive usage of existing ROWs for most of its alignment. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from York County in Pennsylvania. State PSC Approval, CPCN and DOT utility permits and driveway/local road permits may be required.

Environmental Risk Analysis

Peach Bottom North (PECO)-Graceton (BGE) New 500 kV Line: PECO Portion

Wetlands, waterbodies and high-risk flood zones appear to be crossed by the proposed line routes. The routes intersect seven waters that are subject to USACE Section 404 permitting. An on-site delineation would be required to

determine the actual location and extent of wetlands and waterbodies present and to assess permitting implications for jurisdictional features.

The proposed project components are within the range of both federally and state-listed species. The majority of the proposed routes are in woodlands. Construction restrictions, time frame, or mitigation may be necessary to comply with avoidance of sensitive species; however, the extent of which cannot be known until field studies are completed, and coordination with the USFWS and state wildlife agencies takes place.

Proposed routes intersect with protected areas (Private Easements). Coordination with NRCS Admin State PA; Pennsylvania State Government; and Pennsylvania Department of Agriculture – Farmland Preservation Program may be required.

Overall, the constructability risk for components of this proposal is low, with extensive usage of existing ROWs for most of its alignment.

Transmission Line Risk Analysis

Given the extensive reuse of existing ROW for this proposal, transmission line construction risks are low and limited to concerns with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence, and potential design limitations for reuse of existing infrastructure/assets.

A medium risk for this project involves the existing facility outages that will be necessary for the project, particularly for the extensive line rebuilds and substation expansions. To mitigate these risks, Exelon provided a detailed schedule outlining a sequence of construction that will ensure that new brownfield transmission lines are energized within the corridor prior to the rebuild of existing facilities that will require lengthy outages.

Substation Risk Analysis

New West Cooper 500/230 kV Substation

The West Cooper substation is a proposed new 500/230 kV breaker-and-a-half substation in York County, Pennsylvania that would tie into two existing 500 kV lines and one existing 230 kV line in the area. The proposed substation will be a four bay breaker-and-a-half air-insulated 500 kV substation with 14, 5000A, 500 kV live tank circuit breakers, and a new 200 MVA, 500/34.5/13 kV autotransformer that will feed the new Cooper distribution substation.

Other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, if selected, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 6**.

Table 6. Proposal 344 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	New 500 kV 4 Leg Breaker and a Half Substation (West Cooper): PECO	68.75	93.88
2	New 230 kV Line from Cooper to West Cooper: PECO	1.96	2.98
4	Peach Bottom North (PECO)-Graceton (BGE) New 500 kV Line: PECO Portion	13.05	30.39
5	West Cooper-Peach Bottom South New 500 kV Line: PECO	5.50	9.40
6	Rebuild 5012 500 kV Line and Cut-in West Cooper (Peach Bottom South-West Cooper): PECO	7.86	13.09
7	Rebuild 5012 500 kV Line and Cut-in West Cooper (Graceton-West Cooper): PECO Portion	29.86	22.26
8	New Breaker and a Half Leg at Peach Bottom North: PECO	25.93	22.99
10	West Cooper (PECO)-High Ridge (BGE) New 500 kV Line: PECO Portion	13.36	16.45
14	Calpine-Peach Bottom South 500 kV Line Cut In: PECO	1.57	1.75
15	Peach Bottom South Substation Bypass: PECO	0.79	1.64
	Total	**168.63**	**214.81**

The total proposal cost estimate is within 10–20% of the independent cost estimate and is considered medium risk.

Schedule Review

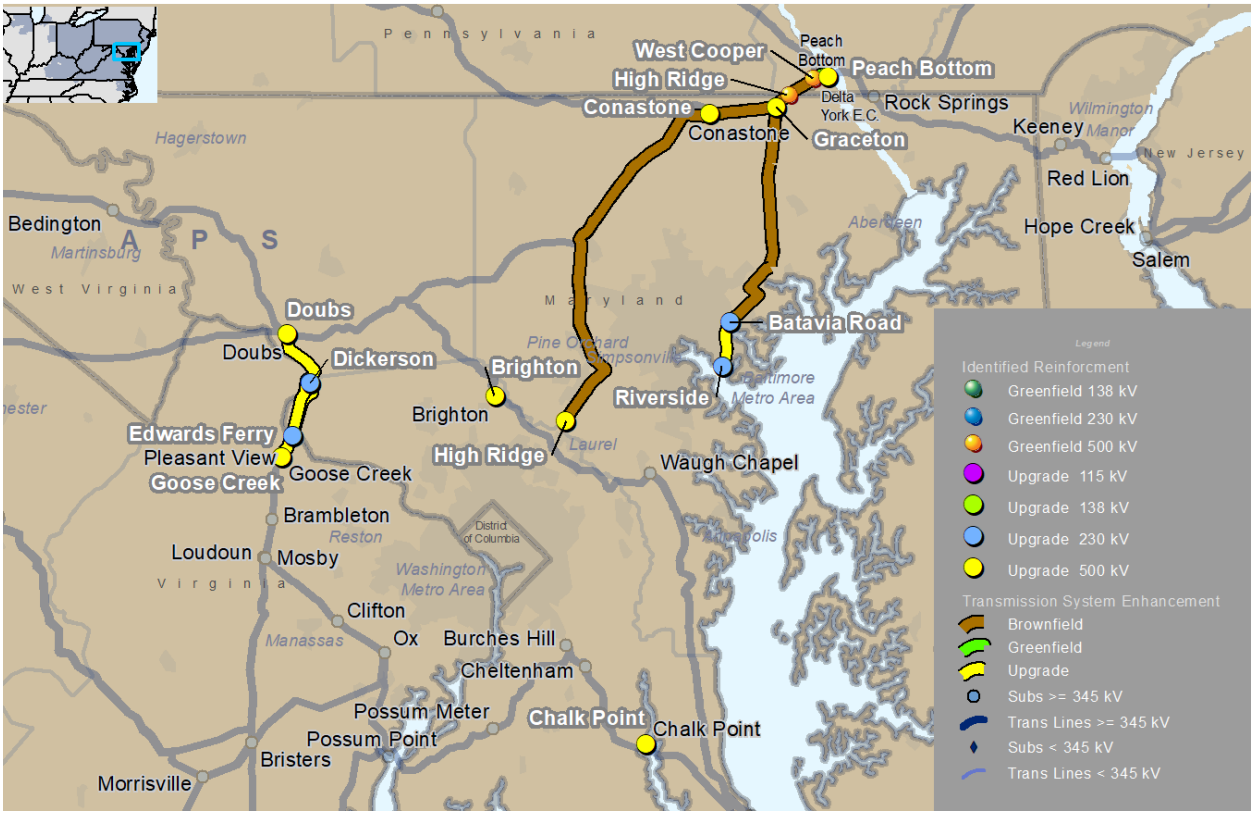
The proposed in-service date of December 2029 is reasonable for the proposed scope of the project, given the extensive use of existing ROW for routing the brownfield transmission lines. The most significant schedule risks to the project involve the long lead time anticipated for procurement of substation equipment such as EHV breakers and transformers for the proposed new substations and substation expansions.

Proposal 660 – Exelon (BGE-PEPCO)

Proposal No. 660 (**Map 8**), described as West Cooper BGE-PEPCO, is located within Howard, Baltimore and Harford counties, Maryland, and includes the construction of several new substations. The majority of the components will be developed within existing ROWs. Proposal No. 660 comprises the BGE-PEPCO portion of Exelon's West Cooper Max solution and is intended to be combined with Proposal No. 344, the PECO portion of Exelon's West Cooper Max

solution. In addition, two components within this proposal is in coordination with a FirstEnergy and Dominion's joint rebuild of the Doubs to Goose Creek corridor to accommodate a new 500 kV circuit, with further details provided in FirstEnergy Proposal 837 (South) and Dominion Proposal (516) reviews.

Map 8. Proposal 660



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Proposal No. 660 includes 22 components all of which are selected for the detailed evaluations.

- Component 1: Graceton 500 kV substation expansion
- Component 2: Batavia Road 230 kV switching station
- Component 3: High Ridge 500 kV substation expansion
- Component 4: West Cooper-High Ridge (500 kV)
- Component 5: Graceton-Batavia Rd (230 kV)
- Component 6: Peach Bottom-Graceton (500 kV)
- Component 7: 5012 line rebuild Graceton-Conastone (BGE Only)
- Component 8: 5012 line rebuild West Cooper-Graceton (BGE Only)
- Component 9: 230 line rebuild Batavia Road to Riverside

- Component 10: 230 kV Dickerson station H to Ed's Ferry
- Component 11: Graceton 230 kV terminal eqp. (BGE)
- Component 12: High Ridge 230 kV terminal eqp. (BGE)
- Component 13: Conastone 500 kV cap bank (BGE)
- Component 14: Conastone 500 kV 5012 line terminal eqp. (BGE)
- Component 15: Brighton 5053 terminal eqp. (PEPCO)
- Component 16: Brighton Statcom (PEPCO)
- Component 17: Brighton 500 kV cap bank (PEPCO)
- Component 18: Brighton 5011 terminal eqp. (PEPCO)
- Component 19: Dickerson to Ed's Ferry terminal eqp. (PEPCO) – associated with proposals FE 837 and DOM 516
- Component 20: Conastone 500 kV 5011 terminal eqp. (BGE)
- Component 21: Chalk Point 500 kV 5073 relay upgrade (PEPCO)
- Component 22: 500 kV Doubs to Goose Creek (PEPCO only) – associated with proposals FE 837 and DOM 516

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Peach Bottom North (PECO)-Graceton (BGE) New 500 kV Line: BGE Portion

The line is a continuation from PECO's portion of the line as part of Proposal 344 that terminated at the Maryland/Pennsylvania state line. This component of the proposal is for BGE's approximately 2-mile portion of greenfield 500 kV overhead transmission line from the Maryland/Pennsylvania state line, to the expanded Graceton substation. The new 500 kV line route entails rebuilding existing Cooper to Graceton 230 kV line as a 500 kV circuit.

West Cooper (PECO)-High Ridge (BGE) New 500 kV Line: BGE Portion

The line is a continuation from PECO's portion of the line as part of Proposal 344 that terminated at the Maryland/Pennsylvania state line. This component of the proposal is for BGE's approximately 59.4-mile portion of greenfield 500 kV overhead transmission line from the MD/PA state line to the expanded High Ridge substation.

The line will travel on single circuit structures within existing ROW created by the demolition of Cooper to Graceton 230 kV and rebuild of Peach Bottom to Conastone 5012 500 kV line from the Maryland/Pennsylvania state line up to Graceton. From Graceton to Conastone, the proposal entails building new 500 kV single circuit poles on the edge of the current ROW (8.6 mi) and transfer existing 5012 circuit to new poles, allowing for the new West Cooper High Ridge 500 kV circuit to be built in place of legacy 5012 structures. From Conastone to Northwest No. 2, the proposal entails building new 500 kV single circuit poles on the edge of the current ROW (24.2 miles) and transfer existing 5011 circuit to new poles, allowing for the new West Cooper-High Ridge 500 kV circuit to be built in place of legacy 5011 structures. The next portion of the route (20.5 miles) entails using free ROW space available on Northwest No. 2 Pleasant Hills 230 kV, Pleasant Hills to Granite 230 kV, Granite to Howard 230 kV, Howard to Columbia 230 kV, and then rebuilds of the Columbia to Snowden River 230 kV and Snowden River to High Ridge 230 kV for 4.6 miles to accommodate the West Cooper-High Ridge 500 kV circuit.

Graceton to Batavia (BGE) New Double Circuit 230 kV Line

This component of the proposal is for an approximately 29-mile double circuit 230 kV greenfield overhead transmission line from the existing Graceton substation to the new Batavia substation. This line will be constructed on the edge of the current ROW of the Graceton to Bagley to Raphael Road to Northeast 230 kV line corridor, with no expansion required.

Overall, the ROW risk for components of this proposal is low, with extensive usage of existing ROWs for its entire alignment. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from three counties in Maryland (Howard, Baltimore and Harford). State PSC approval, CPCN and DOT utility permits and driveway/local road permits may be required.

Environmental Risk Analysis

Wetlands, waterbodies and high-risk flood zones appear to be crossed by the project components of the proposal.

Proposed project intersects waters subject to USACE Section 404 and/or Section 10 permitting. Numerous wetlands subject to USACE Section 404 intersect the project. Coordination with USACE is required for jurisdictional determination. An on-site delineation would be required to determine the actual location and extent of wetlands and waterbodies present and to assess permitting implications for jurisdictional features.

The proposed project components are within the range of both federally and state-listed species. The majority of the proposed routes are in woodlands. Construction restrictions, time frame or mitigation may be necessary to comply with avoidance of sensitive species; however, the extent of which cannot be known until field studies are completed and coordination with the USFWS and state wildlife agencies takes place.

Proposed project components do not intersect conservation easements/protected areas. Coordination with easement holders is not anticipated.

Transmission Line Risk Analysis

Given the extensive reuse of existing ROW for this proposal, transmission line construction risks are low and limited to concerns with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence, and potential design limitations for reuse of existing infrastructure/assets.

Other moderate risks for this project involve the existing facility outages that will be necessary for the project, particularly for the extensive line rebuilds, and substation expansions. To mitigate these risks, Exelon provided a detailed schedule outlining a sequence of construction that will ensure that new brownfield transmission lines are energized within the corridor prior to the rebuild of existing facilities that will require lengthy outages.

Substation Risk Analysis

New Batavia Road 230 kV Station

The Batavia Road 230 kV switching station is a proposed new four four-bay, eight-position 230 kV switching station to be built with ten 230 kV 4000A breakers, associated station bus, control house, relaying and grounding.

Other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 7**.

Table 7. Proposal 660 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Graceton 500 kV Substation Expansion	78.96	82.52
2	Batavia Road 230 kV Switching Station	32.91	44.73
3	High Ridge 500 kV Substation Expansion	116.00	70.03
4	West Cooper-High Ridge (500 kV)	407.11	304.57
5	Graceton-Batavia Rd (230 kV)	176.84	247.94
6	Peach Bottom-Graceton (500 kV)	10.44	19.58
7	5012 Line Rebuild Graceton-Conastone (BGE ONLY)	70.00	45.94
8	5012 Line Rebuild West Cooper-Graceton (BGE ONLY)	10.44	9.66
9	230 Line Rebuild Batavia Road to Riverside	20.16	22.09
10	230 kV Dickerson Sta H to Ed's Ferry	18.60	42.80
11	Graceton 230 kV Terminal Eqp. (BGE)	8.77	5.32
12	High Ridge 230 kV Terminal Eqp. (BGE)	6.11	4.72
13	Conastone 500 kV Cap Bank (BGE)	14.31	10.33
14	Conastone 500 kV 5012 Line Terminal Eqp. (BGE)	4.93	5.99
15	Brighton 5053 Terminal Eqp. (PEPCO)	4.13	6.23
16	Brighton Statcom (PEPCO)	52.20	67.46
17	Brighton 500 kV Cap Bank (PEPCO)	14.31	11.42
18	Brighton 5011 Terminal Eqp. (PEPCO)	4.13	6.54
19	Dickerson To Ed's Ferry Terminal Eqp. (PEPCO)	10.58	8.51
20	Conastone 500 kV 5011 Terminal Eqp. (BGE)	7.16	8.99
21	Chalk Point 500 kV 5073 Relay Upgrade (PEPCO)	0.34	0.57
22	500 kV Doubs to Goose Creek (PEPCO Only)	37.20	34.68
	Total	**1,105.62**	**1,060.63**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

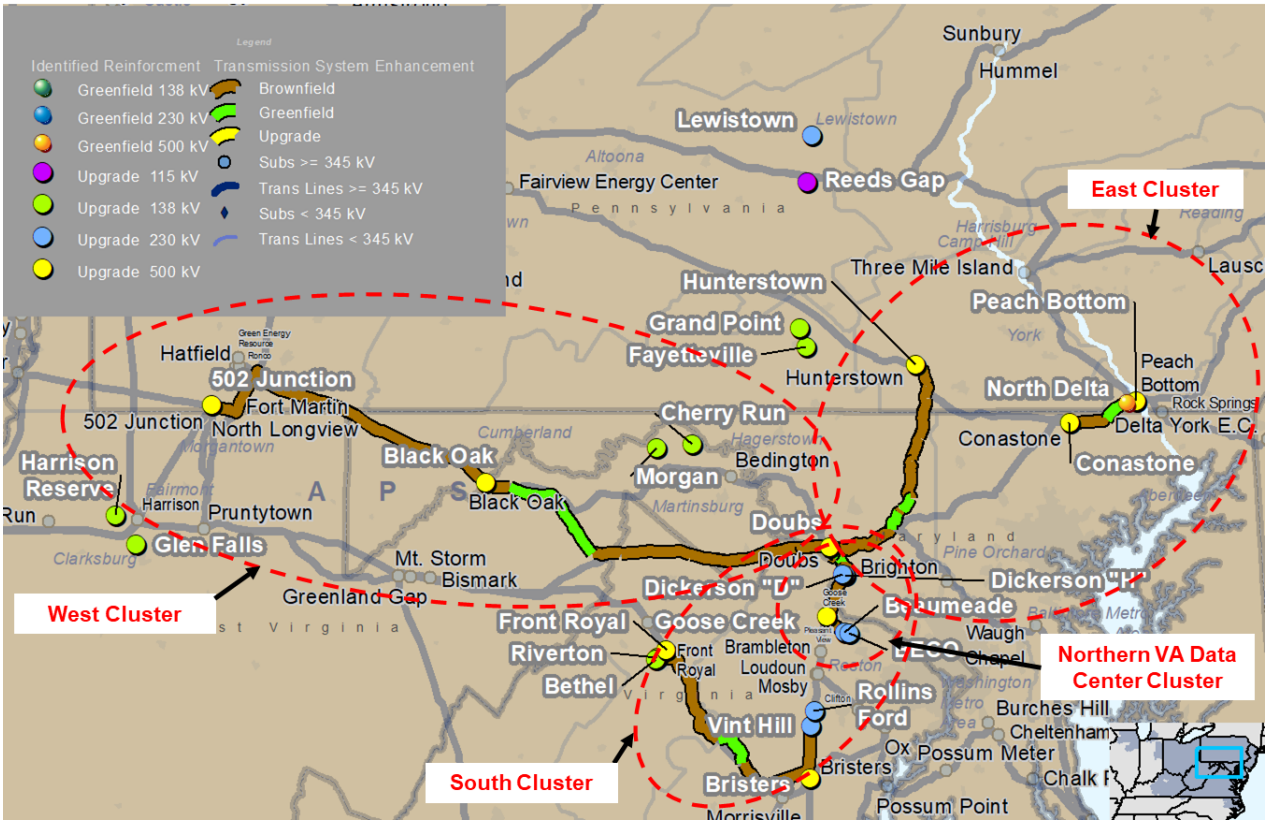
Schedule Review

The proposed in-service date of December 2030 is reasonable for the proposed scope of the project, given the extensive use of existing ROW for routing the brownfield transmission lines. The most significant schedule risks to the project involve the long lead time anticipated for procurement of substation equipment such as EHV breakers and transformers for the proposed new substations and substation expansions.

Proposal 548 (East) – LS Power

LS Power Proposal No. 548 (**Map 9**), described as RTEP Window 3 Solution, provides a holistic solution to the RTEP Window 3 needs, comprising 37 components, which can be grouped into the four regional clusters identified for the Window. Specifically for the East cluster, LS Power proposed several components within multiple counties in Pennsylvania (York, Adams) and Maryland (Harford, Carroll, Frederick).

Map 9. Proposal 548



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

LS Power Proposal 548 components selected for evaluation in the East cluster are as follows:

- Component 10: Conastone substation upgrade
- Component 13: Hunterstown substation upgrade
- Component 14: North Delta substation upgrade
- Component 21: Peach Bottom substation upgrade
- Component 23: Conastone-Peach Bottom rebuild
- Component 27: Hunterstown-Doubs Greenfield 500 kV transmission line
- Component 32: Hunterstown-Doubs Greenfield 500 kV transmission line (shared ROW)
- Component 35: Conastone-North Delta Greenfield 500 kV transmission line (shared ROW)
- Component 37: Peach Bottom-North Delta reconductor

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Conastone to Peach Bottom – 500/230 kV OH Line Rebuild

This component of the proposal is for a double circuit approximately 8-mile 500/230 kV overhead transmission line rebuild from Conastone substation to the Peach Bottom substation. The new line will utilize the existing ROW and is assumed will be able to be completely built within the existing ROW. The existing lattice towers will be taken down and replace with the new double circuit 500/230 kV structures.

The ROW risk for this component is low due to the rebuild occurring within the existing ROW.

Huntertown to Doubs 500 kV OH Line

This component of the proposal is for a 55-mile single circuit, partially greenfield 500 kV overhead transmission line from the existing Huntertown substation to the Existing Doubs substation. The line parallels an existing 500 kV ROW for the first 7 miles of the line, and then follow its own new ROW for approximately 3 miles. At this point, it will replace Germantown-Taneytown 138 kV line and become a double circuit 500/138 kV line for ~13 miles. It will then break off to single circuit for a few structures, and then meet the existing Carroll-Mt Airy 230 kV corridor, which it will rebuild as a 500/230 kV line for about seven miles. Then it becomes a single 500 kV circuit with its own new ROW for ~10 miles, before paralleling Doubs-Brighton 500 kV ROW for the remaining ~15 miles to Doubs substation.

The ROW risk for this component is medium-high to high, with about 35 miles of greenfield route, although only 13 miles are pure greenfield for its entire alignment.

Conastone to North Delta 500 kV OH Line

This component of the proposal is for a ~5.5 mile 500 kV overhead transmission line rebuild from Peach Bottom substation to the North Delta substation. The new line will utilize the existing ROW and is assumed will be able to be completely built within the existing ROW. The existing lattice towers will be taken down and replaced with the new double circuit 500/230 kV structures.

The ROW risk for this component is low due to the rebuild occurring within the existing ROW.

Peach Bottom to North Delta 500 kV OH Line Upgrades

This component of the proposal is for a ~2.5 mile 500 kV overhead transmission line reconductor from Peach Bottom substation to the North Delta substation. It is assumed that existing structures will be used for the upgrades. No new ROW is anticipated for this project.

The ROW risk for this component is low, as this is an upgrade occurring within the existing ROW.

Overall, due primarily to the Hunterstown to Doubs 500 kV OH line component, LS Power's East components ROW risk are considered medium-high.

Environmental Risk Analysis

The proposed Hunterstown-Doubs greenfield route entails seven railroad crossings, 16 transmission line crossings, and 96 road crossings in Adams County, Pennsylvania, and Carroll and Frederick counties in Maryland.

Proposed project components do not intersect conservation easements/protected areas. Coordination with easement holders is not anticipated.

Transmission Line Risk Analysis

The Hunterstown-Doubs component poses some medium construction risks as the design ROW is based on assumed ROW limits. It is not clear that the existing ROW will be adequate to contain the new line (sections that include 138 kV and 230 kV rebuilt to 500/138 kV and 500/230 kV respectively), as requirements may be larger for the 500 kV portion that what the existing ROW can hold. Alongside this, there are many portions where new ROW needs to be obtained, both paralleling existing ROW, and completely new ROW. It should also be noted that the conductor selection for each section may not be adequate to support the specified ratings, especially for the 500 kV line. Final conductor selection can affect span lengths, structure heights, material cost and hardware costs.

Medium-high risks are assessed for outage coordination for the proposed Conastone to Peach Bottom – 500/230 kV OH line rebuild component. This will involve extensive outage of the Conastone-Peach Bottom 500 kV line for its rebuild, and no details were provided regarding mitigation for the anticipated issues with these outages.

Substation Risk Analysis

The substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 8**.

Table 8. Proposal 548 (East) Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
10	Conastone Substation Upgrade	7.56	11.83
13	Hunterstown Substation Upgrade	14.34	17.00
14	North Delta Substation Upgrade	7.56	11.02
21	Peach Bottom Substation Upgrade	4.99	5.26
23	Conastone-Peach Bottom Rebuild	77.26	111.35
27 & 32	Hunterstown-Doubs Greenfield 500 kV Transmission Line	303.98	348.36
35	Conastone-North Delta Greenfield 500 kV Transmission line (Shared ROW)	77.26	100.28
37	Peach Bottom-North Delta Reconductor	2.88	4.34
	Total	495.83	609.44

The total proposal cost estimate is within 10–20% of the independent cost estimate and is considered medium risk.

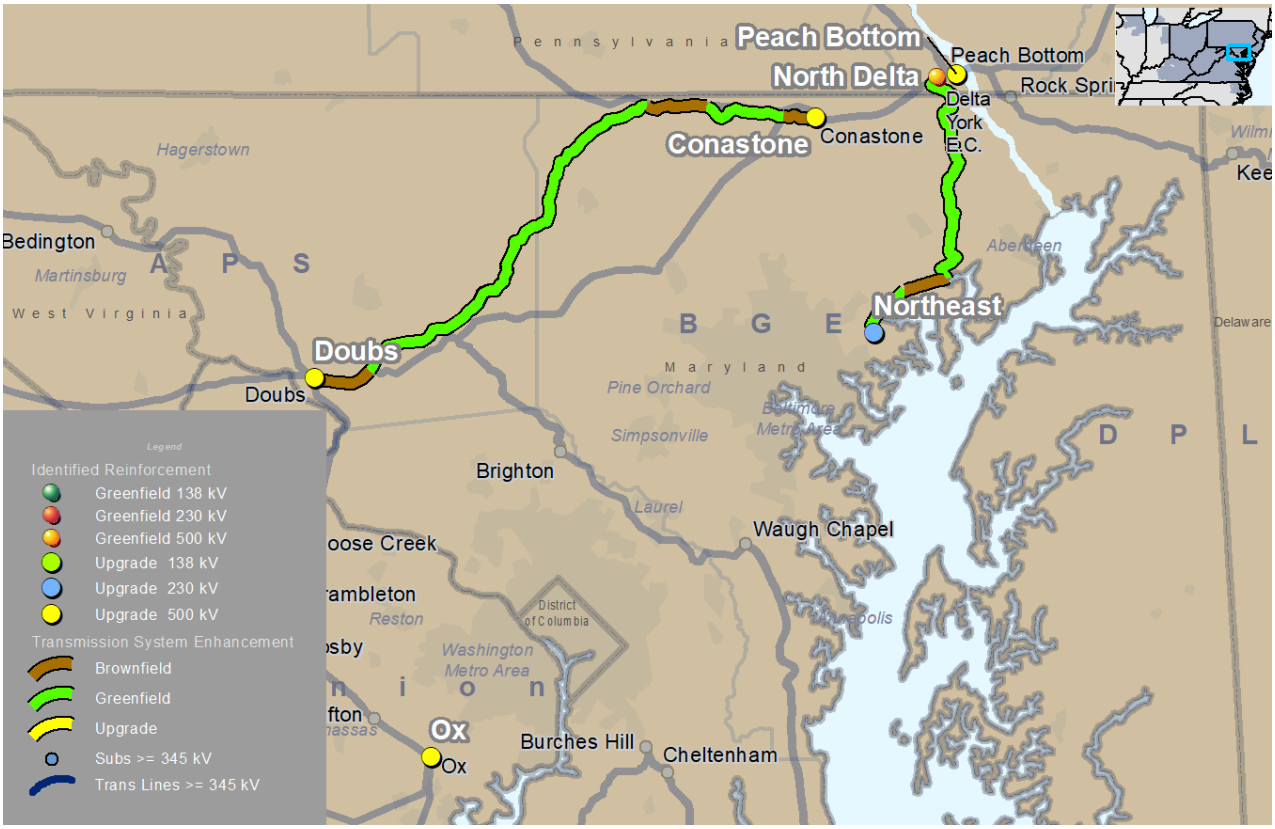
Schedule Review

The proposed in-service date of December 2030 appears to be reasonable for the proposed scope of the project, with a conservative time required to manage outage scheduling risks for Conastone-Peach Bottom rebuild and the ROW risks that may be associated with the Hunterstown-Doubs component.

Proposal 637 – PSEG

PSEG Proposal No. 637 (**Map 10**), described as Proposal D: Conastone-Doubs 500 kV, is located within York County, Pennsylvania, and Frederick, Carroll, Baltimore, and Harford counties, Maryland, and includes the upgrade of multiple substations as well as two greenfield lines.

Map 10. Proposal 637



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

PSEG Proposal 637 components selected for evaluation in the East cluster are as follows:

- Component 1: North Delta 500/230 kV upgrade
- Component 2: Northeast 230 kV upgrade
- Component 3: Peach Bottom 500 kV upgrade
- Component 4: Doubs 500/230 kV upgrade
- Component 5: Conastone 500/230 kV upgrade
- Component 6: Ox 500 kV upgrade
- Component 7: North Delta-Northeast 230 kV
- Component 8: Conastone-Doubs 500 kV

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New 230 kV Line From North Delta to Northeast

This component of the proposal is for a 36.5-mile greenfield 230 kV overhead transmission line tie from the North Delta substation to the Northeast substation. The line will travel through new ROW between North Delta and Northeast.

The ROW risk for this component is high due to the pure greenfield nature of the route.

New 500 kV Line From Conastone to Doubs

This component of the proposal is for an approximate 40.1-mile portion of a greenfield 500 kV overhead transmission line from Conastone substation to the Doubs substation. The line will travel through new ROW between Conastone and Doubs.

The ROW risk for this component is high due to the pure greenfield nature of the route.

Overall, with both transmission line components using a pure greenfield route, this proposal's ROW risk are considered high.

Environmental Risk Analysis

New 230 kV Line From North Delta to Northeast

The proposed North Delta to Northeast route has the potential to impact environmental and cultural resources including: the Lower Deer Creek Valley Historic District, flood plains, streams/wetlands subject to USACE permitting, and woodlands with the potential to serve as a suitable habitat for federally listed threatened and endangered species.

Impacts to these resources will require: coordination with the VA SHPO, the county flood plain administrator, USACE Section 404 and/or Section 10 permitting, and USFWS consultation.

The proposed route intersects a recorded underground storage tank (UST) that may require further soil characterization studies.

Nine easements are intersected by the proposed route. Coordination with easement holders will be required.

New 500 kV Line From Conastone to Doubs

Approximately six railroad crossings with CSXT and one is with Maryland Midland Railway (MMID). Approximately 121 road crossings (242 road entrances) in four counties. Approximately one cemetery crossing. Notification/Agreement may be required with Mount Zion United Methodist Church Cemetery. Approximately one crossing at Torrey C Brown Rail Trail, with the operator MD Department of Natural Resources.

The proposed route has the potential to impact environmental resources including: 19 FEMA High-Risk Flood Zones, 187 streams and 155 wetlands subject to USACE Section 404 and/or Section 10 permitting, and woodlands with the potential to serve as suitable habitat for federally listed threatened and endangered species. Impacts to these resources will require: USACE Section 404 and/or Section 10 permitting and USFWS consultation. The proposed

route intersects six Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. The proposed route intersects a property listed on the National Register of Historic Places – National Park Service (Chambers, Whitakker, Farms), Parker Conservation Area, Union Mills Reservoir Park and a unnamed local park. Coordination with entities is required.

Transmission Line Risk Analysis

The primary transmission line risks are those associated with permitting and land acquisition for the proposed greenfield lines.

Substation Risk Analysis

The substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 9**.

Table 9. Proposal 637 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	North Delta 500/230 kV Upgrade	8.44	10.42
2	Northeast 230 kV Upgrade	56.43	39.45
3	Peach Bottom 500 kV Upgrade	6.57	7.83
4	Doubs 500/230 kV Upgrade	25.20	31.80
5	Conastone 500/230 kV Upgrade	8.14	9.84
6	Ox 500 kV Upgrade	1.17	1.71
7	North Delta-Northeast 230 kV	187.98	139.81
8	Conastone-Doubs 500 kV	390.28	435.50
	Total	**684.22**	**673.36**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

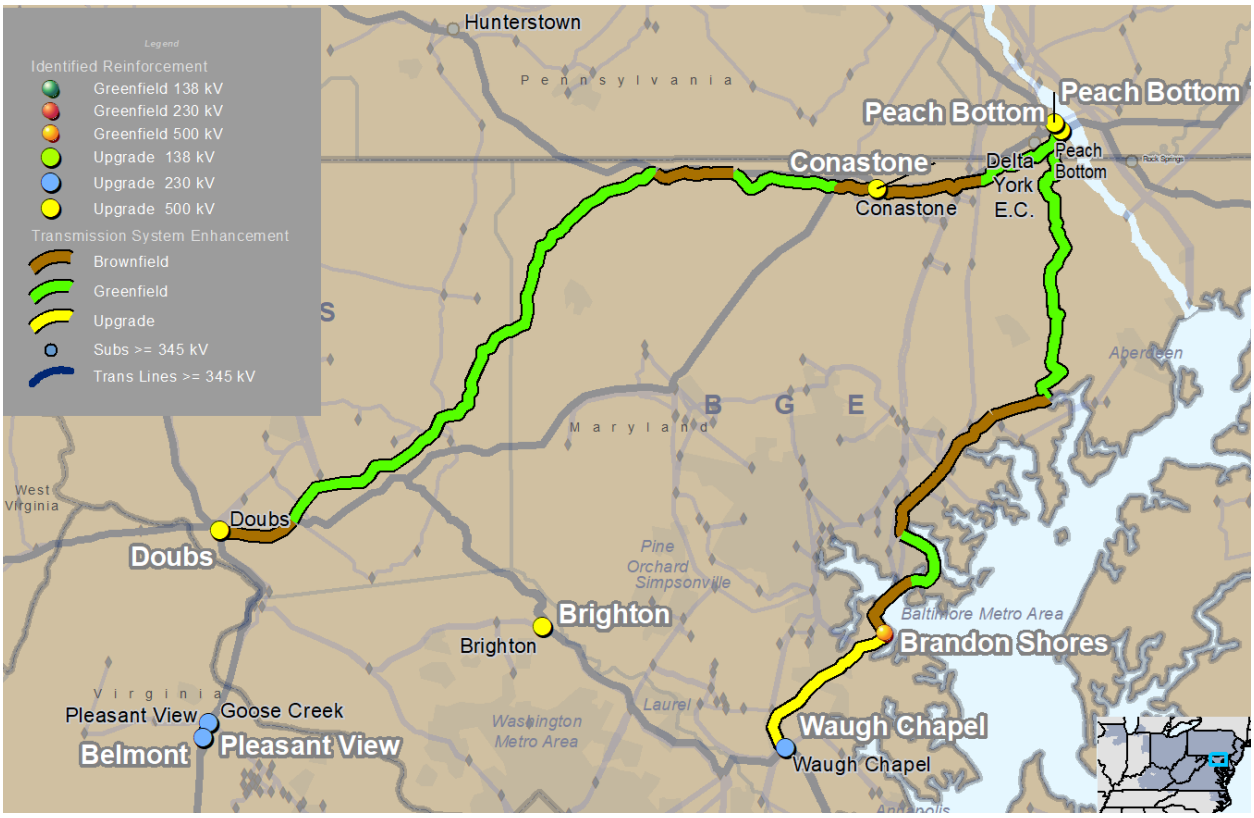
Schedule Review

The proposed in-service date of June 2027 seems to be aggressive for the proposed scope of the project, with a more conservative time required to manage ROW permitting and land acquisition risks associated with the two greenfield line routes.

Proposal 741 – PSEG

PSEG Proposal No. 741 (**Map 11**), is described as Proposal G: Peach Bottom-New Brandon Shores 500 kV; Peach Bottom-Doubs 500 kV is located within York County, Pennsylvania, and Frederick, Carroll, Baltimore, Anne Arundel, and Harford counties, Maryland, and includes new greenfield substations and lines, as well as multiple substation and line upgrades.

Map 11. Proposal 741 (see next page)



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

PSEG Proposal 741 includes 10 components, all of which are selected for the detailed evaluations.

- Component 1: New 500 kV line from Peach Bottom station to Brandon Shores station
- Component 2: New 500 kV line from Doubs Station to Peach Bottom station
- Component 3: Reconductor 230 kV line from Brandon Shores to Waugh Chapel
- Component 4: Reconductor Peach Bottom North to Peach Bottom South Tie #1 and #2
- Component 5: New Brandon Shores 500 kV station
- Component 6: Peach Bottom 500 kV upgrade
- Component 7: Doubs 500/230 kV upgrade
- Component 8: Brandon Shores 230 kV upgrade
- Component 9: Conastone/Brighton 500 kV upgrade
- Component 10: Pleasant View/Belmont 230 kV upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New 500 kV Line From Peach Bottom to Brandon Shores

This component of the proposal is for a 56-mile portion of a greenfield 500 kV overhead transmission line from the existing Peach Bottom substation to the existing Brandon Shores substation. The line is a single circuit steel monopole of either vertical or delta configuration. Part of the line passes through the urban Baltimore area. A major river crossing over the Patapsco River is required. The crossing will have 10–12 structures and will require major permitting and construction costs. Portions of this route parallel existing utility corridors, while the remainder are pure greenfield.

The ROW risk for this component is high due to the extensive greenfield nature of the proposed route.

New 500 kV Line From Doubs to Peach Bottom

This component of the proposal is for an 87-mile portion of a greenfield 500 kV overhead transmission line from the existing Doubs substation to the existing Peach Bottom substation. The line is a single circuit steel H-frame in a horizontal configuration. The line is in a mostly hilly rural area.

The ROW risk for this component is high due to the pure greenfield nature of the proposed route.

Environmental Risk Analysis

New 500 kV Line From Peach Bottom Station to Brandon Shores Station

The proposed route has the potential to impact environmental and cultural resources including: Lower Deer Creek Valley Historic District; 45 FEMA High-Risk Flood Zones; 13 waters subject to USACE Section 10 permitting; numerous streams/wetlands subject to USACE Section 404 permitting; and woodlands with the potential to serve as suitable habitat for federally listed threatened and endangered species. Tree removal restrictions will likely apply due to the likelihood of the presence of listed endangered bats. Field verification of bat habitat is needed to determine presence. Coordination with the following is recommended: MD SHPO, flood plain administrator from each county,

USACE, USFWS. Nine conservation easements are intersected by the proposed route. Coordination with easement holders will be required.

This project will require ROWs with widths of 80–85 feet in residential areas, 125–130 feet in farmland, 150 feet in farmland, and 170 feet at the Patapsco River.

Approximately 39 transmission line crossings with BG&E. Approximately six park crossings: two state parks owned by MD Department of Natural Resources, one local park crossing with Baltimore County, three local park crossings with Harford County. Approximately 32 railroad crossings with the Federal Railroad Administration. Approximately 132 road crossings (264 road entrances) in four counties.

New 500 kV Line From Doubs Station to Peach Bottom Station

Proposed route has the potential to impact environmental resources including: 19 FEMA High-Risk Flood Zones; 187 streams and 155 wetlands subject to USACE Section 404 and/or Section 10 permitting; and woodlands with the potential to serve as suitable habitat for federally listed threatened and endangered species. Impacts to these resources will require: USACE Section 404 and/or Section 10 permitting and USFWS consultation. The proposed route intersects six Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. The proposed route intersects property listed on the National Register of Historic Places – National Park Service (Chambers, Whitakker, Farms) and 46 conservation easements including Parker Conservation Area, Union Mills Reservoir Park and an unnamed local park. Coordination with entities is required.

Approximately six railroad crossings. Five are with CSXT and one is with Maryland Midland Railway (MMID). Approximately 11 transmission line crossings. Approximately 148 road crossings (296 road entrances) in five counties. Approximately one cemetery crossing. Notification/Agreement may be required with Mount Zion United Methodist Church Cemetery. Approximately two park crossings with the operator MD Department of Natural Resources.

Transmission Line Risk Analysis

For the Peach Bottom to Brandon Shores line route, river crossing is a major risk due to engineering, construction and permitting unknowns.

For both routes, conductor selection for each section may not be adequate to support the specified ratings, especially for the 500 kV line. Final conductor selection can affect span lengths, structure heights, material cost and hardware costs. ROW widths may not be adequate for the line to be reliably operated.

Substation Risk Analysis

New Brandon Shores 500 kV Substation

Brandon Shores is a proposed new 500 kV substation that will include two 500/230 kV transformers and a four breaker ring bus.

The other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 10**.

Table 10. Proposal 741 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	New 500 kV line from Peach Bottom station to Brandon Shores station	433.99	424.67
2	New 500 kV line from Doubs Station to Peach Bottom Station	464.48	574.36
3	Reconductor 230 kV line from Brandon Shores to Waugh Chapel	20.79	14.38
4	Reconductor Peach Bottom North to Peach Bottom South Tie #1 and #2	3.01	1.27
5	New Brandon Shores 500 kV station	90.05	74.79
6	Peach Bottom 500 kV Upgrade	31.75	40.95
7	Doubs 500/230 kV Upgrade	17.94	20.19
8	Brandon Shores 230 kV Upgrade	3.31	8.09
9	Conastone/Brighton 500 kV Upgrade	0.00	14.37
10	Pleasant View/Belmont 230 kV Upgrade	0.00	5.69
	Total	**1,065.32**	**1,178.75**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

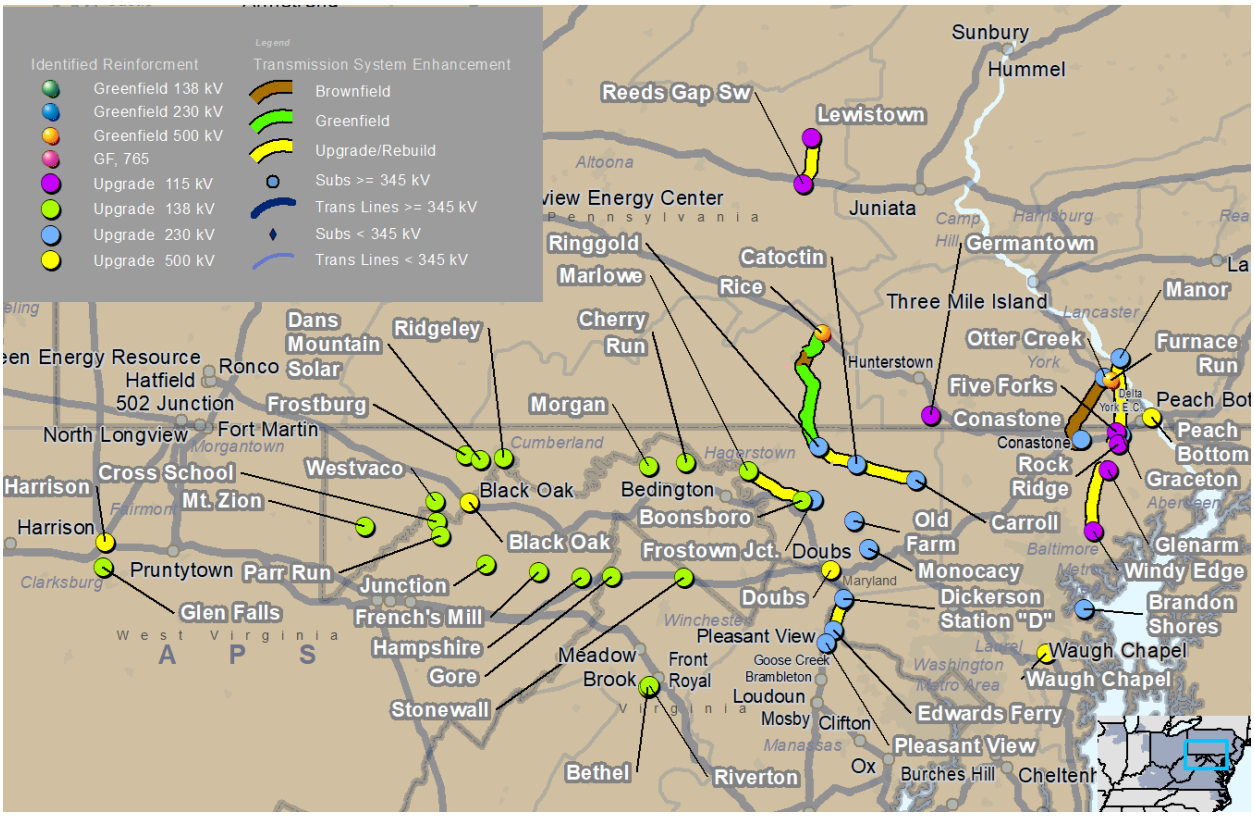
Schedule Review

The proposed in-service date of December 2028 is quite aggressive for the proposed scope of the project, considering the ROW permitting and land acquisition risks associated with the two Greenfield line routes. In particular, the permitting, engineering and construction risks anticipated with the Peach Bottom to New Brandon Shores route have potential to introduce significant schedule challenges. Overall, the schedule risk is considered medium-high.

Proposal 487 – Transource

Transource Proposal No. 487 (**Map 12**), described as the Maryland & Pennsylvania Baseline Reliability Solution, is based on the Transource IEC East and West projects (Project 9A) previously approved by PJM but currently under suspension. This project was submitted with additional incumbent upgrades to address more violations in the Maryland-Pennsylvania corridor. The IEC East components span across Harford and Baltimore counties in Maryland, and York County in Pennsylvania. The IEC West components span across Washington County in Maryland and Franklin County in Pennsylvania.

Map 12. Proposal 487



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Transource Proposal 487 includes 39 components that make up the IEC East and West proposal.

- Component 1: Rice-Ringgold 230 kV greenfield transmission line
- Component 2: Ringgold 230/138 kV station upgrade
- Component 3: Rice 500/230 kV greenfield station
- Component 4: Manor-Graceton 230 kV upgrade
- Component 5: Conastone-Otter Creek 230 kV transmission line upgrade

- Component 6: Furnace Run 500/230 kV greenfield station
- Component 7: Graceton station upgrade
- Component 8: Conastone station upgrade
- Component 9: Ringgold-Catoctin line upgrade (138 kV to 230 kV)
- Component 10: Dickerson station upgrade
- Component 11: Conemaugh-Hunterstown 500 kV line tie-in
- Component 12: Peach Bottom-Three Mile Island tie-in
- Component 13: Catoctin to Carroll line upgrade (138 kV to 230 kV)
- Component 14: Catoctin station upgrade
- Component 15: Carroll station upgrade
- Component 16: Glen Arm 2-Windy Edge 1 115 kV line upgrade
- Component 17: Five Forks-Rock Ridge 1 115 kV line upgrade
- Component 19: Peach Bottom station upgrade
- Component 21: Marlowe-Boonesboro 138 kV series reactor
- Component 22: Germantown station capacitor upgrade
- Component 23: Garrett to Garrett Tap 115 kV line upgrade
- Component 25: Dickerson-Edwards Ferry-Twin Creek-Pleasant View 230 kV rebuild and terminal equipment upgrade
- Remaining components: terminal upgrades at various stations

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New 230 kV Line From Rice to Ringgold

This component of the proposal is for a 29-mile portion of a greenfield 230 kV overhead transmission line from the new 500/230 kV Rice substation to the existing Ringgold substation. While this constitutes a greenfield route with about 42% of its ROW paralleling existing ROWs, the ROW risk for this component is medium due to the extensive permitting and acquisition that has already been completed with 70% of the required ROW obtained by the proposing entity.

Environmental Risk Analysis

Rice 500/230 kV Greenfield Station

The proposed substation footprint intersects with a Karst zone. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching.

Transmission Line Risk Analysis

A medium risk for this project involves the existing facility outages that will be necessary to perform the numerous line and terminal upgrades.

Substation Risk Analysis

Rice 500/230 kV Greenfield Station

The proposed substation, which the proposing entity already has under option for purchase, will tie into the existing Hunterstown-Conemaugh 500 kV line. The Rice station will be laid out as a three-breaker 500 kV ring bus on the 500 kV side with six single-phase 500 kV/230 kV/13.8 kV transformers for two transformer banks.

Furnace Run 500/230 kV Greenfield Station

The proposed substation, which the proposing entity already has under option for purchase, will tie into the existing TMI-Peach Bottom 500 kV line. The Rice station will be laid out as an eight-breaker 500 kV GIS in a breaker-and-a-half configuration, and a fourteen breaker 230 kV AIS in a breaker-and-a-half configuration, with three 500/230 kV transformer banks.

Other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 11**.

Table 11. Proposal 487 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Rice-Ringgold 230 kV Greenfield Transmission Line	64.55	70.00
2	Ringgold 230/138 kV Station Upgrade	14.80	16.00
3	Rice 500/230 kV Greenfield Station	31.62	35.00
4	Manor-Graceton 230 kV Upgrade	21.80	16.50
5	Conastone-Otter Creek 230 kV Transmission Line Upgrade	29.00	35.00
6	Furnace Run 500/230 kV Greenfield Station	75.82	75.00
7	Graceton Station Upgrade	9.40	9.30
8	Conastone Station Upgrade	9.00	9.30
9	Ringgold-Catoctin Line Upgrade (138 kV to 230 kV)	47.20	47.00

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
10	Dickerson Station Upgrade	1.00	1.13
11	Conemaugh-Hunterstown 500 kV line Tie-in	15.20	12.00
12	Peach Bottom-Three Mile Island Tie-in	15.20	12.00
13	Catoctin to Carroll Line Upgrade (138 kV to 230 kV)	45.51	47.00
14	Catoctin Station Upgrade	9.10	8.00
15	Carroll Station Upgrade	10.19	8.00
16	Glen Arm 2-Windy Edge 1 115 kV Line Upgrade	3.06	3.00
17	Five Forks-Rock Ridge 1 115kV Line Upgrade	7.41	7.50
19	Peach Bottom Station Upgrade	4.70	4.80
21	Marlowe-Boonesboro 138 kV Series Reactor	3.92	4.00
22	Germantown Station Capacitor Upgrade	0.72	1.00
23	Garrett to Garrett Tap 115 kV Line Upgrade	9.41	9.90
25	Dickerson-Edwards Ferry-Twin Creek-Pleasant View 230 kV Rebuild and Terminal Equipment Upgrade	28.62	35.00
Remaining Components	Terminal Upgrades at various substations	35.52	37.00
	Total	**492.75**	**503.43**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

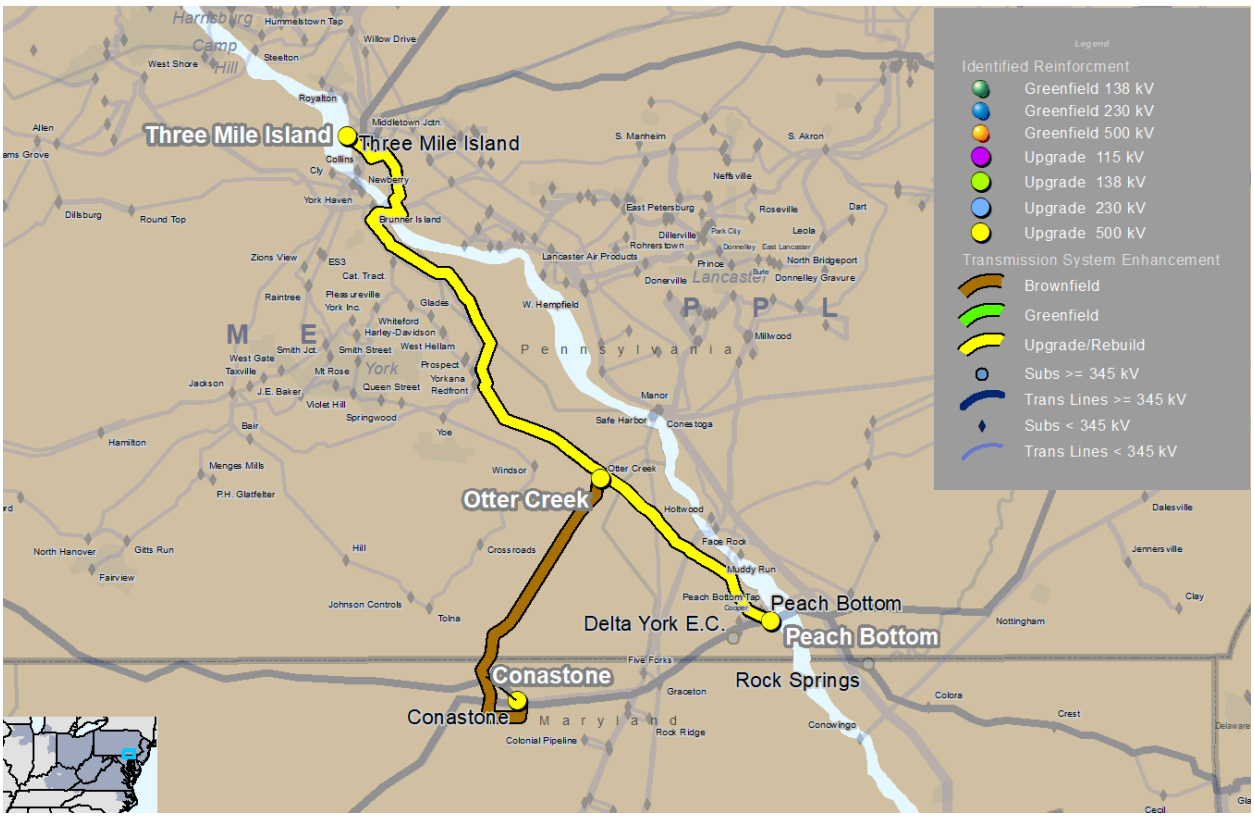
Schedule Review

The proposed in-service date of March 2027 is reasonable for the proposed scope of the project considering the extensive amount of permitting, land acquisition and equipment procurement that has already been completed for this project. Overall, this project poses a low schedule risk.

Proposal 374 – PPL

PPL Proposal No. 374 (**Map 13**), described as Otter Creek-Conastone 500 and 230 kV double circuit line, is located within York County, Pennsylvania, and Baltimore and Harford counties in Maryland and includes a greenfield substation and a greenfield double circuit transmission line.

Map 13. Proposal 374



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

PPL Proposal 374 has the following components:

- Component 1: Tap TMI-Peach Bottom 500 kV line
- Component 2: Otter Creek-Conastone 500 and 230 kV double circuit line (PPL EU section)
- Component 3: Otter Creek-Conastone 500 and 230 kV double circuit line (BGE section)
- Component 4: Otter Creek 500 kV switchyard
- Component 5: Conastone 500 kV substation upgrade
- Component 6: Peach Bottom South Yard bus upgrades

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New 500/230 kV Line From Otter Creek to Conastone

This component of the proposal is for an approximately 17-mile greenfield 230 kV overhead transmission line tie from the new Otter Creek 500 kV substation, which taps into the existing TMI to Peach Bottom 500 kV line to the existing

Conastone station. This will involve expanding existing Otter Creek-Conastone 230 kV line ROW and wrecking and rebuilding the existing 230 kV structures to accommodate a double circuit 500 kV and 230 kV line. The first 12 miles of the line from Otter Creek is owned by PPL, and about 4.76 miles of the remainder of the line to Conastone is owned by BG&E. Additional ROW will need to be acquired to widen the existing transmission line corridor from 150 feet to 200 feet.

The ROW risk for this component is medium, as this project is routed entirely within the existing ROW with the noted expansion included.

Environmental Risk Analysis

New 500/230 kV Line From Otter Creek to Conastone

Wetlands, waterbodies and high-risk flood zones appear to be crossed by project components.

Proposed project intersects with waters subject to USACE Section 404 and/or Section 10 permitting. Coordination with USACE is required for jurisdictional determination. An on-site delineation would be required to determine the actual location and extent of wetlands and waterbodies present and to assess permitting implications for jurisdictional features.

The proposed project components are within the range of both federally and state-listed species. Project components intersect with woodlands. Due to the likelihood of endangered bat species being present, tree-clearing seasonal restrictions are recommended. The project proponents should conduct an independent TE species review once the potential limits of disturbance and environmental impacts are better known. Construction restrictions, time frame or mitigation may be necessary to comply with avoidance of sensitive species; however, the extent of which cannot be known until field studies are completed and coordination with the USFWS and state wildlife agencies takes place.

The proposed project components do not intersect with historic districts. No impacts to cultural resources are anticipated.

Proposed project components intersect conservation easements. Coordination with easement holders is anticipated.

It is anticipated that the proposal could require permits, consultations, clearances and authorizations from three counties in Maryland (Baltimore & Harford) and Pennsylvania (York). State PSC approval, CPCN and DOT utility permits and driveway/local road permits may be required with about 31 road crossings estimated.

Transmission Line Risk Analysis

Given the extensive reuse of existing ROW for this proposal, transmission line construction risks are low and limited to concerns with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence, and potential design limitations for reuse of existing infrastructure/assets.

Other moderate risks for this project involve the existing facility outages that will be necessary for the project, particularly for the line rebuild and substation upgrades.

Substation Risk Analysis

New Otter Creek 500 kV Substation

Otter Creek is a proposed new 500 kV substation tapped into the TMI-Peach Bottom 500 kV line that will include a double-bus double-breaker design with two bays and three breakers with a location for one future breaker.

Other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 12**.

Table 12. Proposal 374 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Tap TMIS-Peach Bottom 500 kV line	6.33	6.00
2	Otter Creek-Conastone 500 and 230 kV double circuit line (PPL EU Section)	77.40	74.23
3	Otter Creek-Conastone 500 and 230 kV double circuit line (BGE Section)	29.95	30.60
4	Otter Creek 500 kV Switchyard	30.44	41.87
5	Conastone 500 kV Substation upgrade	8.86	7.98
6	Peach Bottom South Yard bus upgrades	1.24	2.00
	Total	**154.21**	**162.69**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

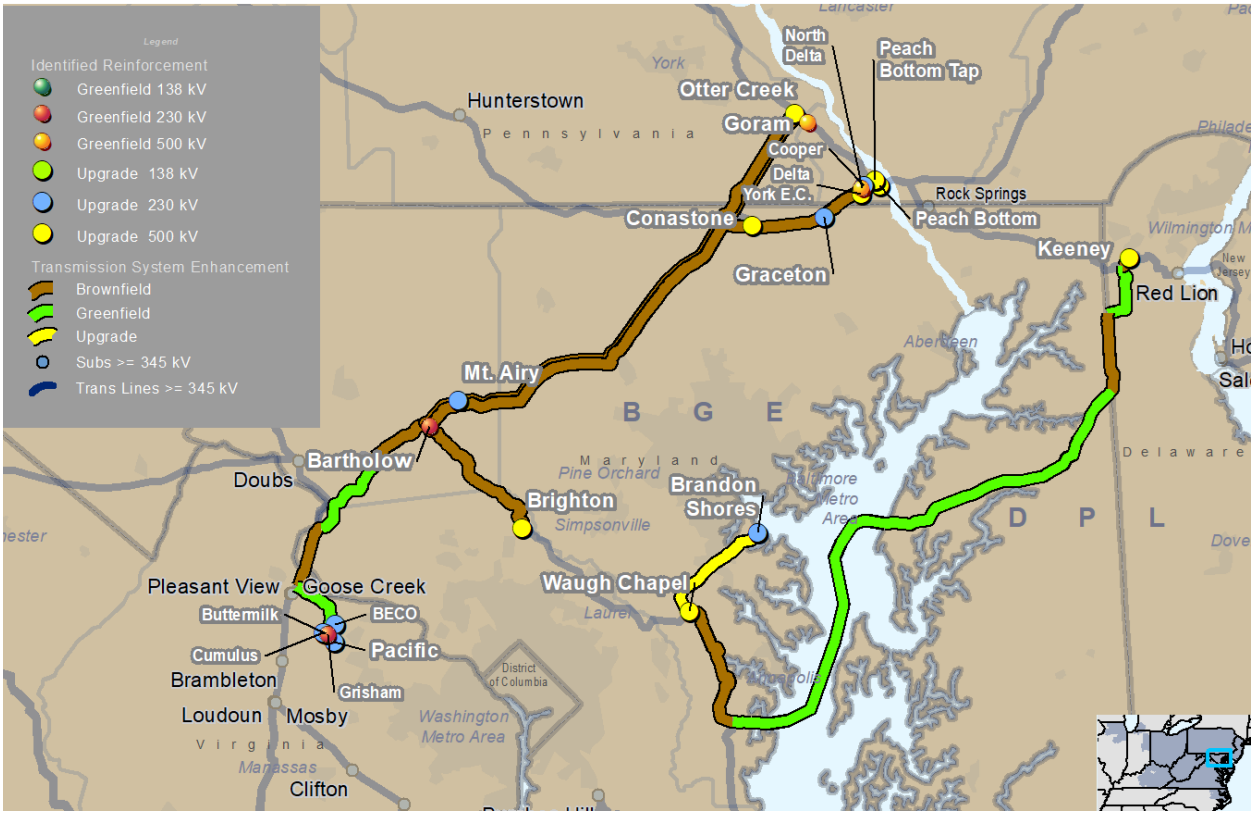
Schedule Review

The proposed in-service date of May 2027 is reasonable for the proposed scope of the project, given the extensive use of the incumbent's existing ROW for the new line construction.

Proposal 948 – NextEra

NextEra Proposal No. 948 (**Map 14**), described as New 500/230 kV Bartholow substation, new 500/230 kV North Delta substation, new 230 kV Grisham switchyard, new 500/230 kV Goram substation, and Keeney to Waugh Chapel tie-in, is located York County, Pennsylvania; Frederick, Montgomery, Anne Arundel, Kent, Baltimore, Cecil, Carroll and Harford counties, Maryland; Loudoun County, Virginia; and New Castle County, Delaware, and includes new greenfield substations and lines, as well as multiple substation and line upgrades.

Map 14. Proposal 948



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

NextEra Proposal 948 includes the following components:

- Component 1: 24e – North Delta to Cooper 230 kV rebuild
- Component 2: 24f – North Delta to Graceton 230 kV rebuild
- Component 3: 26A – New 500 kV transmission line from new North Delta substation to BGE's Conastone substation
- Component 4: 40AB1 – New two single circuit 230 kV transmission lines from new Bartholow substation to new Grisham substation
- Component 5: 27d – North Peach Bottom to South Peach Bottom 500 kV upgrade

- Component 6: 39H1 – New Grisham substation – 6 terminal
- Component 7: 45F1 – New Bartholow substation – 12 terminal
- Component 8: 26b2 – New North Delta substation – 10 terminal
- Component 9: 26c2 – Conastone substation 500 kV and 230 kV substation expansion
- Component 10: 39h1a – Nimbus to Buttermilk 230 kV loop in/out work
- Component 11: 39h1b – Pacific to Beco 230 kV loop in/out work
- Component 12: 47ab – New 230 kV transmission from new Goram substation to existing Otter Creek substation
- Component 13: 47abc – New 500 kV transmission line from new Goram substation to new Bartholow substation
- Component 14: 47ad – New 230 kV transmission line from existing Otter Creek substation to new Bartholow substation
- Component 15: 47b – New double circuit 230 kV transmission from the existing Conastone substation to new Bartholow substation
- Component 16: 47A – New Goram substation
- Component 17: 47ax– Loop in Conastone to Brighton 500 kV line to new Bartholow substation
- Component 18: 43EF – Mt Airy 230 kV substation single breaker expansion
- Component 19: 43e – New 230 kV transmission line from new Bartholow substation to existing Mt. Airy substation
- Component 20: 48b – Two (2) new 230 kV single circuit transmission lines from the existing Keeney substation to existing Waugh Chapel substation
- Component 21: 47ac – Otter Creek 230 kV four circuit breaker expansion
- Component 22: 48C – Keeney substation two new 230 kV terminations
- Component 23: 48d – Waugh Chapel substation two new 230 kV terminations
- Component 24: 50B – Peach Bottom to North Delta 500 kV upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

26A – New 500 kV Transmission Line From New North Delta Substation to BGE's Conastone Substation

This component of the proposal is for an approximate 15-mile portion of new 500 kV overhead transmission line from new North Delta substation to BGE's Conastone substation. The line will largely travel within new ROW between North Delta and Conastone.

40AB1 – New Two Single Circuit 230 kV Transmission Lines From Bartholow to Grisham Substation

This component of the proposal is for an approximate 35-mile portion of two new 230 kV overhead and underground transmission lines from new Bartholow substation to new Grisham substation. The two lines will travel on single circuit structures within new ROW for approximately 60% of the route length. The ROW will be an expansion of existing ROWs for approximately 35% of the route length, while approximately 5% of the route will be underground in narrower and congested areas.

47ab – New 230 kV Transmission From New Goram Substation to Existing Otter Creek Substation

This component of the proposal is for an approximate 1-mile 230 kV greenfield overhead transmission line from the new Goram substation to the existing Otter Creek substation. The line will travel on single circuit structures within new ROW.

47abc – New 500 kV Transmission Line From New Goram Substation to New Bartholow Substation
This component of the proposal is for an approximate 61-mile 500 kV greenfield overhead transmission line from the new Goram substation to the new Bartholow substation. The line will travel on new single circuit monopoles within a new ROW as part of expanded easement alongside existing ROW.

47ad – New 230 kV Transmission Line From Existing Otter Creek Substation to New Bartholow Substation
This component of the proposal is for an approximate 61-mile 230 kV greenfield overhead transmission line from the existing Otter Creek substation to the new Bartholow substation. The line will largely travel on new single circuit monopoles within a new ROW as part of expanded easement alongside existing ROW.

47b – New Double Circuit 230 kV Transmission From the Existing Conastone Substation to New Bartholow Substation
This component of the proposal is for an approximate 48-mile 230 kV greenfield overhead transmission line double circuit project from existing Conastone substation to new Bartholow substation. The line will largely travel on new double circuit monopoles within a new ROW as part of expanded easement alongside existing ROW.

43e – New 230 kV Transmission Line From New Bartholow Substation to Existing Mt. Airy Substation
This component of the proposal is for an approximate 5-mile 230 kV greenfield overhead transmission line from the new Bartholow substation to the existing Mt. Airy substation. The line will largely travel on new single circuit monopoles within a new ROW as part of expanded easement alongside existing ROW.

48b – Two New 230 kV Single Circuit Transmission Lines From Existing Keeney to Existing Waugh Chapel Substation
This component of the proposal is for an approximate 104-mile section of 230 kV line with 34 miles of submarine cable, and roughly 70 miles of new 230 kV overhead transmission from the existing Keeney substation to the existing Waugh Chapel substation. The two single circuit 230 kV lines will be staggered and offset to utilize the same ROW width as a 230 kV double circuit design. The submarine cable will be used to cross the Chesapeake Bay. The ROW will have its own corridor for approximately 85% of the route length. The ROW will be an expansion of an existing transmission corridor for approximately 15% of the route length. Approximately 30% of the route will be submarine.

Overall, the ROW risk for components in this proposal is high due to the extensive greenfield nature of the proposed new transmission line routes.

Environmental Risk Analysis

48b – Two New 230 kV Single Circuit Transmission Lines From Existing Keeney to Existing Waugh Chapel Substation
The proposed route has the potential to impact environmental and cultural resources including New Castle and Frenchtown Railroad ROW, Delaware Boundary Markers, Odessa Historic District (Boundary Increase), and Cooch's Bridge Historic District (Boundary Decrease).

Fifty-seven designated high-risk flood zones, 156 streams and 225 wetlands subject to USACE Section 404 and/or Section 10 permitting are required for crossing the Chesapeake Bay and woodlands with the potential to serve as suitable habitat for federally listed threatened and endangered species.

Coordination with the USACE; USFWS; National Park Service; SHPO (PA); and the county flood plain administrator from New Castle County, Pennsylvania; Cecil County, Kent County, Anne Arundel County, and Queen Anne's County, Maryland, will be required. Proposed route intersects 23 conservation easements and 13 parks/conservation areas. Coordination with easement holders will be required.

New Castle and Frenchtown railroad ROW, Delaware boundary markers, Odessa Historic District (boundary increase), and Cooch's Bridge Historic District (boundary decrease) are intersected by the proposed route.

47abc – New 500 kV Transmission Line From New Goram Substation to New Bartholow Substation
The proposed route has the potential to impact environmental resources including 13 designated high-risk flood zones, 96 streams, and 150 wetlands subject to USACE Section 404 and/or Section 10 permitting, and woodlands with the potential to serve as suitable habitat for federally listed threatened and endangered species.

Coordination with the USACE; USFWS; MD Dept. of Natural Resources; and the county flood plain administrator from Frederick County, Carroll County, Baltimore County, Maryland; and York County, Pennsylvania, will be required.

Proposed route intersects 45 conservation easements. Coordination with easement holders: Maryland Rural Legacy Program; Maryland Environmental Trust; Maryland Agricultural Land Preservation Foundation; NRCS - Admin State PA; Pennsylvania State Government; York County Agricultural Land Preservation Program, Pennsylvania; York County, Pennsylvania; Pennsylvania Department of Agriculture - Farmland Preservation Program; unknown local government will be required.

The proposed route intersects with parks/conservation areas including: Morgan Run Natural Environment Area (MD Department of Natural Resources). Coordination is recommended to determine construction constraints such as special-use permits, construction timing during public use, sound and/or noise considerations, traffic plans and restoration requirements.

New Grisham 230 kV Substation
Proposed location of the Grisham substation appears to intersect with wetlands.

Transmission Line Risk Analysis

48b – Two New 230 kV Single Circuit Transmission Lines From Existing Keeney to Existing Waugh Chapel Substation
Significant engineering, permitting and constructions risks anticipated for the proposed Keeney to Waugh Chapel line route, particularly the 34 miles of submarine line required to cross the Chesapeake Bay. Cable supply constraints are also a significant concern for this proposed route with cost and schedule risks associated with this component.

Substation Risk Analysis

New Grisham 230 kV Substation
Grisham is a proposed new three-bay breaker-and-a-half 230 kV substation to be connected by tapping Pacific to BECO and Buttermilk to Nimbus 230 kV lines. The proposed scope includes looping in and out existing Buttermilk to Nimbus and Pacific to BECO 230 kV lines and terminating two new single circuit 230 kV lines from new Bartholow (T-Point) substation. Major equipment proposed for the new Grisham 230 kV (breaker-and-a-half) switchyard includes three bays, six line terminals, two 150 MVAR shunt capacitor banks, one -300 to +500 MVAR Static VAR

Compensator (SVC), and eleven 230 kV, 5000A, 80 kAIC breakers. The capacitor banks are proposed to be installed on the east bus, and the SVC is proposed to be installed on the west bus.

New Bartholow 230 kV Substation

Bartholow is a proposed new 500-230 kV substation near the location where Conastoane-Brighton and Doubs-Brighton 500 kV lines form a "T-Point." The proposed substation will include two 500/230 transformer banks, a 500 kV switchyard, and a 230 kV breaker-and-a-half switchyard. The new 500 kV switchyard is proposed to be built with three bays, six line terminals, twelve 500 kV, 5000A, 63 kAIC breakers, two shunt 150 MVAR capacitor banks, one -300 to +500 MVAR Static VAR Compensator (SVC), and two 500-230 kV transformer banks. The new breaker-and-a-half 230 kV switchyard is proposed to be built with three bays, six line terminals, and eleven 230 kV, 5000A, 80 kAIC breakers. The proposal includes looping in of existing 500 kV Conastone-Brighton and existing 500 kV Doubs-Brighton lines and termination of one new 500 kV line and six new 230 kV lines.

New Goram 230 kV Substation

Goram is a proposed new 500 kV breaker-and-a-half switchyard to be constructed near existing Otter Creek substation with two bays, three line terminals, six 500 kV, 5000A, 63 kAIC breakers, one 500/230 kV transformer bank, and one 230 kV, 5000A, 80 kAIC breaker. It is also proposed to loop in existing 500 kV Peach Bottom-Three Mile Island line, terminate one new 500 kV line, and terminate one new 230 kV line to existing Otter Creek.

The other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering, and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 13**.

Table 13. Proposal 948 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	24e – North Delta to Cooper 230 kV rebuild	1.84	3.49
2	24f – North Delta to Graceton 230 kV rebuild	15.93	43.47
3	26A – New 500 kV transmission line from new North Delta substation to BGE's Conastone substation.	76.24	106.22
4	40AB1 – New two single circuit 230 kV transmission lines from new Bartholow substation to new Grisham substation	273.05	350.14
5	27d – North Peach Bottom to South Peach Bottom 500 kV upgrade	1.51	1.72
6	39H1 – New Grisham Substation – 6 terminal	40.92	135.78
7	45F1 – New Bartholow Substation – 12 terminal	99.29	221.49
8	26b2 – New North Delta Substation – 10 terminal	71.44	90.83
9	26c2– Conastone substation 500 kV and 230 kV substation expansion	2.80	10.54
10	39h1a – Nimbus to Buttermilk 230 kV loop in/out work	5.00	2.61
11	39h1b – Pacific to Beco 230 kV loop in/out work	5.00	2.61
12	47ab – New 230 kV transmission from new Goram substation to existing Otter Creek substation	2.37	9.27
13	47abc – New 500 kV transmission line from new Goram substation to new Bartholow substation	165.08	415.13
14	47ad – New 230 kV transmission line from existing Otter Creek substation to new Bartholow substation	141.43	267.93
15	47b – New double circuit 230 kV transmission from the existing Conastone substation to new Bartholow substation	142.21	204.43
16	47A – New Goram substation	53.27	72.89
17	47ax – Loop in Conastone to Brighton 500 kV line to new Bartholow substation	5.00	6.22
18	43EF – Mt Airy 230 kV substation single breaker expansion	2.80	5.71
19	43e – New 230 kV transmission line from new Bartholow substation to existing Mt. Airy substation	11.87	23.91
20	48b – Two new 230 kV single circuit transmission lines from the existing Keeney substation to existing Waugh Chapel substation	4250.00*	4250.00*
21	47ac – Otter Creek 230 kV four circuit breaker expansion	1.40	12.06
22	48C – Keeney substation two new 230 kV terminations	5.00	10.01
23	48d – Waugh Chapel substation two new 230 kV terminations	2.80	8.96
24	50B – Peach Bottom to North Delta 500 kV Upgrade	5.00	10.47
	Total	**5,381.25**	**6,265.88**

**Note: The cost estimate for the Component 20 for Keeney – Waugh Chapel was revised by the proposing entity from $490 M to $4,250 M due to cost estimation error, which raised the overall proposal cost estimate from $1,622 M to $5,381 M.*

The total proposal cost estimate is within 10–20% of the independent cost estimate and is considered medium risk.

Schedule Review

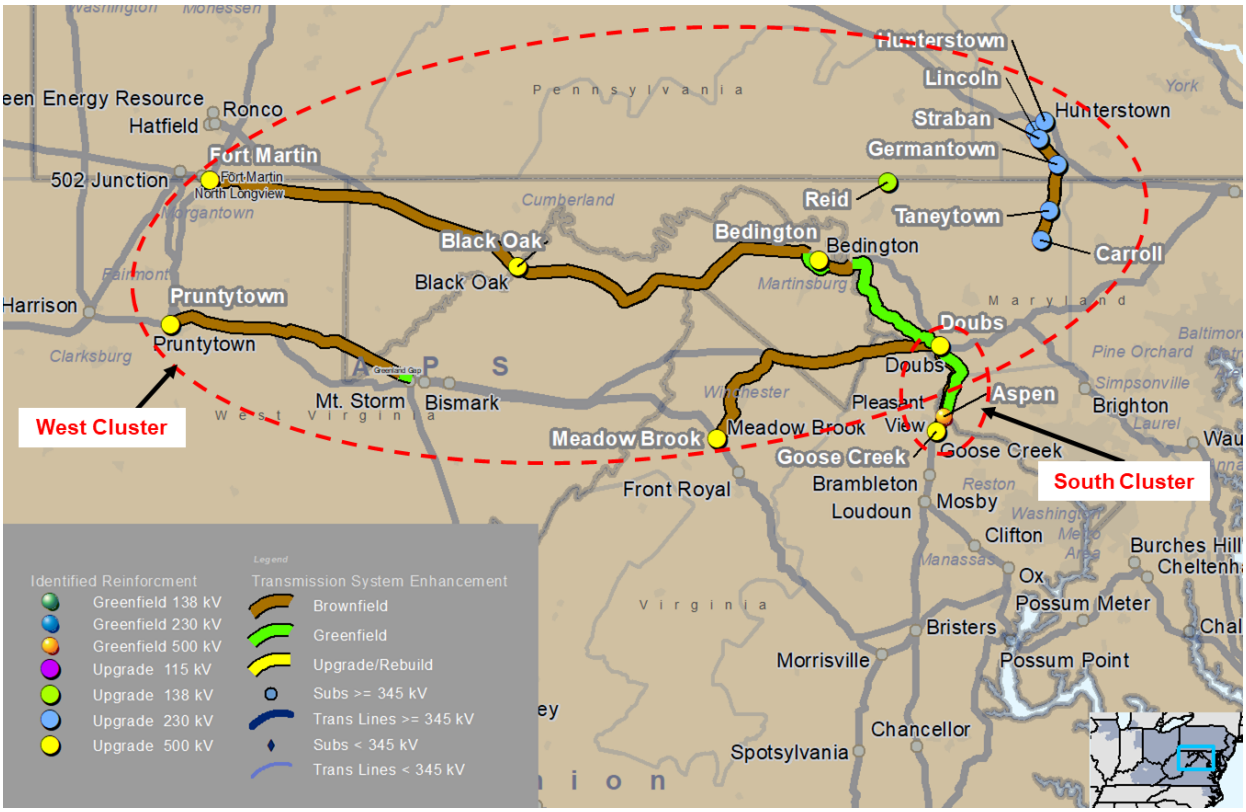
The proposed in-service date of June 2028 is very aggressive for the proposed scope of the project, considering the significant permitting, engineering and construction and land acquisition risks associated with the greenfield line routes. In particular, the permitting, engineering and construction risks anticipated with the Keeney to Waugh Chapel route has the potential to introduce significant schedule challenges. Overall, the schedule risk is considered high.

West Proposal Cluster

Proposal 837 (West) – FirstEnergy (Potomac Edison)

FirstEnergy Proposal No. 837 (**Map 15**), described as Data Center Reinforcement Proposal No. 1, has 30 components, which PJM has grouped into West and South clusters. Specifically for the West cluster, FirstEnergy proposed components in multiple counties across Pennsylvania, West Virginia, Virginia and Maryland, and includes new greenfield lines, as well as multiple substation upgrades.

Map 15. Proposal 837



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

FirstEnergy Proposal 837 includes the following components for the West Cluster:

- Component 1: Doubs substation – Install 500 kV breaker
- Component 2: Doubs substation – Expand 500 kV switchyard
- Component 3: Meadow Brook substation – Expand 500 kV switchyard
- Component 4: Fort Martin substation – Install 500 kV breaker
- Component 5: Pruntytown substation – Expand 500 kV switchyard
- Component 6: Bedington substation – Rebuild & Install 600 MVAR STATCOM
- Component 7: Fort Martin-Doubs 500 kV No. 1 line
- Component 8: Meadow Brook-Doubs 500 kV line
- Component 9: Meadow Brook-Pruntytown 500 kV line
- Components 10–13: Relaying Upgrades – Various stations
- Components 14–15: Overduty Breaker Replacements – Doubs & Pruntytown
- Components 18–30: Carroll-Hunterstown 230 kV line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Fort Martin to Doubs 500 kV OH Line

This component of the proposal is for a single circuit 158-mile greenfield 500 kV overhead transmission line from the existing Fort Martin substation to the existing Doubs substation. The project is located across West Virginia, Virginia and Maryland. The new 500 kV is assumed to parallel an existing ROW for 85.6 miles of the route and has its own ROW that is not adjacent to any existing ROW for approximately 74.4 miles. The terrain for the route is hilly and passes through state and national parks, which may require alternative access route and construction methods.

Meadow Brook to Doubs 500 kV OH Line

This component of the proposal is for a 55.3-mile single circuit greenfield 500 kV overhead transmission line from the existing Meadow Brook substation to the existing Doubs substation. The project is located across West Virginia, Virginia and Maryland. The new 500 kV is assumed to parallel an existing ROW for 22.8 miles of the route and has its own ROW that is not adjacent to any existing ROW for approximately 32.5 miles. The terrain for the route is hilly and passes through state and national parks, which may require alternative access route and construction methods.

Meadow Brook to Pruntytown 500 kV OH Line

This component is for a 50.8-mile new 500 kV transmission line from the existing Pruntytown substation to the structure just north of the existing Mt. Storm substation. It will then cut the existing Meadow Brook to Mt. Storm line and connect to Pruntytown substation to create the new Meadow Brook to Pruntytown line. The project is located across West Virginia and Maryland. The new 500 kV is assumed to parallel an existing ROW for 14.5 miles of the route and has its own ROW that is not adjacent to any existing ROW for approximately 36.3 miles.

Hunterstown to Carroll 230 kV OH Line

This component is for a 24.3-mile new 230 kV overhead transmission line from the existing Hunterstown substation to the existing Carroll substation, using single circuit tubular steel monopole suspension structures. The project spans across Carroll County, Maryland, and Adams County, Pennsylvania. The new line will use the existing ROW of the 115/138 kV transmission corridor from Hunterstown-Lincoln-Germantown-Carroll substations. No additional ROW is required for this proposed line route.

Overall, the ROW risk for the new transmission line components in this proposal is medium-high to high, as the proposed new transmission lines are routed parallel to an existing ROW for most of their alignment, or use entirely new ROW, with the exception of the Hunterstown to Carroll 230 kV line that is an entirely brownfield development.

Environmental Risk Analysis

Fort Martin to Doubs 500 kV OH Line

The proposed route intersects floodways, flood plains, wetlands, navigable waters and public lands, and as a result, permitting is expected to be a lengthy process. This route crosses Cheat and Sleepy Creek lakes, and the Potomac River, and also goes through several national scenic and historic trails (South Mountain State Park and the Appalachian Scenic Trail), historical areas (Antietam, Harpers Ferry and Sharpsburg), intersects public lands, and crosses the Chesapeake and Ohio Canal National Historical Park. This may require permission from the National Park Service (NPS) and require an Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA) to analyze the impacts to the environment and park resource, which could be a lengthy process. Route crosses MD Department of Natural Resource (DNR)-recognized public lands and is also within a short distance of residential areas.

Meadow Brook to Doubs 500 kV OH Line

The proposed route crosses the Potomac River, and also goes through several national scenic and historic trails (Harpers Ferry National Historical Park and the Appalachian Scenic Trail), intersects public lands and conservation easements, and intersects the Chesapeake and Ohio Canal National Historical Park. This may require permission from the National Park Service (NPS) and require an Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA) to analyze the impacts to the environment and park resource, which could be a lengthy process. This route is also within a short distance of residential and commercial areas.

Meadow Brook to Pruntytown 500 kV OH Line

This route crosses national forests in West Virginia and is within a short distance of residential areas.

Medium-high constructability risks assessed for the proposed line routes due to anticipated lengthy regulatory process, potential public opposition, construction difficulty, environmental constraints and property acquisition, which may have significant impacts on the cost and schedule for the proposed project.

Transmission Line Risk Analysis

Significant engineering and construction challenges anticipated for the Ft Martin-Doubs line to construct a 158-mile transmission line through three states, and will require parallel crews and construction where possible to mitigate schedule challenges that will be introduced by the anticipated lengthy permitting process. This is also true, although to a lesser extent, for the Meadow Brook to Doubs and Meadow Brook to Pruntytown lines.

Substation Risk Analysis

The substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 14**.

Table 14. Proposal 837 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Doubs Substation – Install 500 kV Breaker	4.72	5.41
2	Doubs Substation – Expand 500 kV Switchyard	14.44	16.65
3	Meadow Brook Substation – Expand 500 kV Switchyard	16.55	17.88
4	Fort Martin Substation – Install 500 kV Breaker	6.04	5.41
5	Pruntytown Substation – Expand 500 kV Switchyard	28.21	26.32
6	Bedington Substation – Rebuild & Install 600 MVAR STATCOM	131.38	219.32
7	Fort Martin – Doubs 500 kV #1 Line	1445.81	1502.52
8	Meadow Brook – Doubs 500 kV Line	460.60	275.45
9	Meadow Brook – Pruntytown 500 kV Line	418.59	245.99
10-13	Relaying Upgrades – Various Stations	8.27	8.14
14-15	Overduty Breaker Replacements – Doubs & Pruntytown	116.33	116.67
18-30	Carroll-Hunterstown 230 kV Line	137.45	202.30
	Total	**2,788.40**	**2,642.05**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

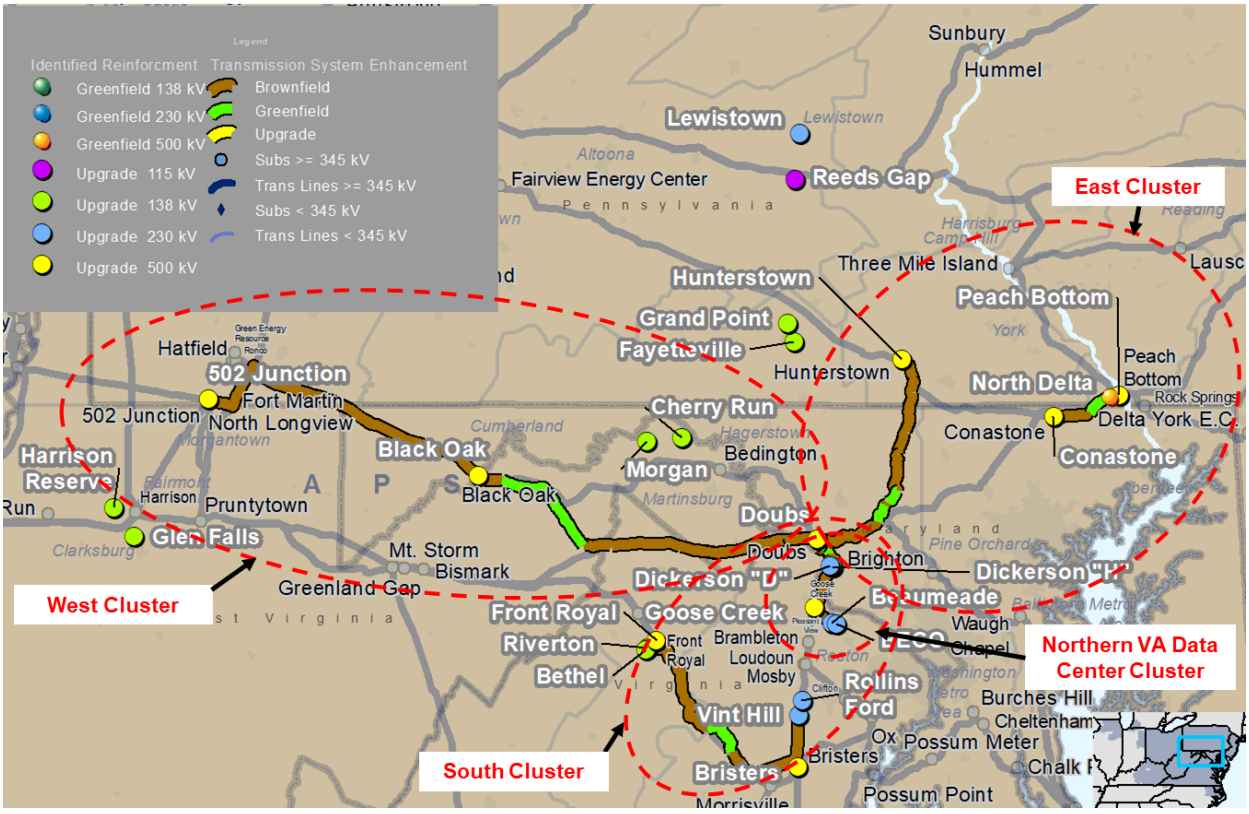
Schedule Review

The proposed in-service date of June 2030, although more reasonable compared to other West cluster proposals of similar scale, is still aggressive for the proposed scope of the project, considering the significant permitting and land acquisition challenges associated with the three proposed 500 kV greenfield line routes through three states. Overall, the schedule risk is considered medium.

Proposal 548 (West) – LS Power

LS Power Proposal No. 548 (**Map 16**), described as RTEP Window 3 Solution, provides a holistic solution to the RTEP Window 3 needs, comprising 37 components that can be grouped into the four regional clusters identified for the window. Specifically for the West cluster, LS Power proposed components in multiple counties across Pennsylvania, West Virginia, Virginia and Maryland and includes new greenfield lines as well as multiple substation upgrades.

Map 16. Proposal 548 (see next page)



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

LS Power Proposal 548 includes the following components for the West Cluster:

- Component 7: 502 Junction substation upgrade
- Component 9: Black Oak substation upgrade
- Component 11: Doubs substation upgrade
- Component 25: 502 Junction-Black Oak 500 kV transmission line
- Components 26 and 29: Black Oak-Doubs Greenfield 500 kV transmission line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

502 Junction-Black Oak 500 kV OH Line

This component of the proposal is for a 73-mile single circuit greenfield 500 kV overhead transmission line from the existing 502 Junction substation to the existing Black Oak substation. The line parallels existing 500 kV ROWs for the entirety of the line, outside of a few short sections to route around constraints adjacent to the existing corridor.

Black Oak to Doubs 500 kV OH Line

This component of the proposal is for an 83-mile single circuit, partially greenfield 500 kV overhead transmission line from the existing Black Oak substation to the existing Doubs substation. The line parallels existing 500 kV ROWs for of the first 31 miles of the line, outside of a 10-mile section to route around constraints adjacent to the existing corridor. At the 32-mile mark, the line route will then involve a rebuild of the existing Hampshire to Stonewall 138 kV line, Stonewall to Millville 138 kV, and Millville to Doubs 138 kV lines as 500/138 kV line until a few spans outside of Doubs substation. At that point, the 500 kV circuit will diverge from the 138 kV centerline to connect to Doubs as single circuit 500 kV. The proposing entity assumes that the entire 52 miles of the 500/138 kV underbuilt development will fit entirely within the existing ROW. This assumption was not researched by the proposing entity with a high degree of confidence, and there is reasonable risk that this underbuilt segment will require additional ROW to accommodate the 500/138 kV double circuit structures.

Overall, the ROW risk for the new West cluster transmission line components in this proposal is medium-high, as the proposed new transmission lines are routed parallel to an existing ROW for majority of their alignment.

Environmental Risk Analysis

502 Junction-Black Oak 500 kV OH Line

Route crosses Pennsylvania and MD Department of Natural Resource (DNR)-recognized public lands and is also within a short distance of residential areas.

Black Oak to Doubs 500 kV OH Line

The proposed route crosses the Potomac River and goes through several national scenic and historic trails (Harpers Ferry National Historical Park and the Appalachian Scenic Trail), intersects public lands and conservation easements, and intersects the Chesapeake and Ohio Canal National Historical Park. This may require permission

from the National Park Service (NPS) and require an Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA) to analyze the impacts to the environment and park resource, which could be a lengthy process. This route is also within a short distance of residential and commercial areas.

Medium-high constructability risks assessed for the proposed line routes due to anticipated lengthy regulatory process, potential public opposition, construction difficulty, environmental constraints and property acquisition, which may have significant impacts on the cost and schedule for the proposed project.

Transmission Line Risk Analysis

Significant engineering and construction challenges anticipated for the proposed lines to construct a total of 156 miles of new transmission through four states and will require parallel crews and construction where possible to mitigate schedule challenges that will be introduced by the anticipated lengthy permitting process.

For the rebuild portions of the proposed line routes, there are challenges with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence and potential design and ROW limitations for reuse of existing infrastructure/assets.

Other medium risks for this project involve the existing facility outages that will be necessary for the project, particularly for the line rebuild, and substation upgrades.

Substation Risk Analysis

The substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 15**.

Table 15. Proposal 548 (West) Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
7	502 Junction Substation Upgrade	7.56	9.94
9	Black Oak Substation Upgrade	11.35	13.20
11	Doubs Substation Upgrade	17.02	24.00
25	502 Junction-Black Oak 500 kV Transmission Line	458.92	335.91
26	Black Oak-Doubs Greenfield 500 kV Transmission Line	200.02	173.55
29	Black Oak-Doubs Greenfield 500 kV Transmission Line (Shared ROW)	277.84	319.42
	Total	**972.71**	**876.03**

The total proposal cost estimate is more conservative than the independent cost estimate and is considered low risk.

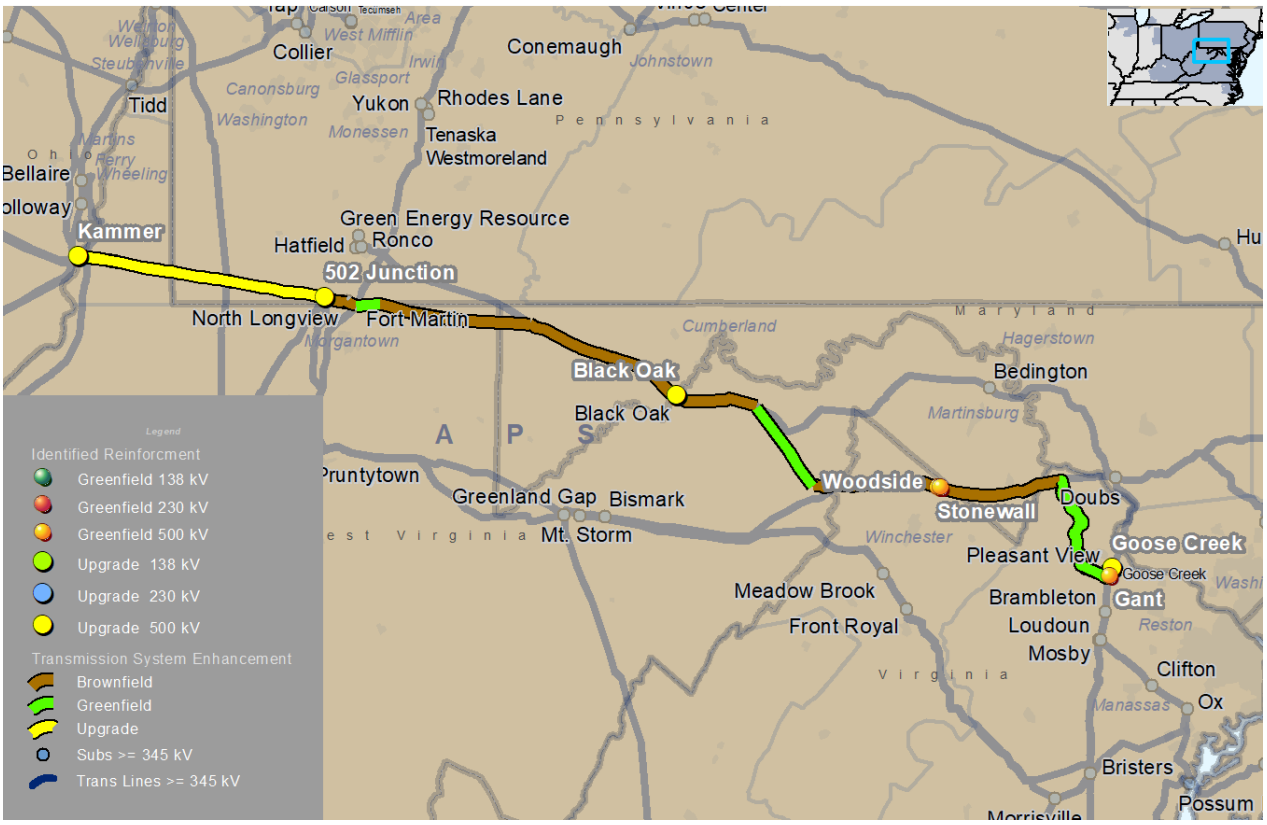
Schedule Review

The proposed in-service date of June 2030, although more reasonable compared to other West cluster proposals of similar scale, is still aggressive for the proposed scope of the project considering the significant permitting and land acquisition challenges associated with the two proposed 500 kV greenfield line routes through four states. Overall, the schedule risk is considered medium.

Proposal 853 – NextEra

NextEra Proposal No. 853 (**Map 17**), described as 502 Junction-Black Oak-Woodside-Gant, Woodside SVC + Cap Banks, includes components in multiple counties across Pennsylvania, West Virginia, Virginia and Maryland and includes new greenfield lines and substations as well as multiple substation upgrades.

Map 17. Proposal 853



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

NextEra Proposal 853 includes the following components for the West cluster:

- Component 1: 4CA – New 500 kV transmission line from existing Black Oak substation and new Woodside substation
- Component 2: 10C1A – New 500 kV transmission line from new Woodside substation to new Gant substation (Segment 1)
- Component 3: 23s5 – New Woodside Substation – 6 terminal
- Component 4: 23sb – Stonewall substation two 138 kV breaker expansion
- Component 5: 04AE – Black Oak substation 500 kV six breaker and new transformer expansion
- Component 6: 10C3 – New 500 kV line between new Woodside substation and new Gant substation (Segment 2)
- Component 7: 39a3 – New Gant substation – 3 terminal
- Component 8: 46a – New 500 kV line from existing 502 Junction substation to existing Black Oak substation
- Component 9: 46b – 502 Junction substation two 500 kV circuit breaker expansion
- Component 10: 46b1 – Kammer to 502 Junction 500 kV upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

46a – 502 Junction to Black Oak OH 500 kV Line

This component of the proposal is for a single circuit 67-mile 500 kV overhead transmission line from the existing 502 substation to the existing Black Oak substation. The project follows an existing transmission ROW, paralleling 502 Jct-Ft Martin 500 kV, then West Run-Lake Lynn-Hazelton-Jennings 138 kV, and then Black Oak-Hatfield 500 kV, only deviating from the existing ROW to route around potential conflict areas. The ROW width for the project will be 165 ft. and will be an expansion of the existing transmission corridor, and this additional ROW width will be reduced to a 75 ft. row for about 5% of the line due to ROW constraints.

4CA – Black Oak to Woodside OH 500 kV Line

This component of the proposal is for a single circuit 53-mile 500 kV overhead transmission line from the new Black Oak substation to the Woodside substation. The line utilizes existing ROW, paralleling Black Oak-Bedington 500 kV, then Hampshire-Ridgeley 138 kV, Hampshire-Gore 138 kV, and then Doubs-Bismark 500 kV up to Gore substation. Starting at Gore, the Gore-Stonewall 138 kV line is rebuilt as a 500/138 kV double circuit for 15 miles to the new Woodside substation. The ROW width will range between 125 ft.–165 ft. depending on location.

10C1A – Woodside to Gant (Segment 1) OH 500 kV Line

This component of the proposal is for a single circuit 22-mile 500 kV overhead transmission line from the new Woodside substation to the point east of the Appalachian Trail where the component 10C3 Segment 2 of the Woodside to Gant line begins to continue the route to Goose Creek substation. For approximately 80% of the route, the line uses existing ROW, rebuilding the Stonewall-Feagan's Mill-Millville-Lovettsville 138 kV lines as double 500/138 kV double circuit, and a ROW width expansion of 30 ft. will be required from the assumed ROW edge. The remaining 20% of the line will use new greenfield ROW with a corridor width of 115 ft.–165 ft. depending on location.

10C3 – Woodside to Gant (Segment 2) OH 500 kV Line

This component of the proposal picks up from the end of the component 10C1A Segment 1 of the proposed Woodside to Gant line. This component is a single circuit 25-mile-long line, which parallels Doubs-Bismark 500 kV for about 0.5 miles before continuing on its own greenfield ROW to the new Gant substation. The anticipated ROW width for this segment of the line route is 165 ft.

Overall, the ROW risk for the new West cluster transmission line components in this proposal is medium-high to high, as the proposed new transmission lines are routed parallel to an existing ROW for majority of their alignment.

Environmental Risk Analysis

46a – 502 Junction to Black Oak OH 500 kV Line

Route crosses West Virginia and MD Department of Natural Resource (DNR)-recognized public lands and is also within a short distance of residential areas.

4CA – Black Oak to Woodside OH 500 kV Line

Route crosses through the Appalachian Mountains and intersects with VA Natural Heritage easements.

10C1A – Woodside to Gant (Segment 1) OH 500 kV Line

The proposed route for this line segment goes through several national scenic and historic trails (Harpers Ferry National Historical Park and the Appalachian Scenic Trail), and intersects public lands and conservation easements. This may require permission from the National Park Service (NPS) and require an Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA) to analyze the impacts to the environment and park resource, which could be a lengthy process. This route is also within a short distance of residential and commercial areas.

10C3 – Woodside to Gant (Segment 2) OH 500 kV Line

The proposed route for this greenfield line segment goes through highly developed residential and commercial developments, as well as state and local conservation easements. This route also crosses the Washington & Old Dominion (W&OD Trail), a regional park in northern Virginia. There is significant risk of public opposition to the proposed route, which may lead to rerouting this segment along the existing corridor from Doubs to Goose Creek.

Overall, for Proposal 853, medium-high constructability risks are assessed for the proposed line routes due to anticipated lengthy regulatory process, potential public opposition, construction difficulty, environmental constraints and property acquisition, which may have significant impacts on the cost and schedule for the proposed project.

Transmission Line Risk Analysis

Significant engineering and construction challenges are anticipated for the proposed lines to construct a total of 167 miles of new transmission through four states and will require parallel crews and construction where possible to mitigate schedule challenges that will be introduced by the anticipated lengthy permitting and land acquisition process.

For the rebuild portions of the proposed line routes, there are challenges with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence, and potential design and ROW limitations for reuse of existing infrastructure/assets.

Other medium risks for this project involve the existing facility outages that will be necessary for the project, particularly for the line rebuild and substation upgrades.

Substation Risk Analysis

New Woodside 500/138 kV Substation

Woodside substation is a proposed new 3-bay breaker-and-a-half 500/138 kV switchyard to be located on about 18 acres. Proposed new equipment to be installed includes three bays; five line terminals; twelve 500 kV, 5000A 63 kAIC breakers; two 500 kV, 150 MVAR shunt capacitor banks; one -300 to +500 MVAR Static VAR Compensator (SVC); two 500 kV–138 kV transformer banks; and two 138 kV, 5000A 80 kAIC breakers. Additionally, termination of one new 500 kV line to Gant and one new 500 kV line Black Oak are proposed along with looping in of the existing 500 kV Doubs-Bismark line.

New Gant 500/230 kV Substation

Gant substation is a proposed new 500/230 kV breaker-and-a-half substation. New 500 kV breaker-and-a-half switchyard equipment proposed includes two bays; three line terminals; seven 500 kV, 5000A 63 kAIC breakers; and two 500/230 kV transformer banks. There is also a proposed 230 kV ring bus switchyard with seven line terminals;

seven 230 kV 80 kAIC breakers; and two 1% reactance series reactors. The proposed scope includes looping in existing 500 kV Goose Creek-Brambleton line, terminating one new 500 kV line, terminating one new 230 kV line, and looping in existing 230 kV Pleasant View-Roundtable line.

The other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 16**.

Table 16. Proposal 853 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	4CA – New 500 kV transmission line from existing Black Oak substation and new Woodside substation	163.50	258.98
2	10C1A – New 500 kV transmission line from new Woodside substation to Goose Creek substation	58.45	114.07
3	23s5 – New Woodside Substation – 6 terminal	125.30	167.58
4	23sb – Stonewall substation two 138kV breaker expansion	2.80	5.18
5	04AE – Black Oak substation 500 kV six breaker and new transformer expansion	14.00	23.31
6	10C3 – New 500 kV line between new Woodside substation and new Gant substation	64.72	155.23
7	39a3 – New Gant substation – 3 terminal	58.08	93.85
8	46a – New 500 kV line from existing 502 Junction substation to existing Black Oak substation	181.90	314.70
9	46b – 502 Junction substation two 500 kV circuit breaker expansion	9.80	9.09
10	46b1 – Kammer to 502 Junction 500 kV upgrade	5.00	53.23
	Total	**683.55**	**1,195.24**

The total proposal cost estimate is less than 30% of the independent cost estimate and is considered high risk

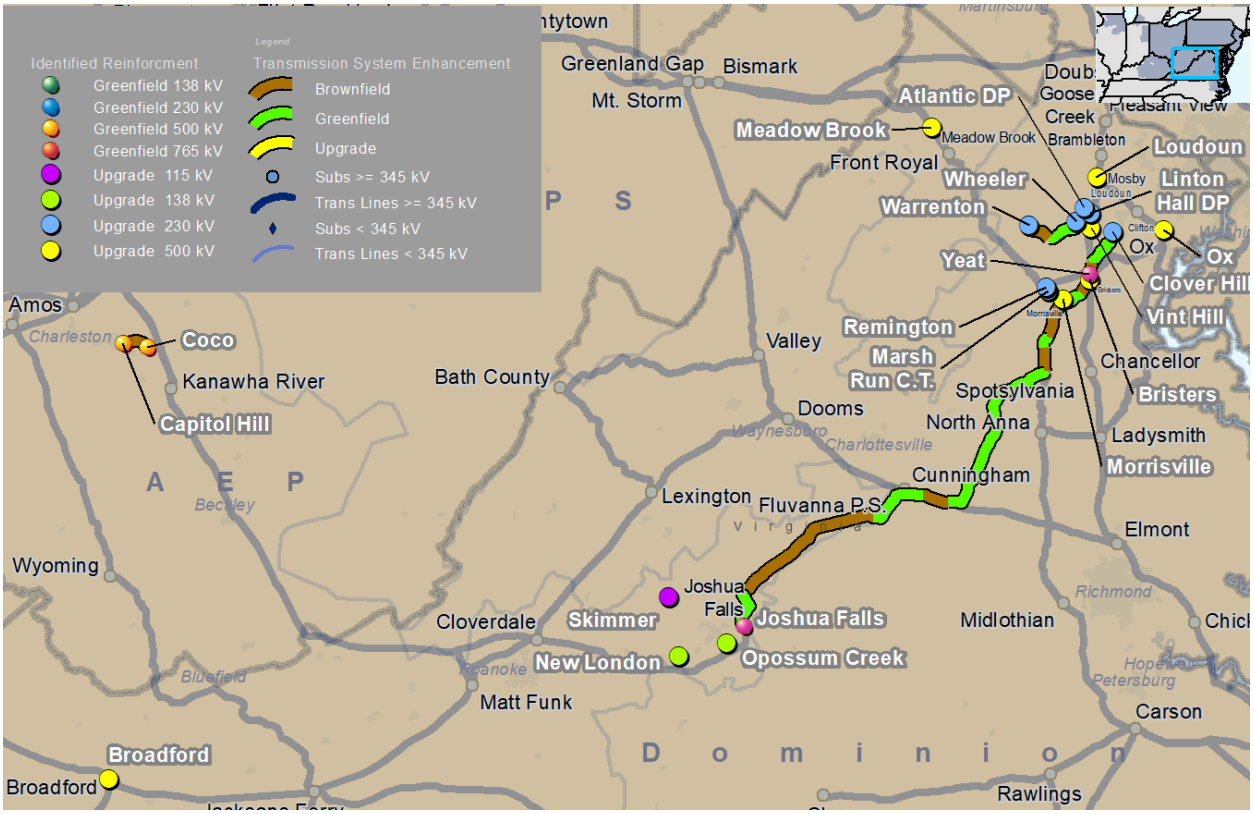
Schedule Review

The proposed in-service date of June 2027 is very aggressive for the proposed scope of the project considering the significant permitting and land acquisition challenges associated with the proposed 500 kV greenfield line routes through four states. Overall, the schedule risk is considered medium-high.

Proposal 904 – Transource

Transource Proposal No. 904 (**Map 18**), described as Joshua Falls-Yeat 765 kV greenfield line and substation, spans across multiple counties across Virginia and includes new greenfield lines and a greenfield substation, as well as multiple line and substation upgrades.

Map 18. Proposal 904



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Transource Proposal 904 includes the following components for the West Cluster:

- Component 1: Joshua Falls-Yeat 765 kV greenfield transmission line
- Component 2: Yeat greenfield station

- Component 3: Bristers-Ox 500 kV and Meadowbrook-Vint Hill 500 kV tie-in lines
- Component 4: Yeat-Clover Hill 230 kV greenfield transmission line
- Component 5: Warrenton-Wheeler 230 kV greenfield transmission line
- Component 6: Vint Hill-Morrisville series reactor
- Component 7: Vint Hill-Loudon 1 series reactor
- Component 8: Marsh Run-Remington Ct 230 kV line upgrade
- Component 9: Wheeler-Linton Tap-Atlantic 230 kV line upgrade
- Component 10: Bristers-Yeat 500 kV line upgrade
- Component 11: Wheeler station 230 kV breaker upgrade
- Component 12: Opossum Creek series reactor
- Component 13: New London station series reactor
- Component 14: Broadford station upgrade
- Component 15: Skimmer station upgrade
- Component 16: Coco-Capitol Hill 500 kV line upgrade
- Component 17: Joshua Falls station upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Joshua Falls-Yeat 765 kV OH Line

A major component of this proposal is the Joshua Falls-Yeat 765 kV transmission line. The proposed route is approximately 135 miles in length and traverses through 11 counties (Albemarle, Amherst, Buckingham, Campbell, Culpeper, Fauquier, Fluvanna, Louisa, Nelson, Orange and Spotsylvania) in Virginia. Land use in the area is mostly agricultural and wooded parcels in relatively hilly terrain. The proposed route parallels existing transmission corridors (ranging from 46 kV sub transmission to 500 kV transmission) for 59 miles (44%) of its alignment and has its own corridor for the remaining 76 miles, with a ROW width of 200 feet.

Yeat-Clover Hill 230 kV OH Line

This component has an 11.69-mile-long route, from the new Yeat substation to the existing Clover Hill substation using a greenfield corridor. The line crosses mostly residential and agricultural parcels in Fauquier and Prince William counties in Virginia.

Warrenton-Wheeler 230 kV OH Line

This component has an 8.8-mile-long route, and from the existing Warrenton substation to the existing Wheeler substation, using a mostly new greenfield corridor, paralleling existing transmission corridors for a portion of its alignment. The line crosses woodland, residential and agricultural parcels in Fauquier and Prince William counties in Virginia.

Environmental Risk Analysis

Joshua Falls-Yeat 765 kV OH Line

The proposed line route has the potential to impact environmental and cultural resources including: the Southern Albemarle Rural Historic District, a FEMA High-Risk Flood Zone, wetlands and several waters subject to USACE Section 10 permitting, the most significant being the James River. The route also intersects local conservation easements and appears to co-locate with pipeline ROWs.

Warrenton-Wheeler 230 kV OH Line

The line crosses woodland, residential and agricultural parcels in Fauquier and Prince William counties in Virginia. The route intersects local conservation easements and potentially impacts environmental resources such as Auburn Battlefield Historic District, flood plains and wetlands.

There are medium constructability risks assessed for the proposed line routes due to anticipated lengthy land acquisition process, potential public opposition and environmental constraints, which will have impacts on the cost and schedule for the proposed project.

Transmission Line Risk Analysis

Transource has an optimistic schedule for several aspects of this component and would require a near perfect execution to maintain the proposed in-service date. Given the scale of the component, a 135 mile 765 kV line with everything from permitting to land acquisition to construction poses a risk for delay, the most critical being land acquisition.

For the 230 kV developments, Yeat-Clover Hill and Warrenton-Wheeler, these facilities will utilize BOLD (Breakthrough Overhead Line Design), which is a structure family developed by AEP. The design features a monopole structure with two arched crossarms to hold two circuits in a delta configuration. Benefits of BOLD include increased line capacity with lower-profile structures. However, utilizing this structure family poses risks to the schedule, specifically procurement of the arched crossarms, construction and maintenance of a non-typical design.

Substation Risk Analysis

Joshua Falls 765 kV Substation Upgrade

The Joshua Falls substation is an existing 765 kV substation with a single 765 kV circuit breaker. The proposed modification of the substation would expand the substation by adding two additional 765 kV circuit breakers to the existing substation. This would require expansion of the existing substation layout. It is not clear if additional space is available for this site expansion. The modification would also require work in the proximity to existing energized facilities, which would limit construction activities without utilizing outages. There is a high risk to the schedule due to the difficult nature of scheduling prolonged outages at a 765 kV facility.

Yeat 765/500/230 kV Greenfield Substation

The Yeat substation is proposed with a Phase 1 construction consisting of 10-500 kV circuit breakers and two 500 kV-230 kV transformers in a breaker-and-a-half configuration. The 500 kV-230 kV transformers are proposed to be connected to common bus in the break-and-a-half configuration, instead of the industry standard of the breaker positions. During Phase 2, the construction would consist of installing one 765 kV circuit breaker and two 765 kV-500 kV 750 MVA transformers. The 765 kV transformers are proposed to be installed in parallel and connected to a single

breaker location on the 500 kV breaker and a half. Proper operation of this substation may require additional equipment and an expanded arrangement compared to what is proposed.

Other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 17**.

Table 17. Proposal 904 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	Joshua Falls-Yeat 765 kV Greenfield Transmission Line	671.16	742.50
2	Yeat Greenfield Station	184.92	200.00
3	Bristers-Ox 500 kV, and Meadowbrook-Vint Hill 500 kV Tie-in Lines	8.60	9.00
4	Yeat-Clover Hill 230 kV Greenfield Transmission Line	45.17	41.00
5	Warrenton-Wheeler 230 kV Greenfield Transmission Line	32.46	31.00
6	Vint Hill-Morrisville Series Reactor	5.76	5.00
7	Vint Hill-Loudon 1 Series Reactor	5.76	5.00
8	Marsh Run-Remington Ct 230 kV Line Upgrade	5.83	6.00
9	Wheeler-Linton Tap-Atlantic 230 kV Line Upgrade	1.47	6.00
10	Bristers-Yeat 500 kV Line Upgrade	3.33	4.50
11	Wheeler Station 230 kV Breaker Upgrade	1.96	3.00
12	Opossum Creek Series Reactor	2.16	1.50
13	New London Station Series Reactor	4.03	1.50
14	Broadford Station Upgrade	17.64	17.64
15	Skimmer Station Upgrade	1.96	1.96

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
16	Coco-Capitol Hill 500 kV Line Upgrade	11.80	16.80
17	Joshua Falls Station Upgrade	44.10	30.00
	Total	**1,048.10**	**1,122.40**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

Schedule Review

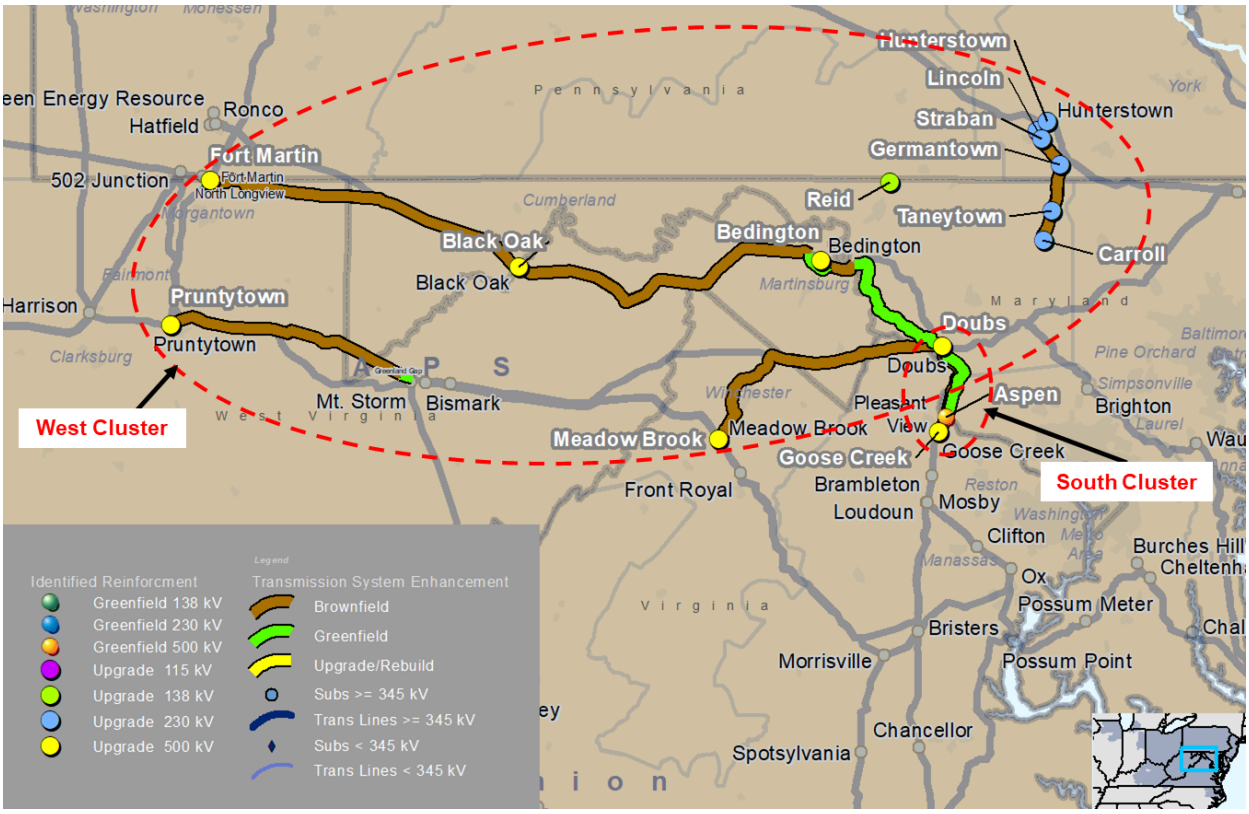
This proposal includes 765 kV substation and transmission line construction, as well as utilization of BOLD (Breakthrough Overhead Line Design) technology for the greenfield 230 kV lines. The sum of all components is a very aggressive undertaking to be completed within the proposed schedule. The primary risks for this proposal are related to the magnitude of the scope of work, procurement and construction of 765 kV equipment and BOLD structures, state permitting and land acquisition for both the 765 kV and 230 kV developments. These all pose a medium-high risk to the December 2029 in-service date proposed by Transource.

South Proposal Cluster

Proposal 837 (South) – FirstEnergy (Potomac Edison)

FirstEnergy Proposal No. 837 (**Map 19**), described as Data Center Reinforcement Proposal No. 1, has 30 components, which PJM has grouped into West and South clusters. Specifically for the South cluster, FirstEnergy proposed components in a joint proposal with Dominion's Proposal 516 that rebuilds the Doubs-Goose Creek 500 kV line and adds a new Doubs to Aspen 500 kV line within the same corridor.

Map 19. Proposal 837



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

FirstEnergy Proposal 837 includes the following components for the South cluster:

- Component 16: Doubs-Goose Creek 500 kV rebuild
- Component 17: Doubs-Aspen 500 kV line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Doubs to Aspen 500 kV OH Line and Doubs to Goose Creek 500 kV Rebuild

The new line from existing Doubs to new Aspen 500 kV OH line and Doubs to Goose Creek 500 kV rebuild projects will occur in the same transmission corridor, which currently contains the existing Doubs-Goose Creek '514' 500 kV, Doubs to Dickerson/Doubs to Aqueduct to Dickerson double circuit 230 kV, and Dickerson to Edwards Ferry to Pleasant View '203' 230 kV. These existing circuits will be rebuilt to accommodate the rebuilt Doubs to Goose Creek line, the existing 230 kV lines, and a new Doubs to Aspen 500 kV line using double circuit 500/230 kV structures for about 8 miles to Dickerson, and as two single circuit 500 kV lines for 7.5 miles up to the Maryland/Virginia state line.

Exelon (PEPCO) will have responsibility for their portion of the scope of work for the Dickerson-Edwards Ferry-Pleasant View 230 kV rebuild to double circuit 500/230 kV to accommodate the new Doubs-Aspen 500 kV line up to the Maryland/Virginia state line, and this scope is incorporated within PEPCO's proposal 660, component 22.

FirstEnergy proposal 837 scope ends at the Maryland/Virginia state line, and Dominion's proposal 516 continues with the rebuild of the Doubs to Goose Creek '514' 500 kV line as a double circuit 500/230 kV, and a rebuild of the Dickerson-Edwards Ferry-Pleasant View '203' 230 kV line as a double circuit 500/230 kV to accommodate the both the new Doubs to Aspen 500 kV line and the existing '203' 230 kV line. Dominion's scope will occur within the same transmission corridor which is about 3 miles long.

Overall, the ROW risk for both FirstEnergy proposal 837 and Dominion proposal 516 is low due to the utilization of existing ROW for the entire alignment of the proposed new line and rebuild projects.

Environmental Risk Analysis

Doubs to Aspen 500 kV OH Line and Doubs to Goose Creek 500 kV Rebuild

The project area is in the northern Virginia Piedmont region, which is predominately vegetated utilizing existing ROW. The proposed line routes will cross the Potomac and Monocacy rivers, the Dickerson Conservation Park, and parallels the Chesapeake and Ohio Canal National Historical Park. However, given the use of existing ROW for the route's entire alignment, permitting impacts are likely to be reasonable.

Transmission Line Risk Analysis

For the rebuild portions of the proposed line routes, there are challenges with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence and potential design and ROW limitations for reuse of existing infrastructure/assets.

Other medium risks for this project involve the existing facility outages that will be necessary for the project, particularly for the line rebuild, and required substation upgrades.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 18**.

Table 18. Proposal 837 (South) Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
16	Doubs-Goose Creek 500 kV Rebuild	87.74	76.56
17	Doubs-Aspen 500 kV Line	115.64	132.60
	Total	**203.38**	**209.16**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

Schedule Review

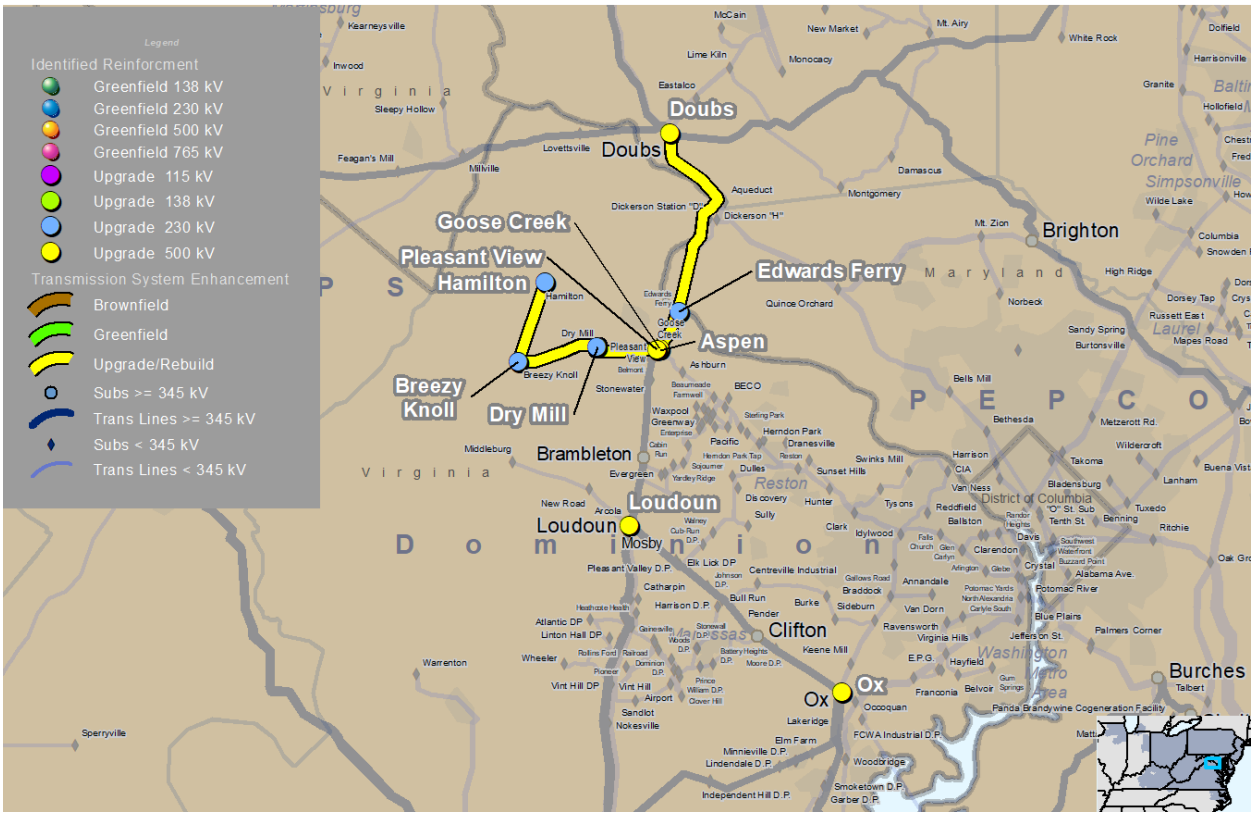
FirstEnergy proposal 837 South components are assumed to have the same December 2027 in-service date as Dominion joint-proposal proposal 516, instead of the overall Proposal 837 in-service date of June 2030, which is more applicable to the Proposal 837's West cluster components.

Given the low-risk brownfield development proposed for proposals 837 and 516, the proposed December 2027 in-service date is reasonable, and schedule risk is considered low.

Proposal 516 – Dominion

Dominion's Proposal No. 516 (**Map 20**), described as interregional solution Aspen-Doubs second 500 kV line, is a joint proposal with FirstEnergy's Proposal 837 that rebuilds the Doubs-Goose Creek 500 kV line, and adds a new Doubs to Aspen 500 kV line within the same corridor.

Map 20. Proposal 516



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Dominion's Proposal 516 includes the following components for the South cluster:

- Component 1: Aspen substation terminal equipment installation for 5000A line to Doubs
- Component 2: Breezy Knoll relay reset
- Component 3: Dry Mill South relay reset
- Component 4: Goose Creek substation equipment upgrade
- Component 5: Hamilton relay reset
- Component 6: Pleasant View substation equipment upgrade
- Component 7: Line No. 203 (Pleasant View-Dickerson) rebuild
- Component 8: New 500 kV line (Aspen to Doubs)
- Component 9: Line No. 514 (Goose Creek-Doubs) rebuild
- Component 10: Line No. 2098 (Pleasant View-Hamilton) partial rebuild
- Component 11: Loudoun substation overdutied breaker replacement
- Component 12: Ox substation overdutied breaker replacement
- Component 13: Pleasant View substation overdutied breaker replacement
- Component 14: Edwards Ferry substation equipment upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Doubs to Aspen 500 kV OH Line and Doubs to Goose Creek 500 kV Rebuild

The new line from existing Doubs to new Aspen 500 kV OH line and Doubs to Goose Creek 500 kV rebuild projects will occur in the same transmission corridor, which currently contains the existing Doubs-Goose Creek '514' 500 kV, Doubs to Dickerson/Doubs to Aqueduct to Dickerson double circuit 230 kV, and Dickerson to Edwards Ferry to Pleasant View '203' 230 kV. These existing circuits will be rebuilt to accommodate the rebuilt Doubs to Goose Creek line, the existing 230 kV lines, and a new Doubs to Aspen 500 kV line, using double circuit 500/230 kV structures for about 8 miles to Dickerson, and as two single circuit 500 kV lines for 7.5 miles up to the Maryland/Virginia state line. Exelon (PEPCO) will have responsibility for the Proposal 837 scope of work for the Dickerson-Edwards Ferry-Pleasant View 230 kV rebuild to double circuit 500/230 kV to accommodate Doubs-Aspen up to the Maryland/Virginia state line.

FirstEnergy proposal 837 scope ends at the MD/VA state line, and Dominion's proposal 516 continues with the rebuild of the Doubs to Goose Creek '514' 500 kV line as a double circuit 500/230 kV, and a rebuild of the Dickerson-Edwards Ferry-Pleasant View '203' 230 kV line as a double circuit 500/230 kV to accommodate the both the new Doubs to Aspen 500 kV line and the existing '203' 230 kV line. Dominion's scope will occur within the same transmission corridor which is about 3 miles long.

Overall, the ROW risk for both FirstEnergy proposal 837 and Dominion proposal 516 is low due to the utilization of existing ROW for the entire alignment of the proposed new line and rebuild projects.

Environmental Risk Analysis

Doubs to Aspen 500 kV OH Line and Doubs to Goose Creek 500 kV Rebuild

The project area is in the northern Virginia Piedmont region, which is predominately vegetated utilizing existing ROW. The proposed line routes will cross the Potomac and Monocacy rivers, the Dickerson Conservation Park, and parallels the Chesapeake and Ohio Canal National Historical Park. However, given the use of existing ROW for the route's entire alignment, permitting impacts are likely to be reasonable.

Transmission Line Risk Analysis

For the rebuild portions of the proposed line routes, there are challenges with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence and potential design and ROW limitations for reuse of existing infrastructure/assets.

Other medium risks for this project involve the existing facility outages that will be necessary for the project, particularly for the line rebuild, and required substation upgrades.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 19**.

Table 19. Proposal 516 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	Aspen Substation Terminal Equipment Installation for 5000A Line to Doubs	12.99	16.00
2	Breezy Knoll Relay Reset	0.02	0.05
3	Dry Mill South Relay Reset	0.02	0.05
4	Goose Creek Substation Equipment Upgrade	4.09	5.60
5	Hamilton Relay Reset	0.01	0.05
6	Pleasant View Substation Equipment Upgrade	3.62	5.00
7	Line #203 (Pleasant View-Dickerson) Rebuild	6.87	7.90
8	New 500 kV Line (Aspen to Doubs)	12.02	14.00
9	Line #514 (Goose Creek-Doubs) Rebuild	12.02	14.00
10	Line #2098 (Pleasant View-Hamilton) Partial Rebuild	3.44	3.50

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
11	Loudoun Substation Overdutied Breaker Replacement	2.32	5.00
12	Ox Substation Overdutied Breaker Replacement	2.51	4.20
13	Pleasant View Substation Overdutied Breaker Replacement	1.29	2.10
14	Edwards Ferry Substation Equipment Upgrade	0.51	0.50
	Total	**61.72**	**77.95**

The total proposal cost estimate is within 20–30% of the independent cost estimate and is considered medium-high risk.

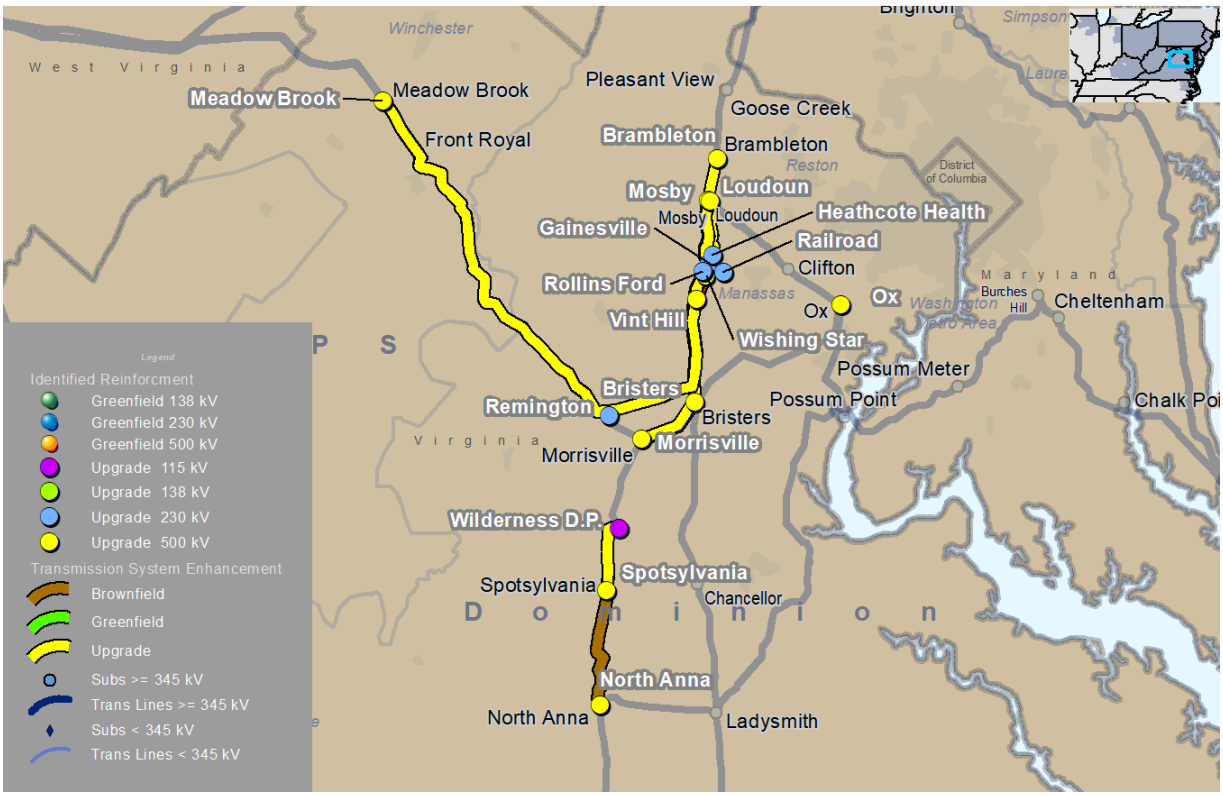
Schedule Review

Given the low-risk brownfield development proposed for Dominion's Proposal 516 and FirstEnergy Proposal 837, the proposed December 2027 in-service date is reasonable, and schedule risk is considered low.

Proposal 711 – Dominion

Dominion's Proposal No. 711 (**Map 21**), described as Regional Solution 500 kV North Anna-Wishing Star Upgrades, involves a comprehensive solution to add new 500 kV transmission lines from North Anna to Wishing Star with extensive use of existing transmission ROWs. The project spans multiple counties in Virginia and involves addition of three new greenfield 500 kV transmission lines and multiple existing line rebuilds and substation upgrades.

Map 21. Proposal 711



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Dominion's Proposal 711 includes the following components:

- Component 1: New 500 kV line (North Anna-Spotsylvania) (993169)
- Component 2: North Anna equipment uprate (993169)
- Component 3: Spotsylvania equipment uprate (993169)
- Component 4: Loudoun 230 kV overdutied breaker replacement (993208_2)
- Component 5: North Anna 500 kV overdutied breaker replacement (993208_2)
- Component 6: Ox 500 kV overdutied breaker replacement (993208_2)
- Component 7: New 500 kV line (Spotsylvania to Vint Hill) (993232)
- Component 8: New 500 kV line (Vint Hill to Wishing Star) (993232)
- Component 9: Line No. 37 (Spotsylvania-Wilderness D.P.) rebuild
- Component 10: Line No. 545 (Bristers-Morrisville) rebuild
- Component 11: Line No. 569 (Loudoun to Morrisville) rebuild
- Component 12: Line No. 535 (Meadow Brook-VintHill- Loudoun) rebuild

- Component 13: Line No. 546 (Mosby-Wishing Star) rebuild
- Component 14: Line No. 590 (Mosby-Wishing Star) rebuild
- Component 15: Line No. 2030 (Gainesville-Loudoun) rebuild
- Component 16: Line No. 2045 (Loudoun-Brambleton) rebuild
- Component 17: Line No. 2094 & 2227 (Brambleton-Racefield-Loudoun) rebuild
- Component 18: Line No. 2101 (Bristers-Vint Hill) rebuild
- Component 19: Line No. 2114 (Remington CT-Rollin Ford) rebuild
- Component 20: Line No. 2140 (Loudoun-Heathcote) rebuild
- Component 21: Line No. 2151 (Railroad DP-Gainesville) rebuild
- Component 22: Line No. 2163 (Vint Hill-Liberty) rebuild
- Component 23: Line No. 2176 (Heathcote-Gainesville) rebuild
- Component 24: Line No. 2222 (Rollins Ford-Gainesville) rebuild
- Component 25: Line No. 183 (Bristers-Ox) rebuild
- Component 26: Line No. 535 (Meadow Brook-VintHill- Loudoun) Resag
- Component 27: Bristers substation
- Component 28: Brambleton substation
- Component 29: Dawkins branch substation
- Component 30: Gainesville substation
- Component 31: Heathcote substation
- Component 32: Loudoun substation
- Component 33: Mint Springs substation
- Component 34: Morrisville substation
- Component 35: Mosby substation
- Component 36: North Star substation
- Component 37: Racefield substation
- Component 38: Railroad substation
- Component 39: Spotsylvania substation
- Component 40: Vint Hill substation
- Component 41: Wishing Star substation
- Component 42: Youngs branch substation

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New 500 kV OH Line (North Anna-Spotsylvania) (993169)

The new 13.94-mile 500 kV OH line from existing North Anna to existing Spotsylvania will be built parallel to the existing North Anna to Spotsylvania '573' line, using the same transmission corridor, which will not require any expansion. The line route is located in a predominantly vegetated area within Virginia Piedmont region.

New 500 kV OH Lines (Spotsylvania to Vint Hill and Vint Hill to Wishing Star) (993232)

The project involves a rebuild of Dominion's existing two 500/230 kV line corridor from Spotsylvania-Morrisville-Bristers-Nokesville-Vint Hill in order to accommodate the new Spotsylvania to Vint Hill (16.59 miles) and Vint Hill to Wishing Star (38.45 miles) 500 kV OH lines The final configuration will be a three-structure configuration, with the new 500 kV lines on single circuit monopoles, and the existing 500 kV and 230 kV lines on two 500/230 kV double circuit poles existing transmission corridor all fitting within the same existing transmission ROW, which will not require any expansion in width.

Overall, the ROW risk for this proposal is low due to the utilization of existing ROW for the entire alignment of the proposed new lines and rebuild projects.

Environmental Risk Analysis

The project area is in the northern Virginia Piedmont region, which is predominately vegetated utilizing existing ROW. Given the use of existing ROW for the route's entire alignment, environmental impacts are expected to be minimal.

Transmission Line Risk Analysis

The proposed three structure configuration for the Spotsylvania to Wishing Star line route poses some design risk and will require significant detailed engineering to ensure construction feasibility. Special considerations may need to be taken into account for the close proximity of the lines for outage scheduling when pulling conductor and swinging from wind gusts.

The outage coordination required for rebuilding multiple transmission line rebuilds and building three new transmission lines in existing ROW is significant. Delays to any project component would have a cascading effect on the following outage schedule for other components. To help address these concerns, Dominion provided a reasonable outage sequencing plan for the project, with potential transmission outage windows already identified. Overall, a medium risk was assessed for outage coordination for the project.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 20**.

Table 20. Proposal 516 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	New 500 kV Line (North Anna-Spotsylvania) (993169)	119.37	105.00
2	North Anna Equipment Uprate (993169)	11.43	12.00
3	Spotsylvania Equipment Uprate (993169)	7.06	6.50
4	Loudoun 230 kV Overdutied Breaker Replacement (993208_2)	1.72	4.00
5	North Anna 500 kV Overdutied Breaker Replacement (993208_2)	1.33	2.80
6	Ox 500 kV overdutied Breaker Replacement (993208_2)	1.29	2.80
7	New 500 kV Line (Spotsylvania to Vint Hill) (993232)	219.53	230.00
8	New 500 kV Line (Vint Hill to Wishing Star) (993232)	87.81	99.00
9	Line #37 (Spotsylvania-Wilderness D.P.) Rebuild	17.56	17.84
10	Line #545 (Bristers-Morrisville) Rebuild	65.86	59.00
11	Line #569 (Loudoun to Morrisville) Rebuild	175.62	185.00
12	Line #535 (Meadow Brook-VintHill- Loudoun) Rebuild	65.86	62.00
13	Line #546 (Mosby-Wishing Star) Rebuild	43.91	36.00
14	Line #590 (Mosby-Wishing Star) Rebuild	43.91	36.00
15	Line #2030 (Gainesville-Loudoun) Rebuild	17.56	22.00
16	Line #2045 (Loudoun-Brambleton) Rebuild	17.56	17.78
17	Line #2094 & 2227 (Brambleton-Racefield-Loudoun) Rebuild	17.56	17.00
18	Line #2101 (Bristers-Vint Hill) Rebuild	17.56	43.00
19	Line #2114 (Remington CT-Rollin Ford) Rebuild	17.56	47.00
20	Line #2140 (Loudoun-Heathcote) Rebuild	17.56	20.00
21	Line #2151 (Railroad DP-Gainesville) Rebuild	4.39	2.45
22	Line #2163 (Vint Hill-Liberty) Rebuild	17.56	18.00
23	Line #2176 (Heathcote-Gainesville) Rebuild	8.78	3.00
24	Line #2222 (Rollins Ford-Gainesville) Rebuild	13.17	4.86
25	Line #183 (Bristers-Ox) Rebuild	8.78	7.20
26	Line #535 (Meadow Brook-VintHill- Loudoun) Resag	111.53	128.70
27	Bristers Substation	5.72	5.72
28	Brambleton Substation	4.65	4.00
29	Dawkins Branch Substation	0.02	0.02
30	Gainesville Substation	3.71	3.20
31	Heathcote Substation	0.02	0.02
32	Loudoun Substation	16.70	13.00
33	Mint Springs Substation	0.03	0.03
34	Morrisville Substation	9.30	14.00
35	Mosby Substation	11.75	11.20
36	North Star Substation	0.03	0.03
37	Racefield Substation	0.03	0.03
38	Railroad Substation	0.02	0.03

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
39	Spotsylvania Substation	7.98	8.40
40	Vint Hill Substation	23.73	24.00
41	Wishing Star Substation	12.30	12.00
42	Youngs Branch Substation	0.02	0.02
	Total	**1,227.84**	**1,284.62**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

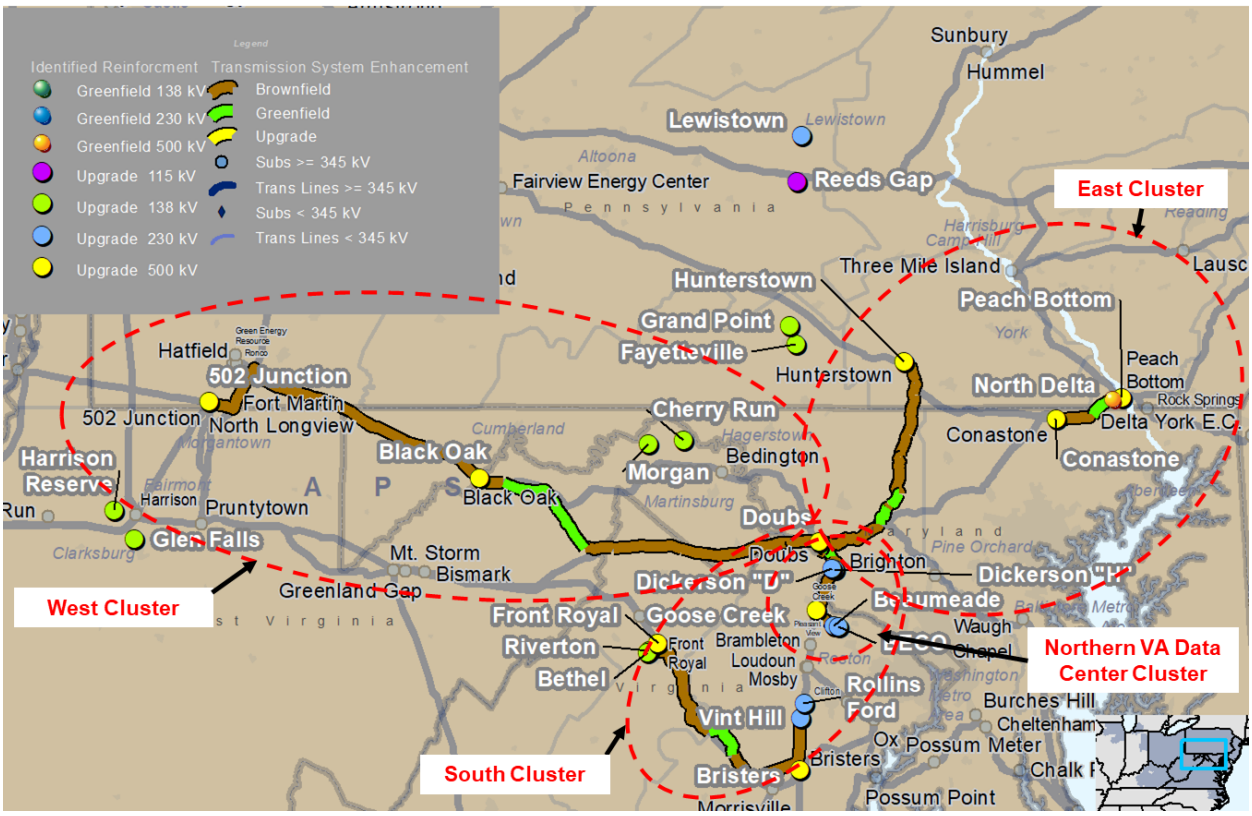
Schedule Review

Given the low-risk brownfield development proposed for Dominion's Proposal 711, the proposed December 2027 in-service date is achievable, but in consideration of the outage coordination risks posed by the significant number of line rebuilds, a medium schedule risk is assessed for this project.

Proposal 548 (South) – LS Power

LS Power Proposal No. 548 (**Map 22**), described as RTEP Window 3 Solution, provides a holistic solution to the RTEP Window 3 needs, comprising 37 components, which can be grouped into the four regional clusters identified for the Window. Specifically for the South cluster, LS Power proposed components in multiple counties across Maryland and Virginia, and includes new greenfield lines, as well as multiple substation upgrades.

Map 22. Proposal 548



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

LS Power Proposal 548 includes the following components for the South cluster:

- Component 12: Goose Creek substation upgrade
- Component 15: Vint Hill substation upgrade
- Component 22: Vint Hill-Loudoun reconductor
- Component 28: Doubs-Goose Creek greenfield 500 kV transmission line
- Component 30: Front Royal substation upgrade
- Component 33: Doubs-Goose Creek greenfield 500 kV transmission line (shared ROW)
- Component 34: Front Royal-Vint Hill greenfield 500 kV transmission line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New Doubs to Goose Creek 500 kV Line

The new approximately 20-mile 500 kV line route from existing Doubs to existing Goose Creek 500 kV starts with the first 10 miles on new ROW parallel to the Doubs to Dickerson 230 kV line, up to Dickerson station D, and then the Dickerson station D to Pleasant View 230 kV line will be rebuilt as a double circuit 500/230 kV line to accommodate the 500 kV line for about 8 miles up to Pleasant View, and then the Pleasant View to Hamilton 230 kV line is added onto the line in a rebuilt 500/230/230 kV configuration for about 1 mile before the 500 kV circuit enters the Goose Creek substation.

New Front Royal-Vint Hill 500 kV Line

The new 64-mile 500 kV line route from existing Front Royal to existing Vint Hill starts from Front Royal and parallels Front Royal-Morrisville until it meets up with Remington substation. The line then parallels the Remington CT to Gainesville 230 kV line corridor all the way to Vint Hill substation. The proposed route only deviates from paralleling the existing corridor to avoid any conflicts adjacent to the existing corridor.

Overall, the ROW risk for both LS Power proposed line routes is medium-high due to the extensive utilization of greenfield paralleling existing ROW for the majority of the proposed project's alignment.

Environmental Risk Analysis

New Doubs to Goose Creek 500 kV Line

The project area is in the northern Virginia Piedmont region which is predominately vegetated utilizing existing ROW. The proposed line route will cross the Potomac and Monocacy rivers, the Dickerson Conservation Park, and parallels the Chesapeake and Ohio Canal National Historical Park.

New Front Royal – Vint Hill 500 kV Line

The proposed route for this line segment goes through national scenic trails (Appalachian Scenic Trail). This may require permission from the National Park Service (NPS) and require an Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA) to analyze the impacts to the environment and park resource, which could be a lengthy process. The route also intersects multiple conservation easements and recreation areas crossing in five counties (Fauquier, Prince William, Culpeper, Rappahanock, Warren) in Virginia.

Medium-high constructability risks assessed for the proposed Front Royal to Vint Hill line routes due to anticipated challenges with permitting, property acquisition and public opposition given historical difficulty with permitting projects in Fauquier and Prince William counties, and the need to expand the existing TRAIL corridor for the new Front Royal-Vint Hill line.

Transmission Line Risk Analysis

For the rebuild portions of the proposed line routes, there are challenges with existing overhead transmission infrastructure components needing to be removed/salvaged before construction of proposed brownfield lines can commence and potential design and ROW limitations for reuse of existing infrastructure/assets.

Other medium risks for this project involve the existing facility outages that will be necessary for the project, particularly for the line rebuild components, and required substation upgrades.

Substation Risk Analysis

The substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 21**.

Table 21. Proposal 548 (South) Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
12	Goose Creek Substation Upgrade	52.36	54.00
15	Vint Hill Substation Upgrade	20.32	21.00
22	Vint Hill-Loudoun Reconductor	13.23	15.00
28 & 33	Doubs-Goose Creek Greenfield 500 kV Transmission Line	105.52	114.00
30	Front Royal Substation Upgrade	33.42	35.00
34	Front Royal-Vint Hill Greenfield 500 kV Transmission Line	403.70	378.00
	Total	**628.56**	**617.00**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

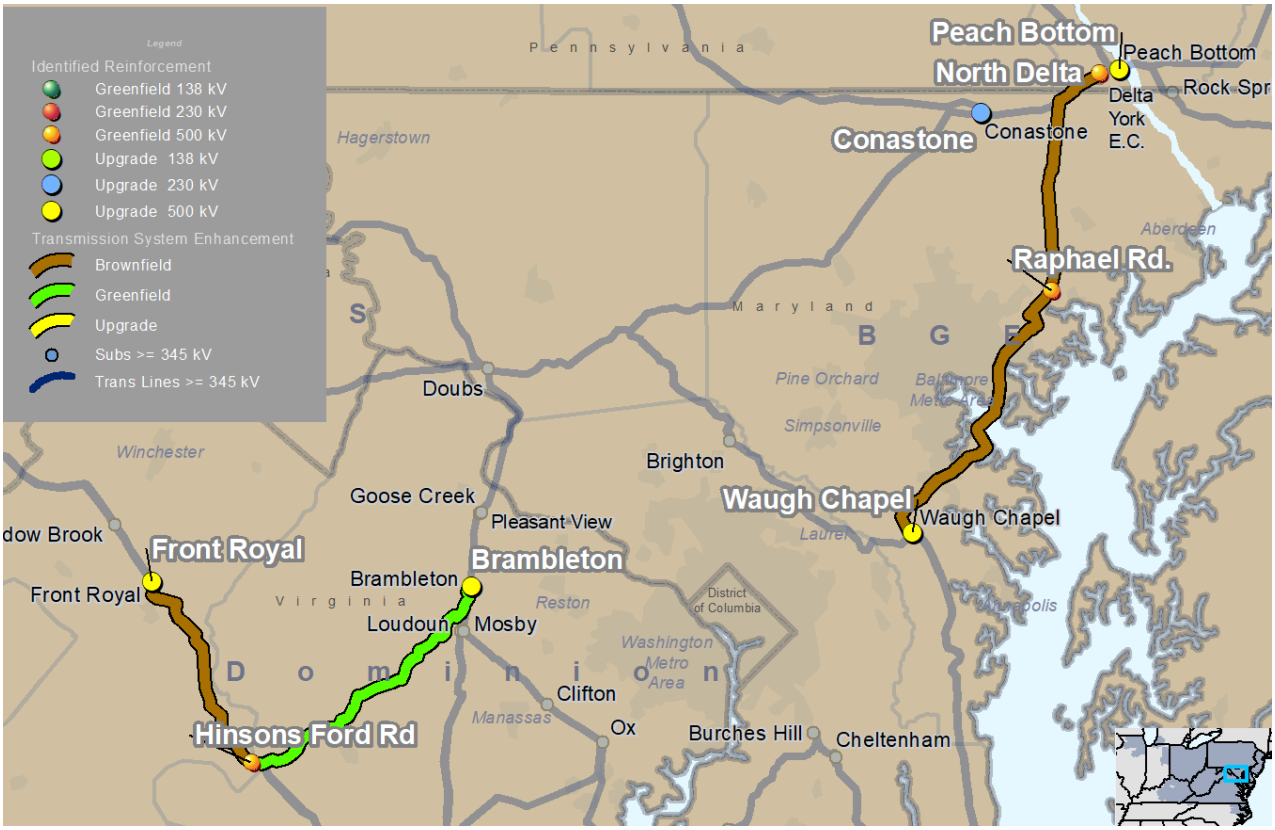
Schedule Review

The proposed in-service date of June 2030 is considered a medium-high risk due to the anticipated constructability challenges with the new Front Royal-Vint Hill line.

Proposal 325 – PSEG

PSEG Proposal No. 325 (**Map 23**), described as Proposal E – Brambleton-Hinsons Ford Rd 500 kV, has 12 components out of which three were included for evaluation in the South clusters. These components involve greenfield lines and a greenfield substation, as well as a line upgrade in four counties (Prince William, Fauquier, Rappahannock, Loudoun) within Virginia.

Map 23. Proposal 325



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

PSEG Proposal 325 includes the following components for the South cluster:

- Component 9: New Brambleton to Hinsons Ford Rd 500 kV line
- Component 10: Reconductor Front Royal-Hinson Ford Rd 500 kV
- Component 12: Hinsons Ford Rd 500 kV

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New Brambleton to Hinsons Ford Rd 500 kV Line

The new line from existing Brambleton to new Hinsons Ford 500 kV OH line involves a 34-mile route in an entirely greenfield corridor, with the terrain a combination of urban and rural areas.

The ROW risk for this project is high due to the pure greenfield nature of the proposed development.

Environmental Risk Analysis

New Brambleton to Hinsons Ford Rd 500 kV Line

The proposed route intersects flood plains, multiple conservation easements and a local park in four counties (Fauquier, Prince William, Rappahanock, Loudoun) in Virginia.

High constructability risks assessed for the proposed route due to anticipated challenges with permitting, property acquisition and public opposition given historical difficulty with permitting projects in Fauquier and Prince William counties, and also considering the greenfield nature of the project.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 22**.

Table 22. Proposal 325 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
9	New Brambleton to Hinsons Ford Rd 500 kV line	185.48	204.00
10	Reconductor Front Royal-Hinson Ford Rd 500 kV	43.18	43.56
12	Hinsons Ford Rd 500 kV	38.71	28.00
	Total	**267.38**	**275.56**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

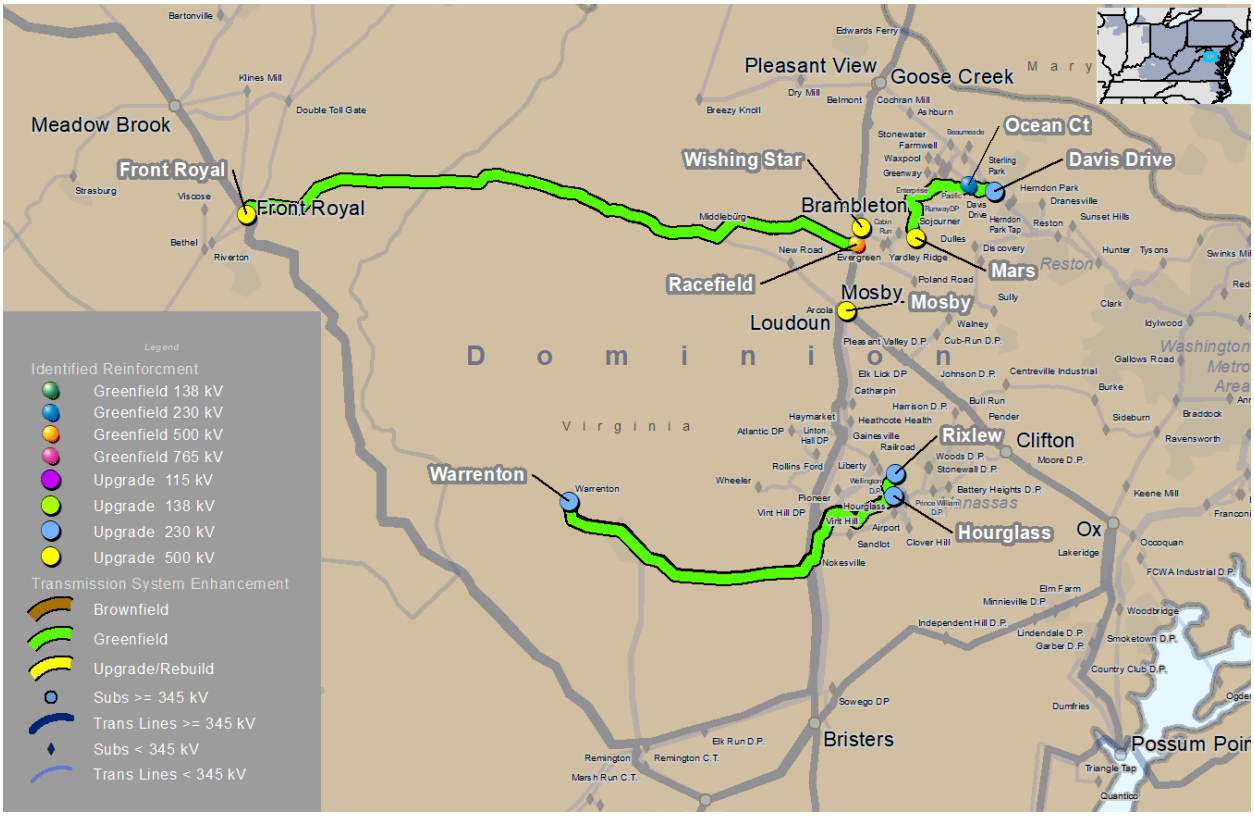
Schedule Review

The proposed in-service date of June 2027 is considered a high schedule risk due to the anticipated constructability challenges with the new Brambleton-Hinsons Ford Rd 500 kV line.

Proposal 663 – NextEra

NextEra Proposal No. 663 (**Map 24**), described as Front Royal-Racefield, Warrenton-Rixlew, Warrenton-Hourglass, Mars-Ocean Court-Davis Drive, has components that span Fauquier, Prince William and Loudoun counties in Virginia. These components involve greenfield lines and a greenfield GIS substation, as well as multiple substation upgrades.

Map 24. Proposal 663 (see next page)



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

NextEra Proposal 663 includes the following components for the South cluster:

- Component 1: 1B – New 500 kV transmission line from Allegheny substation Front Royal to new Racefield switchyard
- Component 2: 01A – New 500 kV line termination at Front Royal substation
- Component 3: 1F – New Racefield GIS substation – 5 terminal
- Component 4: 33E – Warrenton substation 230 kV ring bus expansion
- Component 5: 40C – Mars substation 230 kV ring bus expansion

- Component 6: 40a – New 230 kV transmission line from existing Mars substation to existing Ocean Court substation
- Component 7: 40b – New 230 kV transmission line from existing Ocean Court substation to existing Davis Drive substation
- Component 8: 40f – New 230 kV transmission line from existing Warrenton substation to existing Hourglass substation
- Component 9: 40g – New 230 kV transmission line from existing Warrenton substation to future Rixlew substation
- Component 10: 40D – Ocean Court substation 230 kV ring bus expansion
- Component 11: 40E – Davis Drive 230 kV line termination
- Component 12: 40h – Hourglass substation 230 kV single breaker expansion
- Component 13: 40i – Rixlew substation 230 kV single-breaker expansion
- Component 14: 50C – Mosby to Wishing Star 500 kV upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

1B – New Front Royal to Racefield 500 kV OH Line

The new line from existing Front Royal to new Racefield 500 kV OH line involves a 48-mile route in an entirely greenfield corridor. The project is located in the rolling hills and pastures of the Virginia Piedmont region, crossing Fauquier and Loudoun counties.

40f and 40g – Warrenton to Hourglass and Warrenton to Rixlew 230 kV Lines

The existing Warrenton to existing Hourglass 230 kV line route is approximately 16 miles long, with its entire route a new greenfield ROW. The existing Warrenton to future Rixlew 230 kV line route is approximately 18 miles long, with its entire route a new greenfield ROW. Both projects are located within the Prince William and Fauquier counties in Virginia.

40a and 40b – Mars to Ocean Court and Ocean Court to Davis Drive 230 kV Lines

The existing Mars to existing Ocean Court line is a new approximately 6-mile line, with about 60% of its route a new greenfield ROW, and the remaining 40% paralleling an existing transmission line. The existing Ocean Court to existing Davis Drive line is a new approximately 2-mile line, with its entire route a new greenfield ROW. Both projects are located in the valley south of the Potomac River in Loudoun County, Virginia.

Overall, the ROW risk for this Proposal 663 is high due to the extensive greenfield development involved in the proposed line routes.

Environmental Risk Analysis

1B – New Front Royal to Racefield 500 kV OH Line

The proposed route for this line segment goes through national scenic trails (Appalachian Scenic Trail) and intersects public lands and conservation easements. This may require permission from the National Park Service (NPS) and require an Environmental Assessment (EA) pursuant to the National Environmental Policy Act (NEPA) to analyze the

impacts to the environment and park resource, which could be a lengthy process. The proposed route also intersects flood plains, multiple conservation easements, and recreation lands in Fauquier and Loudoun counties in Virginia.

Overall, High constructability risks assessed for the proposed line routes, especially for the Front Royal to Racefield 500 kV line, due to anticipated challenges with permitting, property acquisition and public opposition given historical difficulty with permitting projects in Fauquier and Loudoun counties, and also considering the greenfield nature of the project.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 23**.

Table 23. Proposal 663 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	1B – New 500 kV Transmission Line from Allegheny Substation Front Royal to new Racefield switchyard	143.02	288.00
2	01A – New 500 kV line termination at Front Royal substation	2.80	6.00
3	1F – New Racefield GIS Substation – 5 terminal	23.44	48.00
4	33E – Warrenton substation 230 kV ring bus expansion	1.40	8.00
5	40C – Mars substation 230 kV ring bus expansion	1.40	2.00
6	40a – New 230 kV transmission line from existing Mars substation to existing Ocean Court substation	11.51	20.47
7	40b – New 230 kV transmission line from existing Ocean Court substation to existing Davis Drive substation	4.51	7.00
8	40f – New 230 kV transmission line from existing Warrenton substation to existing Hourglass substation	40.92	56.00
9	40g – New 230 kV transmission line from existing Warrenton substation to future Rixlew substation	43.88	63.00
10	40D – Ocean Court substation 230 kV Ring Bus Expansion	2.80	4.00
11	40E – Davis Drive 230 kV line termination	0.70	0.70
12	40h – Hourglass substation 230 kV single breaker expansion	1.40	2.00
13	40i – Rixlew substation 230 kV single breaker expansion	1.40	2.00
14	50C – Mosby to Wishing Star 500 kV Upgrade	5.00	7.00
	Total	**284.17**	**514.17**

The total proposal cost estimate is less than 30% of the independent cost estimate and is considered high risk

Schedule Review

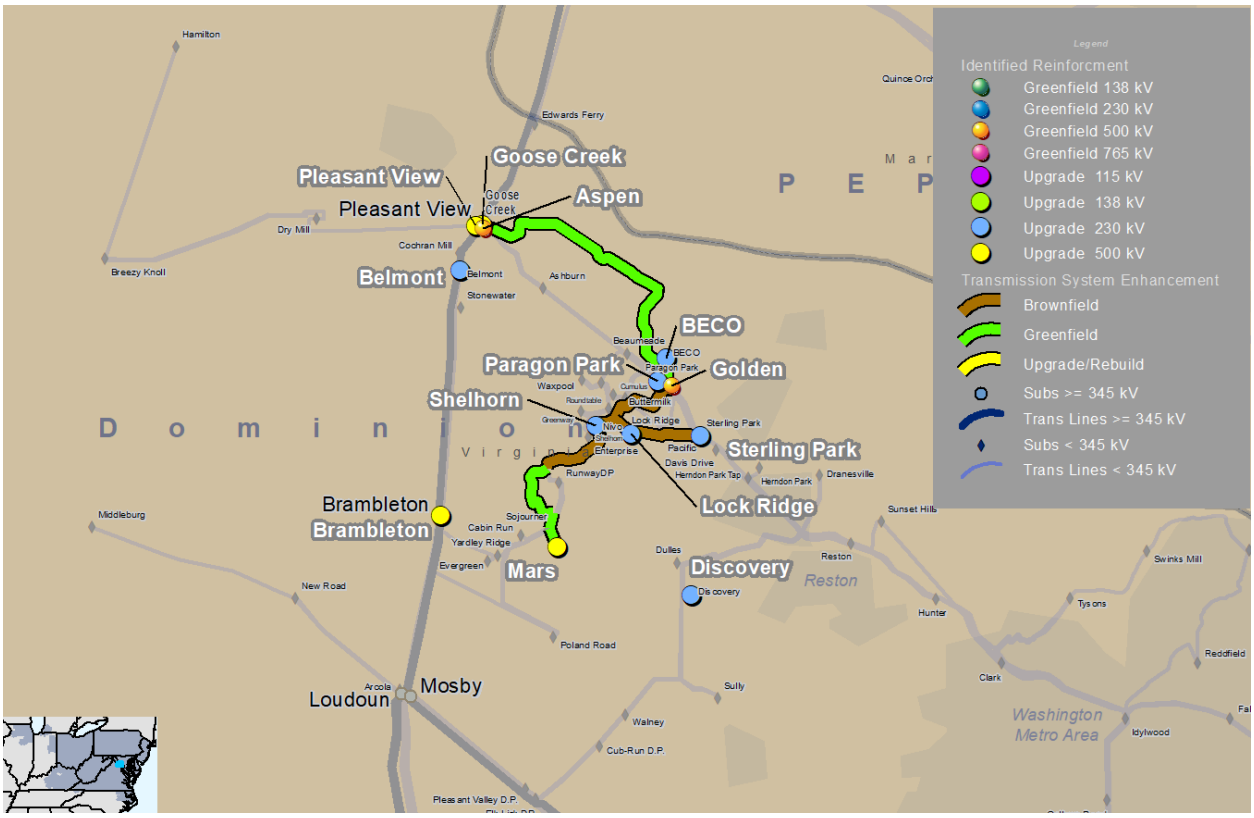
The proposed in-service date of June 2027 is considered a high schedule risk due to the anticipated constructability challenges with the proposed line routes.

Northern VA Data Center Proposal Cluster

Proposal 692 – Dominion

Dominion's Proposal No. 692 (**Map 25**), described as Data Center Alley Local solution – New 500 kV/230 kV Aspen-Golden and Golden-Mars lines, involves a local solution intended to facilitate interconnections of data centers in the Dominion Service area. The project includes new greenfield transmission lines and substations, as well as multiple existing line and substation upgrades, all within Loudoun County, Virginia.

Map 25. Proposal 692



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Dominion's Proposal 692 includes the following components:

- Component 1: Aspen-Golden 500 kV line build (99-2971)
- Component 2: Mars 500-230 kV transformer installation (99-3197)
- Component 3: Line No. 2150 (Golden to Paragon Park Circuit 1) reconductoring (99-3188)
- Component 4: Line No. 2081 (Golden to Paragon Park Circuit 2) reconductoring (99-3188)
- Component 5: Paragon Park substation equipment rating upgrade (99-3188)
- Component 6: Golden relay setting upgrade reset (99-3188)
- Component 7: Line No. 2207 (Paragon Park-Beco) reconductoring (99-3200)
- Component 8: Paragon Park substation equipment rating upgrade (99-3200)
- Component 9: Beco substation equipment rating upgrade (99-3200)
- Component 10: New Mars-Lockridge-Golden 230 kV line construction (99-2970)
- Component 12: New Mars-Golden 500 kV line construction (99-2970)
- Component 13: 500 kV line No. 558 (Brambleton-Goose Creek) cut-in to Aspen (99-2971)
- Component 14: New 500 kV line from Aspen to Goose Creek (99-2971)
- Component 15: Line No. 2150 (Sterling Park to Paragon Park Circuit 1) cut-in to Golden (99-2971)
- Component 16: Line No. 2081 (Sterling Park to Paragon Park Circuit 2) cut-in to Golden (99-2971)
- Component 17: New 230 kV line from Aspen-Golden (99-2971)
- Components 1–19: Golden, Lockridge and Mars substation upgrades (99-2970)
- Components 20–25: Beaumeade, Beco, Belmont, Discovery, Pleasant View and Shellhorn substation overdutied breaker replacements (99-3208)
- Component 26: New Aspen 500/230 kV substation (99-2971)
- Component 27: New Golden 500/230 kV substation (99-2971)
- Components 28–32: Brambleton, Goose Creek, Paragon Park, Sterling Park and Sycolin Creek substation upgrades (99-2971)

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New Aspen to Golden 500 kV and 230 kV OH Lines

The new 8.5-mile 500 kV OH lines from new Aspen to new Golden substation will require an entirely new ROW corridor for the line route using 500/230 kV double circuit two-pole structures. The line route is located in a predominantly vegetated and urban development area within northern Virginia Piedmont region in Loudoun County, Virginia.

New Golden to Mars 500 kV and 230 kV OH Lines

The new 8.3-mile 500 kV OH lines from new Golden to future Mars substation will require an entirely new ROW corridor for the line route using 500/230 kV double circuit two-pole structures. The line route is located in a predominantly vegetated and urban development area within northern Virginia Piedmont region in Loudoun County, Virginia.

Overall, the ROW risk for this proposal is high due to the utilization of greenfield ROW for the entire alignment of the proposed new lines.

Environmental Risk Analysis

The proposed routes go through wetlands, and the Mars-Golden line appears to cross the Dulles Greenway.

Medium constructability risks assessed due to anticipated challenges for land acquisition, and public opposition, given historical difficulty siting projects in Loudoun County and the greenfield nature of the project.

Transmission Line Risk Analysis

Given the short length of the proposed greenfield lines, the main transmission line risks are associated with land acquisition, siting and schedule risks.

Substation Risk Analysis

New Aspen 500/230 kV Substation

Aspen is a proposed new 500/230 kV substation located in Loudoun County, Virginia. Dominion has already acquired the land for this site. The substation includes a 500 kV double breaker, double bus GIS bus, one 500/230 kV transformer bank, and a 230 kV Breaker and a Half GIS bus.

New Golden 500/230 kV Substation

Golden is a proposed new 500/230 kV substation located in Loudoun County, Virginia. The substation includes a 500 kV double-breaker, double-bus GIS bus, two 500/230 kV transformer banks, and a 230 kV breaker-and-a-half GIS bus.

Other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects). Specifically for this proposal, there is some schedule risk for the procurement of the transformers and GIS bus components.

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 24**.

Table 24. Proposal 692 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Aspen-Golden 500 kV Line Build (99-2971)	98.35	93.50
2	Mars 500-230 kV Transformer Installation (99-3197)	42.19	38.00
3	Line #2150 (Golden to Paragon Park Circuit 1) Reconductoring (99-3188)	1.44	2.65
4	Line #2081 (Golden to Paragon Park Circuit 2) Reconductoring (99-3188)	1.44	2.65
5	Paragon Park Substation Equipment Rating Upgrade (99-3188)	0.09	0.10
6	Golden Relay Setting Upgrade Reset (99-3188)	0.02	0.05
7	Line #2207 (Paragon Park-Beco) Reconductoring (99-3200)	3.36	3.50
8	Paragon Park Substation Equipment Rating Upgrade (99-3200)	0.10	50.00
9	Beco Substation Equipment Rating Upgrade (99-3200)	1.86	2.00
10	New Mars-Lockridge -Golden 230 kV Lines Construction (99-2970)	76.52	78.15
11	New Mars-Golden 500 kV Line Construction (99-2970)	142.10	148.00
12	500 kV Line # 558 (Brambleton-Goose Creek) Cut-In to Aspen (99-2971)	10.93	10.93
13	New 500 kV Line from Aspen to Goose Creek (99-2971)	21.86	21.86
14	Line #2150 (Sterling Park to Paragon Park Circuit 1) Cut-In to Golden (99-2971)	16.39	16.39
15	Line #2081 (Sterling Park to Paragon Park Circuit 2) Cut-In to Golden (99-2971)	16.39	16.39
16	New 230 kV Line from Aspen-Golden (99-2971)	54.64	53.00
17 - 19	Golden, Lockridge and Mars Substation upgrades (99-2970)	42.74	44.00
20 - 25	Various Substation Overdutied Breaker Replacement (99-3208)	8.66	13.65
21	Beco Substation Overdutied Breaker Replacement (99-3208)	1.81	2.86
22	Belmont Substation Overdutied Breaker Replacement (99-3208)	1.90	2.86
23	Discovery Substation Overdutied Breaker Replacement (99-3208)	0.49	0.72
24	Pleasant View 230 kV Substation Overdutied Breaker Replacement (99-3208)	0.51	0.72

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
25	Shellhorn Substation Overdutied Breaker Replacement (99-3208)	0.93	1.50
26	New Aspen 500/230 kV Substation (99-2971)	195.13	196.00
27	New Golden 500/230 kV Substation (99-2971)	315.68	295.00
28 - 32	Various Substation Upgrades (99-2971)	8.56	13.14
	Total	**1,058.45**	**1,098.96**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

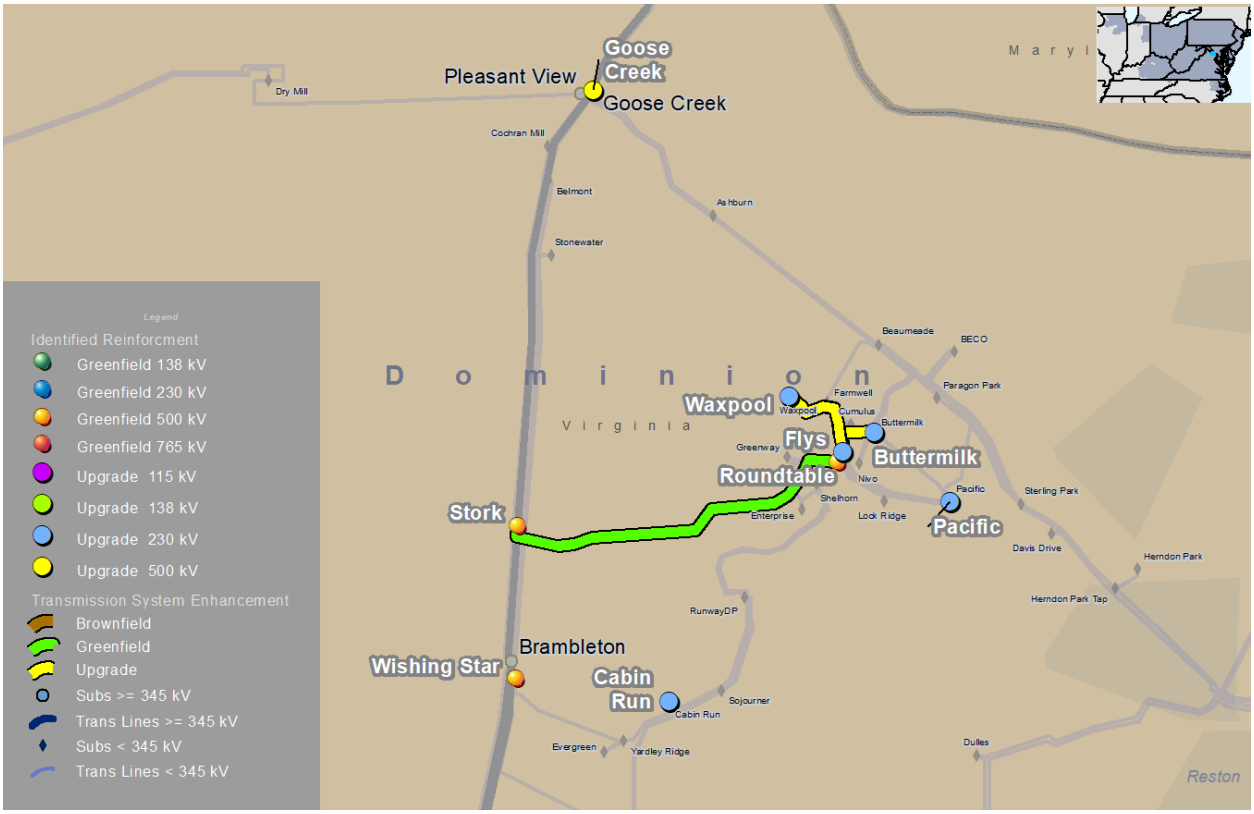
Schedule Review

Given the greenfield nature of the proposal and the noted concerns with siting transmission projects in Loudoun County, and potential schedule risks with the new Aspen and Golden substation equipment procurement, a medium schedule risk is assessed for this project.

Proposal 858 – Transource

Transource's Proposal No. 858 (**Map 26**), described as Stork-Flys 500 kV greenfield line and substations, involves a local solution intended to facilitate interconnections of data centers in the Dominion Service area. The project includes a new greenfield underground transmission line, greenfield substations, as well as multiple existing line and substation upgrades, all within Loudoun County, Virginia.

Map 26. Proposal 858



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

Transource's Proposal 858 includes the following components:

- Component 1: Stork 500 kV greenfield substation
- Component 2: Stork-Flys 500 kV underground line
- Component 3: Flys 500/230 kV substation
- Component 4: Roundtable-Buttermilk 230 kV line rebuild
- Component 5: Roundtable-Waxpool 230 kV line rebuild
- Component 6: Waxpool-Farmwell 230 kV line rebuild
- Component 7: Roundtable station upgrade
- Component 8: Wishingstar station upgrade
- Component 9: Cabin Run station upgrade
- Component 10: Pacific station upgrade
- Component 11: Goose Creek station upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New Stork to Flys 500 kV Underground Line

The main transmission line component for this proposal is the Storks-Flys 500 kV underground cable line, which is 5.04 miles long. The proposed route is entirely within public road right of way, and the proposed facilities are expected to occupy a 50 ft. corridor, with the specific plans to use the median of the public roads – Loudon County Pkwy. and Ryan Rd., which are large, divided thoroughfares.

Overall, the ROW risk for this proposal is high due to the utilization of greenfield ROW for the entire alignment of the proposed new lines. Although the project proposed use of public road ROW, it is considered greenfield due to the absence of an existing transmission corridor for the proposed route, which would mitigate concerns with permitting feasibility.

Environmental Risk Analysis

The transmission line is in a dense residential and commercial area and the proposed construction will have significant impact on Loudon County Pkwy. and Ryan Rd. due to the route feasibility being largely dependent on permitting approval from state and local permitting agencies, especially the Virginia Department of Transportation (VDOT). PJM consulted VDOT to obtain their feedback on the proposed underground route.

VDOT officials shared overall concerns with feasibility of the proposed project and specifically cited concerns with the construction approach for the proposed underground circuits and potential undermining of the road integrity, traffic mitigation concerns with anticipated lengthy closures to the impacted roads, and potential conflicts with existing sensitive underground fiber communication infrastructure that already occupy the public ROW. VDOT also noted the possibility that any issued single-use permit could still be rescinded by VDOT in order to accommodate future road improvement projects, resulting in the need to move the underground transmission line.

Due to the above risks, an overall high constructability risk was assessed for the proposed project.

Transmission Line Risk Analysis

Proposed route is along public roadways with numerous adjacent residential and commercial properties. Route crosses a major highway interchange, several busy intersections, and several culverts likely requiring trenchless crossing methods (HDD or boring). Road restoration will be required following construction. Given the short length of the proposed underground greenfield line route, the primary transmission line risks are those associated with permitting and some schedule risk associated with availability of 500 kV XLPE cables and accessories (e.g., splices).

Substation Risk Analysis

New Stork 500 kV Substation

Stork is a proposed new 500/230 kV substation located in Loudoun County, Virginia. The substation includes a 500 kV three-position GIS ring bus with three 500 kV CBs.

New Flys 500/230 kV Substation

Flys is a proposed new 500/230 kV substation located in Loudoun County, Virginia. The substation includes a 500 kV GIS building with one 500 kV CB and connections for the Stork-Flys underground line and two transformers, two 500/230 kV transformer banks, and a four-leg 230 kV double breaker, double bus GIS bus, with eight 230 kV CBs.

Other substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk. Schedule risk for the procurement of the transformers and GIS bus components.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 25**.

Table 25. Proposal 858 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Stork 500 kV Greenfield Substation	46.42	48.00
2	Stork-Flys 500 kV Underground Line	266.73	263.50
3	Flys 500/230 kV Substation	155.26	170.00
4	Roundtable-Buttermilk 230 kV Line Rebuild	3.41	3.00
5	Roundtable-Waxpool 230 kV Line Rebuild	9.88	6.30
6	Waxpool-Farmwell 230 kV Line Rebuild	5.00	3.30
7	Roundtable Station Upgrade	2.97	3.00
8	Wishingstar Station Upgrade	6.86	6.00
9	Cabin Run Station Upgrade	2.94	4.00
10	Pacific Station Upgrade	6.08	4.50
11	Goose Creek Station Upgrade	4.90	5.00
	Total	**510.44**	**516.60**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

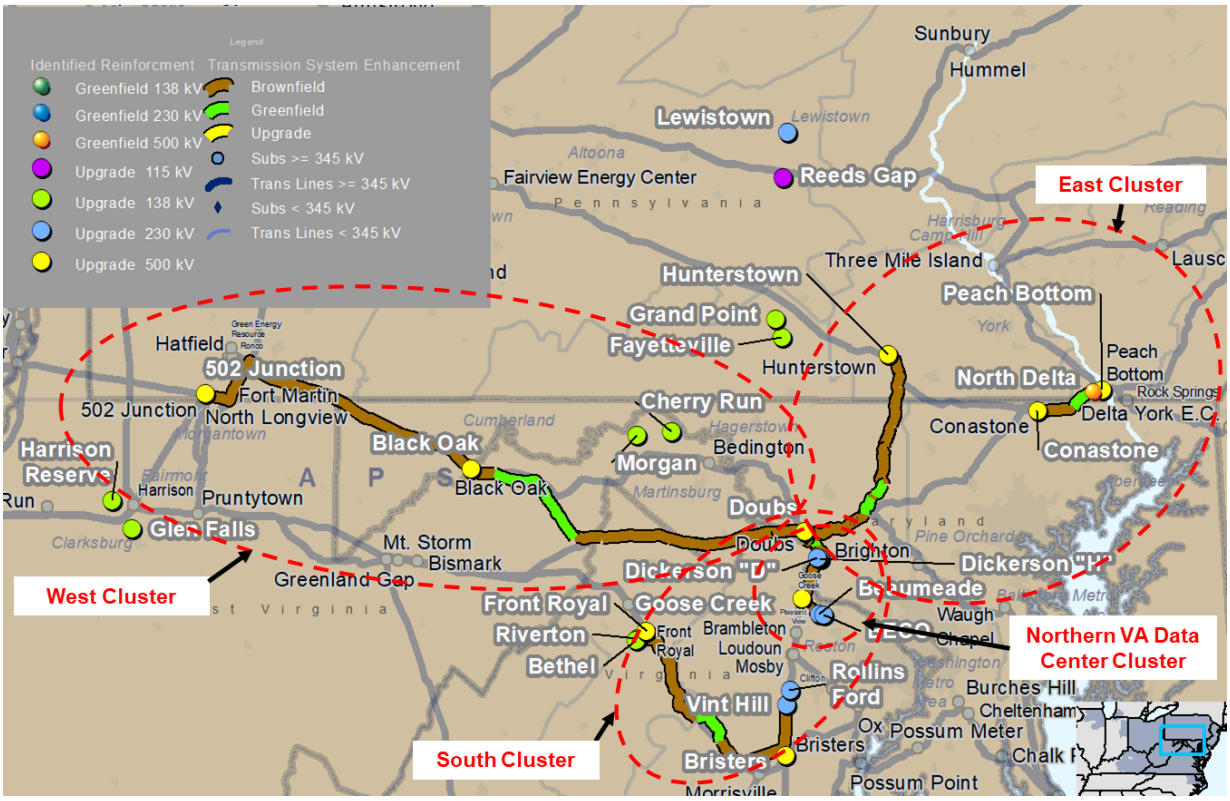
Schedule Review

Given the noted constructability concerns with permitting the underground Stork to Flys 500 kV line, and potential schedule risks with the new Stork and Flys GIS substation equipment procurement, a medium-high schedule risk is assessed for this project's proposed December 2027 in-service date.

Proposal 548 (Northern VA Data Center) – LS Power

LS Power Proposal No. 548 (**Map 27**), described as RTEP Window 3 Solution, provides a holistic solution to the RTEP Window 3 needs, comprising 37 components that can be grouped into the four regional clusters identified for the Window. Specifically for the Northern VA Data Center cluster, LS Power proposed components in Loudoun County, Virginia, which includes new greenfield underground line, as well as multiple substation and line upgrades.

Map 27. Proposal 548



*NOTE: This map is only intended to illustrate the general electrical connectivity of the projects and should **not** be relied upon for exact geographical substation locations or line routes.*

Project Overview

LS Power Proposal 548 includes the following components for the Northern VA Data Center cluster:

- Component 8: Beaumeade substation upgrade
- Component 16: DTC substation upgrade
- Component 17: Mars substation upgrade
- Component 24: Beaumeade-BECO-DTC 230 kV transmission line upgrade
- Component 31: BECO substation upgrade
- Component 36: Goose Creek-Beaumeade greenfield underground 500 kV double circuit transmission line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New Goose Creek-Beaumeade Greenfield Underground 500 kV Double Circuit Line

The main transmission line component for this proposal is the Beaumeade to Goose Creek 500 kV underground cable line, which is about 5.7 miles long. The Goose Creek-Beaumeade 500 kV underground double circuit line proposes the use of existing overhead line ROW, which also contains bicycle and walking trails on a former railroad ROW, known as the Washington and Old Dominion Trail (W&OD Trail) that traverses suburban residential areas. A ROW width of 8 feet was given for the underground corridor, but there was no information given on the need for construction or O&M easements which would undoubtedly be required.

The ROW risk for this proposal is medium-high due to the route paralleling existing overhead transmission for the entire length of greenfield ROW for the entire alignment of the proposed new lines.

Environmental Risk Analysis

Route is already occupied by multiple overhead transmission lines and passes through many dense residential neighborhoods with homes abutting the trail. Several water and roadway crossings will require trenchless crossing methods (HDD or jack and bore).

This route proposes use of the Washington and Old Dominion Trail (W&OD Trail) and will require permitting with the Northern Virginia Regional Park Authority, which adds a layer of complexity to the overall process given the recreational use of this corridor and the NOVA Park's requirement that any construction projects must ensure continued access to the park's recreational facilities at all times. An added significant concern is that the NOVA Park's indication that the Dominion Virginia Power owns the easement for the entire W&OD Park and that construction on the park would require Dominion's explicit approval.

LS Power noted potential alternative routes were considered, with the VA State Route 7 as an example but did not offer any detailed information on these alternatives.

Due to the above risks with permitting and siting of the underground line, an overall high constructability risk was assessed for the proposed project.

Transmission Line Risk Analysis

Given the short length of the proposed underground greenfield line route, the primary transmission line risks are those associated with permitting and some schedule risk associated with availability of 500 kV XLPE cables and accessories (e.g., splices).

Substation Risk Analysis

The substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades in general are low risk.

There are currently long lead times of two to three years for all circuit breakers above 115 kV. Therefore, the procurement of these circuit breakers will most likely be the critical path for the majority of the substation components (projects).

Given the above lead-time constraints, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

Cost Review

As part of the detailed constructability analysis, PJM and its consultants prepared a high-level conceptual independent cost estimate for the components of this proposal. This estimate is based on a high-level assessment of probable costs for the current conceptual design and is reflective of recent supplier quotes and previous experience with substation engineering, transmission line engineering and construction. The independent cost estimate includes a contingency of 30%, as it is a concept-level estimate. A side-by-side comparison of proposing entity costs and independent cost estimates are contained in **Table 26**.

Table 26. Proposal 548 (Dominion) Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
8	Beaumeade Substation Upgrade	61.30	45.00
16	DTC Substation Upgrade	6.38	7.00
17	Mars Substation Upgrade	46.21	50.00
24	Beaumeade-BECO-DTC 230 kV Transmission Line Upgrade	2.30	3.00
31	BECO Substation Upgrade	5.67	6.00
36	Goose Creek-Beaumeade Greenfield Underground 500 kV Double Circuit Transmission Line	161.93	196.52
	Total	**283.78**	**307.52**

The total proposal cost estimate is within 10% of the independent cost estimate and is considered low risk.

Schedule Review

Given the noted constructability concerns with permitting the underground Goose Creek to Beaumeade underground 500 kV double circuit line, a medium-high schedule risk is assessed for this project's proposed December 2030 in-service date.

FINANCIAL ANALYSIS

Approach

Altogether, PJM received 72 proposals submitted by 10 different entities, including both incumbent transmission owners and non-incumbent entities, and each proposal was reviewed for completeness and consistency of cost information. Ultimately, a subset of projects were selected for a more detailed 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' present value revenue requirements (PVRR) 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, component current year and escalated costs, and key dates (construction start, capital spend start and in service).
- Project Financial Information Schedule (Attachment 7 or CapEx Template) – Developers completed the financial information schedule for each proposed project. The financial information schedule depicts annual capital spend by project element for both the proposer and "Work by Others" entities. It also includes an estimate of AFUDC (Allowance for Funds Used During Construction), the Capital Spend Start Date, Construction Start Date, and Commercial Operation Date.
- 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 for all projects, described later in this report, to ensure comparability. However, the proposer's revenue requirement schedule was used to obtain model inputs, such as operations and maintenance (O&M), property taxes and working capital.

Additional documents submitted by some proposers included:

- Cost Containment Legal Language (Attachment 11) – Developers proposing projects with cost-capping mechanisms submitted a separate document describing their cost containment in detail and typically in the form of a draft Schedule E for potential inclusion in the non-standard terms of a Designated Entity Agreement (DEA).

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

With the common template developed, PJM and its consultants then conducted a detailed cost analysis for the 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 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 PVRR 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, a well-capped proposal could considerably lower-cost overrun risks, while a poorly capped or uncapped proposal could result in millions of extra ratepayer dollars over the lifetime of the project if actual project costs are higher than proposed.
- Sensitivity Analysis – In addition to the base case NPVRR comparison for the modeled proposals, PJM also modeled eight scenarios that alter one or multiple model inputs. Seven of the scenarios alter a single variable (setting the return on equity to 12%, increasing the cost of debt to 9%, increasing project costs by 50% or 100%, increasing O&M by 50%, setting the capital structure at 60% equity, and increasing work by others "WBO" project costs by 50%). An eighth, referred to as "downside," combines the impacts of the multiple 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.

Analysis Results

The following sections outline the results of PJM and its consultant's detailed financial evaluations performed on select proposals. The outcome of the financial analysis factors into the cost containment risk assessment, a category within the risk assessment matrices that are included in Appendix A of this report.

Cost Containment

Proposal Cost Containment Overview

The cost containment mechanisms for each proposal are defined by developer and are summarized in **Figure 2** and **Figure 3** detailed in the supporting text below:

Figure 2. Overview of Cost Containment by Developer

Cap Type	Transource	LSP	NextEra	PSEG	PECO	PEPCO	PPL
Project Cost		✓	✓	✓	✓	✓	✓
Soft (Hybrid) Cap	✓	✓	✓		✓	✓	
Hard Cap				✓			✓
ROE Cap (inclusive of adders)		✓	✓	✓			
Equity % Cap		✓	✓	✓			
Schedule Guarantee			✓				

Note: *Proposals from AEP, Dominion and First Energy did not provide cost containment mechanisms.*

Detailed Cost Containment Review

Transource

Transource provided a hybrid cost cap. For any capital expenditures that exceed their original cost estimate, Transource's ROE on that incremental capital is reduced from 10% to 9.5%, as it is foregoing the 50 basis point RTO participation adder. Transource is still recovering all depreciation expense and debt costs associated with the incremental capital spend.

For three of their four proposals (858, 904, 977), Transource only capped four specific cost elements deemed to be within their control (Engineering and Design, Materials and Equipment, Construction and Commissioning, Construction Management).

For proposal 487, Transource capped all cost elements except contingency. Transource did not offer a binding ROE cap.

LS Power

LS Power provided a hybrid cost cap. For any capital expenditures that exceed their original cost estimate, LS Power's ROE on that incremental capital is reduced based on the amount of the exceedance. LS Power is still recovering all depreciation expense and debt costs associated with the incremental capital spend.

The ROE LS Power will request on incremental capital spend above the original cost estimate is reduced from 9.8% according to the tiers listed below:

- For capital cost overages of 1–25% (inclusive), LSP's ROE on the incremental capital spend shall be 8.5%.
- For capital cost overages above 25% up to and including 50%, LS Power's ROE on the incremental capital spend shall be 7%.
- For capital cost overages above 50%, LSP's ROE on the incremental capital spend shall be 5.5%.

LS Power offered a binding ROE cap of 9.8% and a binding equity percentage cap of 50%. The ROE cap adjusts downward due to the project cost cap reducing total project ROE if actual capital costs exceed the CapEx estimate according to the tiers above.

NextEra

NextEra offered a binding ROE cap of 9.8% and a binding equity percentage cap of 45%.

NextEra provided a hybrid cost cap. For any capital expenditures that exceed their original cost estimate, NextEra's ROE on that incremental capital is reduced from 9.8% to 0%. NextEra is still recovering all depreciation expense and debt costs associated with the incremental capital spend.

Twenty-three of 26 NextEra proposals have a "Soft Cap," which means that regardless of other cost containment provisions, the total earned ROE cannot be lower than 7% or 7.5%, depending on the proposal. The three proposals with a "Hard Cap" do not have a minimum earned ROE. All three NextEra proposals modeled in this evaluation (663, 853, 948) have a "Soft Cap."

NextEra provided a schedule guarantee where the total project ROE is reduced by 2.5 basis points for each month delay past the guaranteed completion date up to a maximum of 30 basis points.

PSEG

PSEG submitted a traditional binding Hard Cap on capital costs, in which they will not request recovery of any depreciation expense, return on equity, or debt costs associated with any capital expenditures above their cost cap. All of PSEG's cost caps were set at 120% of their original capital expenditure estimate.

PSEG offered a binding ROE cap of 9.60% and a binding equity percentage cap of 45%.

Exelon (PECO & PEPCO)

PECO and PEPCO both submitted proposals with a hybrid cost cap, which entailed a special mechanism to provide a return of 1–2% of cost overruns to ratepayers once project costs exceed 5% of estimates. This mechanism is uncapped and covers a small percentage of cost overruns relative to other proposals. However, this hybrid cost cap mechanism was not modeled due to excessive exclusions.

PECO and PEPCO excluded the following from their cost cap that led PJM's consultant to the decision to not model their cost cap for the sensitivity analysis:

- All components of proposal are not selected by PJM.
- An easement or corridor is not available as described in bid.
- Deratings of transmission lines
- A transmission line crossing is not available.
- Labor cost escalation exceeds 5% annually until 2030.
- Steel, copper and aluminum prices exceed 2.5% compound increase from date of purchase.

PPL

PPL submitted proposals with a traditional hard cost cap, but the hard cost caps were not modeled due to excessive exclusions.

PPL excluded the following from their cost cap that led PJM's consultant to the decision to not model their cost cap for the sensitivity analysis.

- Inability to acquire land rights
- Environmental permitting delays
- Cost of materials, components or equipment increase by 10%.
- 3.5% annual increase in labor costs
- PJM does not award project before Oct. 1, 2023.

Cost Containment Observations

As shown in the above section, developers submitted varying levels of cost containment. The most common cost containment mechanism was a project cost cap, with seven of ten developers offering some type of project cost cap. NextEra, LS Power and PSEG also submitted binding ROE caps and equity percentage caps.

Despite a majority of developers offering a project cost cap, it is important to differentiate between a true "traditional" Hard cost cap and what is considered as a Soft "hybrid" cost cap.

A traditional cost cap prevents the developer from requesting recovery in rates for any depreciation expense, cost of debt, or return on equity associated with incremental dollars of CapEx spent above the cost cap. A "hybrid" cost cap is one that allows the developer to recover depreciation expenses and cost of debt associated with incremental dollars above the cost cap, while the return on equity on the incremental CapEx is reduced (as low as 0%). This is a significantly less-effective cost cap, as shown by the results from the sensitivity analysis in later sections of this report. Additionally, as discussed in the above section, some entities submitted a cost cap, but the exclusions to the cost cap were so excessive that led to the decision not to model the cost cap.

Modeling Approach & Assumptions

Modeling Approach

To evaluate a proposal's lifetime cost to ratepayers, Consultant computes the Present Value Revenue Requirement (PVRR). Revenue requirement, or cost of service, reflects the total revenue that needs to be collected in rates for a company to recover its capital, operational expenses, tax expenses and earn a fair return on its capital investments.[1] In the revenue requirement model, revenue requirement in each modeling period is calculated as the sum of O&M/A&G (administrative & general) expenses, depreciation on capital investment, income and property taxes, cost of debt (interest), and equity return on rate base. The revenue requirement model was developed using a standard FERC-accepted cost recovery approach. Consultant built up the various components of revenue requirement for every month during the project's useful life, then discounted future streams of revenue requirement using a common discount rate for all proposals.

The cost-of-service inputs used in the model are mostly provided directly by developers. For fair comparison, Consultant also made several common assumptions that may be different from developers' inputs, such as the inflation rate and discount rate. These assumptions are explained in more detail in the following Modeling Assumptions section.

For certain components included in proposals, the entity responsible for construction is not the proposing entity or one of its affiliates. These are known as "Work by Others" or "WBO" components. All results shown in this report include Work by Others.

[1] The rate of return on equity will be reviewed and approved/adjusted by FERC for transmission projects.

If a proposal included WBO, the developer also provided an estimated CapEx for these WBO elements.

For some proposals, a total estimated WBO CapEx was provided, rather than an estimated CapEx in each year. In these cases, the WBO is assumed to follow the same spend curve as the proposer.

Baseline Assumptions

Across all proposals, Consultant applied several standardizing assumptions, summarized in **Table 27**, to ensure a fair comparison of present value outcomes:

Table 27. Baseline Model Assumptions

Discount Rate	6.81%
Inflation Rate	2.10%[2]
Earliest Capital Spend Start Date	1/1/2024
Date Used for Discounting	1/1/2024

Modeling Period Assumptions

Projects with construction periods starting in 2023 were adjusted to begin on Jan. 1, 2024. No project spending was modeled until 2024. Any CapEx submitted the year after the in-service date was moved to the final year of construction. Additionally, property tax and O&M were not modeled until a project is placed in service.

For projects with partial in-service dates (in which some parts of the project are placed in service during the construction period), Consultant still assumed that revenue requirement recovery does not begin until the final in-service date unless the project is earning a return on CWIP.

The revenue requirement model uses monthly granularity. While developers provided specific month-year clarity around construction start and in-service dates, much of the revenue requirement and capital spend data is provided on an annual basis. To account for this, Consultant divided annual expenditures by the number of relevant months when partial-year spending data occurs (typically only the first and last year of the project).

CapEx and Depreciation Assumptions

CapEx

Capital costs are collected from Attachment 7, which provides a year-by-year spend schedule broken down by cost element (Engineering & Design, Materials and Equipment, etc.).

[2] For the year 2024, a 3.1% inflation rate was used, but 2.1% is used for every year after 2024.

The associated financing costs of construction are modeled using either return on Construction Work In Progress (CWIP) or AFUDC for each proposal. Both returns on CWIP and AFUDC are calculated using the developer-specific after-tax WACC. If a developer does not specify collecting a return on CWIP versus AFUDC, Consultant modeled AFUDC. Transource is the only developer that clearly claimed a return on CWIP.

Capital Streams

To isolate the financial behavior of different parts of each proposal, three capital streams were developed and modeled independently. Streams isolate the behavior of different types of CapEx:

- CapEx Stream 1 – Capped work by the proposer
- CapEx Stream 2 – Uncapped work by the proposer
- CapEx Stream 3 – Uncapped work by others

Contingency is modeled separately for each CapEx stream for the purposes of the capital spend increase sensitivities but is included in total CapEx.

All revenue requirement results in this report show the sum of the revenue requirements of each of the three CapEx streams.

Book Depreciation

Straight-line depreciation method is used for all proposals, assuming no salvage value or removal cost. Book depreciation is calculated using the useful life, which is derived from the developer-provided revenue requirement workbooks.

Tax Depreciation

Each project uses the 15-Year Modified Accelerated Cost Recovery System (MACRS) mid-year convention schedule for tax depreciation.

O&M/A&G Assumptions

In instances where O&M/A&G is not provided, it was estimated using the following methodology:

- Consultant assumed that 1% of total CapEx would yield a reasonable estimate of Year 1 O&M. This is an industry-standard value. Additionally, Consultant verified this estimate by calculating the proportion of total capital expenditures spent on O&M for all revenue requirement workbooks that did include O&M. On average, O&M was 1.06% of total capital expenditures.
- For each proposal, Consultant calculated 1% of the proposal total CapEx and assumed this value as the Year 1 annual O&M (adjusted for in-service date as necessary).

- After the first year of in-service date, Consultant inflated O&M by 2.1% annually over the useful life of the project.

In cases where cash working capital was not provided, it was modeled as one-eighth of the total O&M for each year, which is another industry-standard value.

Consultant did not model pre-in-service O&M/A&G when a developer submitted it as part of their revenue requirement.

Tax Assumptions

Each developer submitted a unique tax profile, which is used to gross up ROE requirements. Different state tax rates are provided based on the specific state geography of the projects.

Property Tax

Consultant did not model pre-in-service property taxes when a developer submitted it as part of their revenue requirement. If property tax estimates were not provided by the developers, property tax was calculated as 1% of net plant.

In any year in which the project is not in service for the entire year (the first and last year of the project life if the in-service date is anything other than Jan. 1), Consultant scaled the depreciation by the number of months in service to calculate partial-year property tax.

Income Tax

Deferred taxes were calculated based on tax-book life differences and used accordingly to reduce rate base each month.

Contingency

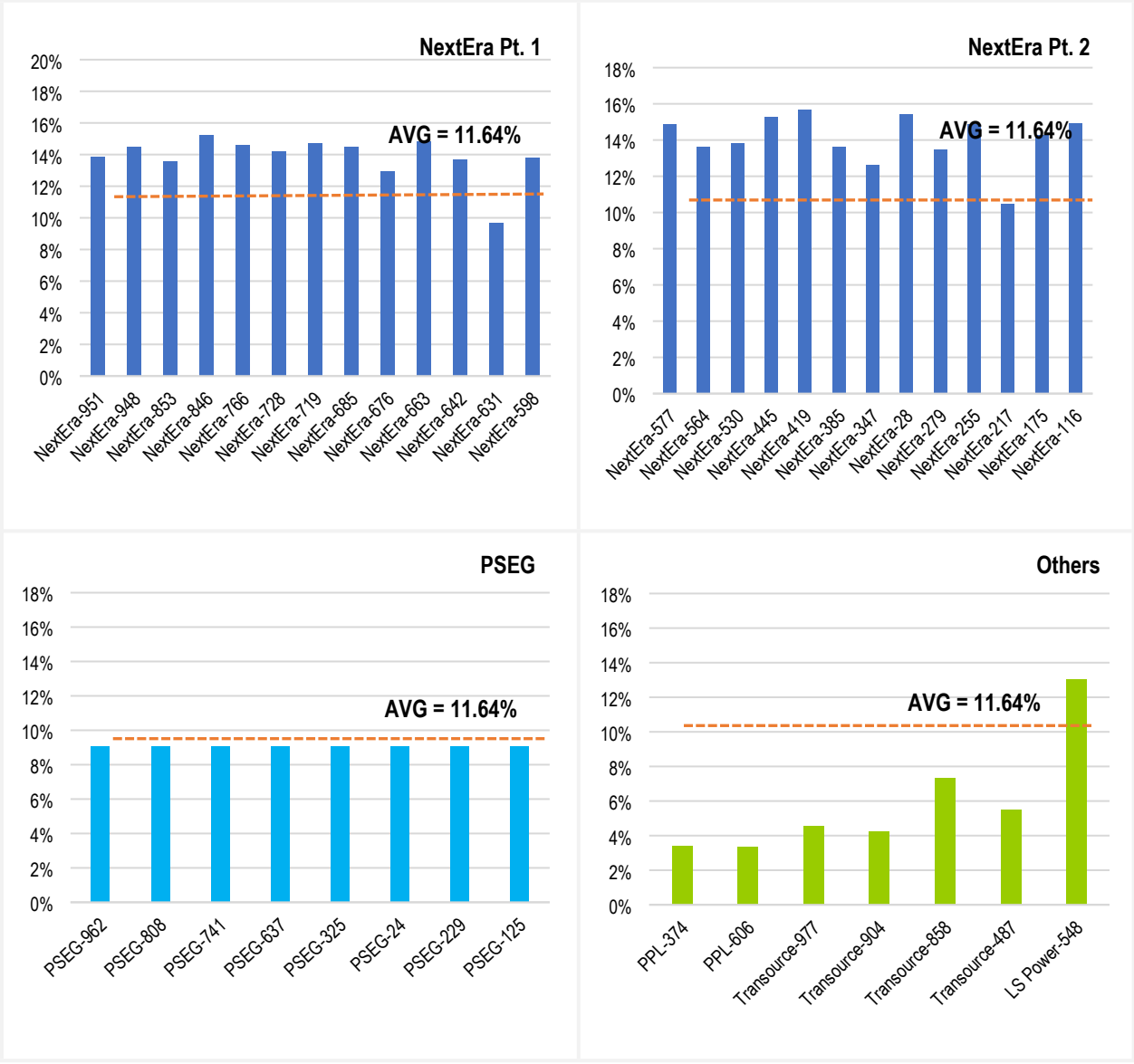
All proposers, with the exception of the Exelon companies (PECO and PEPCO), provided some level of contingency in their cost estimates. The revenue requirement model provides a vehicle to compare the revenue requirement resulting from the various proposals' submitted costs. Consultant did not choose to standardize contingency because each proposer strategically developed its own level of contingency. Additionally, there could be multiple "layers" of contingency built into each CapEx element. With that said, a brief analysis of the various levels of contingency proposed is useful in adding to the information available in the selection process.

While a low level of contingency allows the total costs to be lower than similar proposals with higher contingencies, that cost advantage comes with a greater risk of exceeding cost estimates and risking the ability to recover costs when cost containment measures are in place. **Contingency (**Cost-Contained Proposals) below, provides a comparison of contingency levels by proposer. Developers listed in the tables are split by whether the developer offered cost containment or not. All contingency amounts apply only to costs incurred by the proposer and exclude costs incurred by other entities (WBO). The percentages are calculated by dividing the contingency amount by the total proposer CapEx, excluding the contingency.

The contingency as a percentage of total cost across all proposals, excluding WBO, ranges from 0% to 15.67%. For the proposers that offered cost containment, the average contingency is 11.64%; however, there is significant variation.

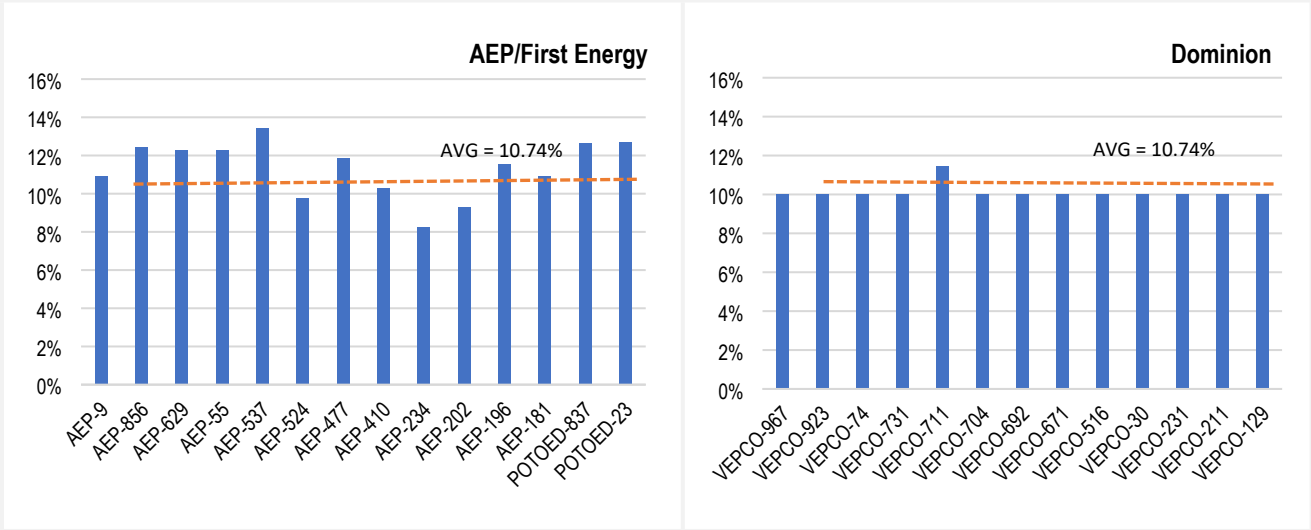
PPL proposals have a contingency of 3.37%, which is the lowest among proposers offering contingency estimates. Transource proposal contingencies range from 4.21% to 7.34%, PSEG proposals have a contingency of 9.09%, NextEra proposal contingencies range from 9.65% to 15.65%, and the LSP proposal has a contingency of 13.04%.

Figure 3. Contingency (Cost-Contained Proposals)



In **Contingency (**Cost-Contained Proposals) illustrates the proposals that did not offer cost containment, the contingency ranges from 8.26% to 13.43%, with an average of 10.74%. Dominion has contingencies that range from 9.99% to 11.45%, AEP ranges from 8.26% to 13.43%, and FirstEnergy ranges from 12.67% to 12.69%.

Figure 4. Contingency (Non-Cost-Contained Proposals)



For model sensitivities where capital cost increases, contingency is removed from capital cost prior to the 125% or 150% multiplier being applied (See Section 0 for Model Sensitivities). This is because Consultant assumes that the contingency will be used to absorb project cost increases. Once the contingency is fully exhausted, the sensitivity will increase the project cost accordingly, subject to cost containment.

PJM Proposal Scenarios

PJM's proposal scenarios are a combination of individual proposals and are representative of the solutions being offered by the participating entities. These scenarios will be subjected to the sensitivity analysis. The scenarios are identified in **Table 28** through **Table 35** defined below:

Table 28. Transource Scenario A Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
487	Maryland & Pennsylvania Baseline Reliability Solution	Transource
858	Stork-Flys 500 kV Greenfield Line and Substations	Transource
904	Joshua Falls-Yeat 765 kV Greenfield Line and Substation	Transource

Table 29. NextEra Scenario B Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
663	Front Royal-Racefield, Warrenton-Rixlew, Warrenton-Hourglass, Mars-Ocean Court-Davis Drive	NextEra
853	502 Junction-Black Oak-Woodside-Gant, Woodside SVC + Cap Banks	NextEra
948	New 500/230 kV Bartholow substation, new 500/230 kV North Delta substation, new 230 kV Grisham switchyard, new 500/230 kV Goram substation, and Keeney to Waugh Chapel tie-in.	NextEra

Table 30. LS Power Scenario C Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
548	RTEP Window 3 Solution	LS Power

Table 31. Exelon Scenario D Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
344	PECO Expansion Plan for DOM Window 2023	PECO
660	West Cooper BGE-PEPCO	PEPCO

Table 32. First Energy Scenario E Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
837	Data Center Reinforcement Proposal #1	POTOED

Table 33. Dominion Scenario F Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
74	Line #2090 (Ladysmith CT-Fredericksburg) Rebuild	Dominion
211	Hollymead-Gordonsville Line # 2135 Rebuild	Dominion
516	Interregional solution – Aspen-Doubs Second 500 kV Line	Dominion
671	Lines #541 (Front Royal to Morrisville) Rebuild	Dominion
692	Data Center Alley Local solution – New 500 kV/230 kV Aspen-Golden & Golden-Mars lines	Dominion
711	Regional Solution – 500 kV North Anna-Wishing Star Upgrades	Dominion
731	Locks Substation 230/115 kV Transformer Upgrade	Dominion
923	The second 500 kV line from Lexington to Dooms	Dominion
967	Charlottesville-Hollymead Line # 2054 Rebuild	Dominion

Table 34. PPL Scenario G Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
374	Otter Creek-Conastone 500 and 230 kV double circuit Line	PPL
606	Juniata-Lewistown 230 kV # 2 line	PPL

Table 35. PSEG Scenario H Definition

Proposal ID Combination	Proposal ID Combination	Proposing Entity
741	Proposal G – Peach Bottom-New Brandon Shores 500 kV; Peach Bottom-Doubs 500 kV	PSEG

Model Sensitivities

Eight sensitivities, summarized in **Table 36**, were applied to each proposal to assess financial performance. They were used to test the effectiveness of cost-containment mechanisms against potential project cost increases.

Table 36. Model Sensitivities

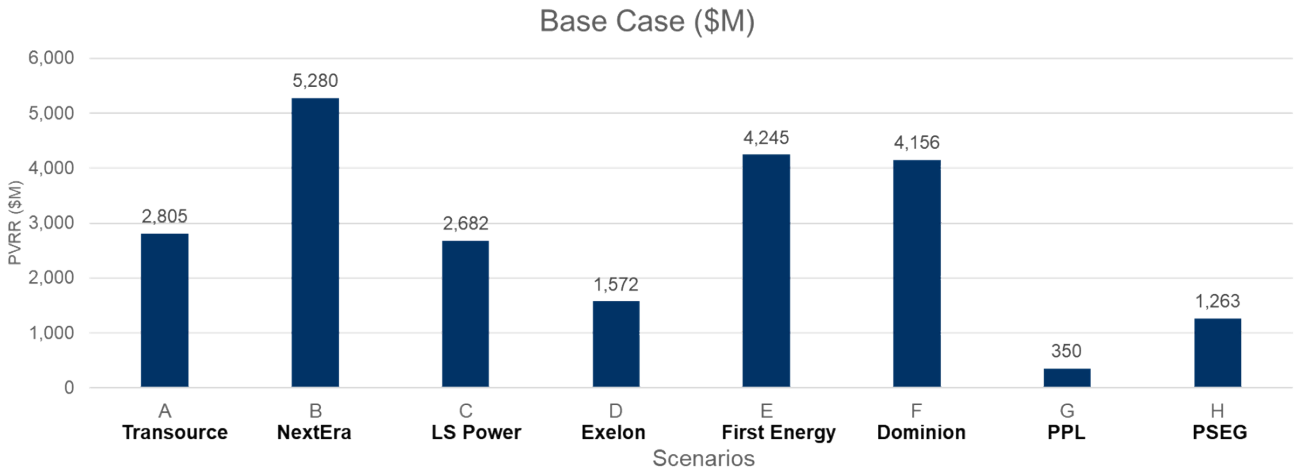
#	Sensitivity	Variable	Description
1	**Base Case**	None	Model the proposal using inputs from developer and revenue requirement model calculations
2	**WBO +50%**	Single Variable	Work by others project cost increased by 50% for all periods
3	**Project Cost +50%**	Single Variable (*changes to capex may affect Return On Equity ("ROE") for some developers*)	Proposer's project cost increased by 50% for all periods *(unless capped)*
4	**Project Cost +100%**	Single Variable (*changes to capex may affect Return On Equity ("ROE") for some developers*)	Proposer's project cost increased by 100% for all periods *(unless capped)*
5	**ROE 12%**	Single Variable	Return on Equity raised to 12% for all periods *(unless capped)*
6	**Cost of Debt 9%**	Single Variable	Cost of Debt raised to 9% for all periods
7	**Equity 60%**	Single Variable (*changes to Debt-to-Equity ratio may affect ROE for some developers*)	Equity thickness set to 60% for all periods *(unless capped)*
8	**O&M +50%**	Single Variable	O&M expense increased by 50% for all periods *(unless capped)*

#	Sensitivity	Variable	Description
9	**Downside** (*includes various changes above*)	Multiple Variables (*changes to capex and equity % may affect ROE for some developers*)	Proposer's project cost +50% *(unless capped)* O&M +50% *(unless capped)* ROE 12% *(unless capped)* COD 9% Equity 60% *(unless capped)*

Results and Key Observations

Scenario Base Case PVRR Comparisons

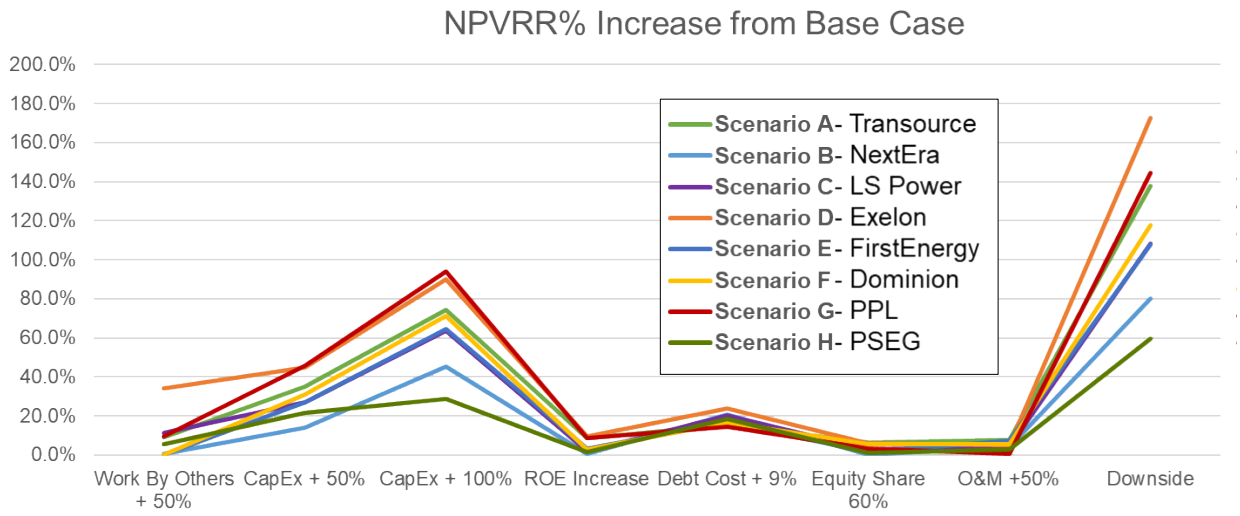
Figure 5. Base Case PVRR Comparison



PJM Scenario Results: The final PJM scenarios are grouped by developer and vary in PVRR from $0.4 B to $5.3 B based on the projects included in each scenario. Because the projects are not analogous, comparisons between proposal scenarios for the base case PVRR can best be viewed in conjunction with project benefits, which are not included in the above **Figure 5**. However, the next set of results focusing on scenario sensitivities are more informative about the relative performance of the developer's cost containment mechanisms in mitigating cost overruns.

Scenario PVRR Sensitivity Comparisons

Figure 6. Scenario Sensitivity Results



PJM Scenario Results: The above **Figure 6** demonstrates the volatility of scenarios across modeled sensitivities. PSEG Scenario H, with the traditional Hard Cost Cap displays the best performance and is least volatile in most sensitivities, including the downside sensitivity.

APPENDIX A – CONSTRUCTABILITY MATRICES

Risk Assessment Criteria

PJM Risk Assessment Criteria						
Risk Assessment	**Cost Estimate Risks**	**Cost Containment Risk**	**Schedule Risks**	**Constructability Risks**	**Use of Existing ROW/Brownfield**	**Outage Coordination Risks**
Low	Greater than or within 0-10% of Independent Estimate	Hard cost cap	Ratings assessed based on independent assessment of proposed in-service dates, and assessment of significant schedule risks such as such as permitting and constraint mitigation, long-lead material procurement, land/ROW acquisition, construction complexity.	Ratings assessed based on independent assessment of the number and severity of constructability risks assessed for the proposed project scope, such as permitting and constraint mitigation, land/ROW acquisition, construction complexity.	Rebuild/Reconductor Upgrades or Pure Brownfield	Minimal existing facility outages required, beyond short outages to cut-in to existing facilities
Medium	Within 10-20% of Independent Estimate	Soft cost containment (e.g ROE caps)			Mostly Brownfield (i.e. Uses/Overlaps existing ROW but requires expansion)	Significant existing facility outages required, with reasonable outage coordination plan proposed
Medium-High	Within 20-30% of Independent Estimate	Minimal cost containment/Excessive Exclusions			Greenfield paralleling existing ROW	Significant existing facility outages required, with no coordination plan proposed
High	Less than 30% of Independent Estimate	No cost containment			Pure Greenfield	Significant existing facility outages required, with known operational concerns and no coordination plan proposed.

NOTE:

- PJM conducted its constructability evaluation of the project data submitted by proposers, and engaged expert consultants to evaluate the constructability, cost estimation and cost containment risks of the projects.
- PJM also reached out to key regulatory agencies for their insight on certain projects to help clarify permitting risks.
- This risk assessment is not intended as a pass/fail or quantitive test, but rather as qualitative information on potential risks PJM has considered along with the reliability performance in selection of the finalist scenarios, and ultimately the recommended solution.

East Cluster Constructability Matrix

East Cluster Projects – Selected for Detailed Evaluation											
PJM Proposal ID	Proposing Entity	Project Title	Proposed In-Service Date	Proposal Costs ($M)	Independent Costs ($M)	Cost Estimate Risks	Cost Containment Risks	Schedule Risks	Constructability Risks	Use of Existing ROW & Brownfield	Outage Coordination Risks
344	Exelon	PECO Expansion Plan for DOM Window 2023	12/1/2029	$ 168.63	$ 214.81	Medium	Medium-High	Low	Low	Low	Medium
660	Exelon	West Cooper BGE-PEPCO	12/1/2030	$ 1,105.62	$ 1,060.63	Low	Medium-High	Low	Low	Low	Medium
548	LS Power	RTEP Window 3 Solution (East)	6/1/2030	$ 495.83	$ 609.44	Medium	Medium	Low	Medium	Medium-High	Medium-High
637	PSEG	Proposal D-Conastone-Doubs 500kV	6/1/2027	$ 684.22	$ 676.36	Low	Low	Medium	Medium	High	Low
741	PSEG	Proposal G - Peach Bottom-New Brandon Shores 500kV; Peach Bottom-Doubs 500kV	6/1/2028	$ 1,065.32	$ 1,178.75	Low	Low	Medium-High	High	High	Low
487	Transource	Maryland & Pennsylvania Baseline Reliability Solution	3/1/2027	$ 492.75	$ 503.43	Low	Medium	Low	Low	Medium	Medium
374	PPL	Otter Creek - Conastone 500 and 230 kV DCT Line	5/1/2027	$ 154.21	$ 162.69	Low	Medium-High	Low	Low	Medium	Medium
948	NextEra	New 500/230kV Bartholow substation, new 500/230kV North Delta substation, new 230kV Grisham switchyard, new 500/230kV Goram substation, and Keeney to Waugh Chapel tie-in	6/1/2028	$ 5,381.25	$ 6,265.88	Medium	Medium	High	High	High	Low

West Cluster Constructability Matrix

West Cluster Projects – Selected for Detailed Evaluation											
PJM Proposal ID	Proposing Entity	Project Title	Proposed In-Service Date	Proposal Costs ($M)	Independent Costs ($M)	Cost Estimate Risks	Cost Containment Risks	Schedule Risks	Constructability Risks	Use of Existing ROW & Brownfield	Outage Coordination Risks
837	POTOED - FirstEnergy	Data Center Reinforcement Proposal #1 (West)	6/1/2030	$ 2,788.40	$ 2,642.05	Low	High	Medium	Medium-High	High	Low
548	LS Power	RTEP Window 3 Solution (West)	6/1/2030	$ 972.71	$ 876.03	Low	Medium	Medium	Medium-High	Medium-High	Medium
853	NextEra	502 Junction - Black Oak - Woodside - Gant, Woodside SVC + Cap Banks	6/1/2027	$ 683.55	$ 1,195.24	High	Medium	Medium-High	Medium-High	High	Medium
904	AEP - Transource	Joshua Falls - Yeat 765kV Greenfield Line and Substation	12/1/2029	$ 1,048.10	$ 1,122.40	Low	Medium	Medium-High	Medium	High	Low

South Cluster Constructability Matrix

South Cluster Projects – Selected for Detailed Evaluation											
PJM Proposal ID	Proposing Entity	Project Title	Proposed In-Service Date	Proposal Costs ($M)	Independent Costs ($M)	Cost Estimate Risks	Cost Containment Risks	Schedule Risks	Constructability Risks	Use of Existing ROW & Brownfield	Outage Coordination Risks
516	Dominion	Interregional solution- Aspen-Doubs Second 500 kV Line	12/1/2027	$ 61.72	$ 77.95	Medium-High	High	Low	Low	Low	Medium
711	Dominion	Regional Solution - 500 kV North Anna-Wishing Star Upgrades	12/1/2027	$ 1,227.84	$ 1,284.62	Low	High	Medium	Low	Low	Medium
548	LS Power	RTEP Window 3 Solution (South Components)	6/1/2030	$ 628.56	$ 617.00	Low	Medium	Medium-High	Medium-High	Medium-High	Medium
325	PSEG	Proposal E - Brambleton-Hinsons Ford Rd 500kV	6/1/2027	$ 267.38	$ 275.56	Low	Low	High	High	High	Low
837	POTOED - FirstEnergy	Data Center Reinforcement Proposal #1 (South)	6/1/2030	$ 203.38	$ 209.16	Low	High	Low	Low	Low	Medium
663	NextEra	Front Royal - Racefield, Warrenton - Rixlew, Warrenton - Hourglass, Mars - Ocean Court - Davis Drive	6/1/2027	$ 284.17	$ 514.17	High	Medium	High	High	High	Low

Northern VA Data Center Cluster Constructability Matrix

Northern VA Data Center Cluster Projects – Selected for Detailed Evaluation											
PJM Proposal ID	Proposing Entity	Project Title	Proposed In-Service Date	Proposal Costs ($M)	Independent Costs ($M)	Cost Estimate Risks	Cost Containment Risks	Schedule Risks	Constructability Risks	Use of Existing ROW & Brownfield	Outage Coordination Risks
692	Dominion	Data Center Alley Local solution - New 500 kV/230 kV Aspen-Golden & Golden-Mars lines	12/1/2027	$ 1,058.45	$ 1,098.96	Low	High	Medium	Medium	High	Low
858	AEP - Transource	Stork - Flys 500kV Greenfield Line and Substations	12/1/2027	$ 510.44	$ 516.60	Low	Medium	Medium-High	High	High	Low
548	LS Power	RTEP Window 3 Solution (Dominion Components)	6/1/2030	$ 283.78	$ 307.52	Low	Medium	Medium-High	High	Medium-High	Low

DOCUMENT REVISION HISTORY

11/17/2023 - V1: Original version posted

12/01/2023 – V2: Version 2 incorporating stakeholder feedback posted