Constructability & Financial Analysis Final Report

2024 RTEP Window 1

For Public

The information contained herein is based on information provided in project proposals submitted to PJM by third parties through its 2024 RTEP Window 1. PJM analyzed such information for the purpose of identifying potential solutions for the 2024 RTEP Window 1. 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. The 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.

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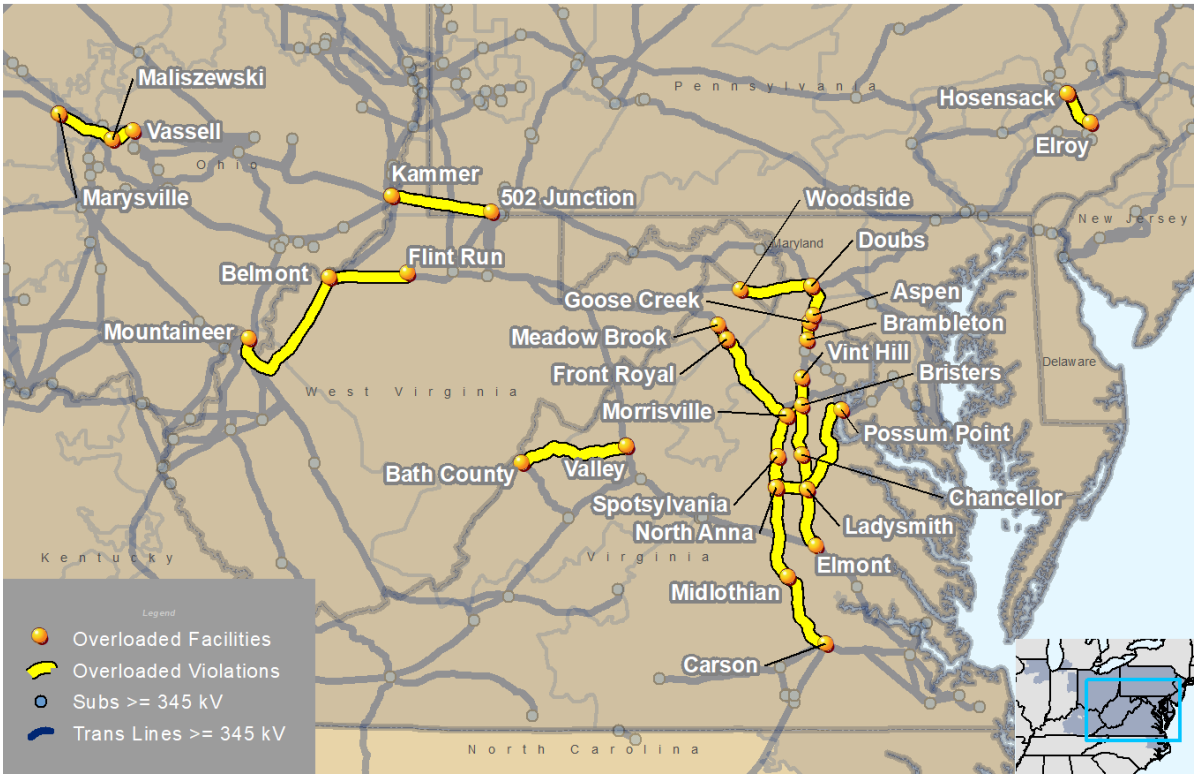
INTRODUCTION

Window Objective

PJM sought proposals to resolve identified reliability criteria violations as demonstrated in the 2029 RTEP model suite and to also resolve a select set of needs demonstrated in the 2032 RTEP model suite requiring long-lead solutions. The objective is to develop complete solutions to address the identified criteria violations. The large number of violations seen in the 2024 RTEP were driven by a number of factors: significant load increase in the south and east, along with higher forecasted load in the MAAC, Dominion and APS zones, caused heavy transmission interface flows west to east. There is a 10 GW and 15 GW load increase for 2029 and 2032 between the load forecasts used for the 2022 and 2024 RTEPs, respectively. The significant load growth is attributed to data centers, some electrification and electric vehicle developments.

While the proposed reinforcements recommended through the 2022 RTEP Window 3 and the 2023 RTEP Windows 1 and 2 are performing well, there are additional load pockets in AEP, ATSI, Dominion, PECO, BGE and PPL transmission zones that have emerged and are requiring additional regional transfer improvement as shown by the high loading levels and number of 500 kV and 765 kV thermal overloads. There are also 70 contingencies that did not converge, many of which were 500 kV contingencies. The magnitude of violations in the 2024 RTEP analysis is primarily due to a shift in generation flow as a result of overall system load increase and over 2 GW of generator deactivations across the transmission system (See **Map 1**).

Map 1. 2024 RTEP Window 1 Map of Regional/Local Needs



Proposals Submitted to PJM

The 2024 RTEP Window 1 opened on July 15, 2024, and closed on Sept. 17, 2024. PJM received 94 proposals from 16 different entities as part of this window. PJM received 48 upgrade proposals, 40 greenfield proposals and six joint proposals. Proposals range from simple facility upgrades to new extra-high-voltage transmission lines and facilities.

The proposals submitted to target west-east regional flows recommended 765 kV solutions. Multiple proposals recommend variations of a Joshua Falls/Axton to Morrisville area 765 kV line. Some of the proposals recommended a northern, John Amos-Northern Virginia 765 kV development. The west-east regional solution(s) requires at least one variant of the 765 kV development, with accompanying 500 kV and 765 kV upgrades.

A number proposals targeting more of the local needs may not be required depending on the robustness of the selected regional solution.

A number of the proposals submitted through the window were full-scale solutions that address the majority of posted reliability violations. As preliminary analysis shows that these holistic proposals perform well, PJM is considering their performance individually. Based on the individual proposal performance, PJM may develop scenarios with components from various proposals to determine a more efficient or cost-effective solution.

Proposal Clusters/Groupings

The below **Table 1** shows the proposals received, including those that focus on the regional need, along with more targeted proposals to address local violations. The focus areas were named and numbered where appropriate, based on the TO zone in which the targeted flowgates reside. Where the focus area indicates "No Cluster," this indicates that the proposal was the only one submitted in order to address the targeted flowgates; in other words, no competing proposals were submitted. Focus area "0" (zero) was assigned to indicate that the proposal includes components that are regional in nature, typically including 500 kV and 765 kV solutions that improve regional transfer. Furthermore, the focus area "0 & DOM - 1" indicates scenario proposals, where the proposal could be evaluated on its own to address not only the regional need but also the Dominion zone flowgates. While there are flowgates in other TO zones that would be influenced by whatever regional solution is to be selected, the flowgates in the Dominion zone are so heavily intertwined with the regional solution due to the sheer magnitude of data center load driving the need for improved transfer capability. This is why the proposals assigned to "0 & DOM - 1" are considered scenario proposals, as they are holistic solutions that address the majority of the posted violations.

Table 1. 2024 RTEP Window 1 Submitted Proposals

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
1	408	AEPSCT	AEP - 3/4/5	Maliszewski 765/345 kV Upgrades	$145.49
2	459		No Cluster	Mountaineer and Belmont Station Upgrades	$10.52
3	738	AEPSCT	AEP - 1	Boxwood-Bremo 138 kV Rebuild	$140.36
4	949		AEP - 1	Boxwood-Bremo 138 kV Sag Study and Partial Rebuild	$10.58
5	117		No Cluster	Tidd-Mahans Lane 138 kV Rebuild	$15.05
6	574		No Cluster	Tiltonsville-West Bellaire 138 kV Rebuild	$28.57
7	863		AEP - 3/4	Maliszewski Series Reactor Upgrades	$2.33
8	167		No Cluster	Leesville Station Conductor Replacement	$0.12
9	756		AEP - 6	Cyprus Station Reconfiguration	$1.75
10	769		AEP - 6	Rebuild Beatty-Cyprus 138 kV Line	$33.11
11	276		AEP - 2	Bixby-Buckeye Steel 138 kV Reconfiguration	$4.08
12	856		AEP - 2	Canal-Mound Street 138 kV Rebuild	$31.09
13	744		AEP - 4	Maliszewski-Polaris Rebuild	$8.88
14	940		No Cluster	Canal-Gay 138 kV Rebuild	$15.59
15	338		AEP - 3	Genoa-Westar Rebuild	$8.79
16	464		AEP - 3	Genoa-Westar Sag Remediation	$2.81
17	605	ATSI	ATSI	ATSI 138 kV Rebuild + Substation Terminal Upgrades	$265.16
18	843		ATSI	Lemoyne-Lake Ave 345 kV Line	$455.04

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
19	78	CNTLTM	0 & DOM - 1	F5 Solution	$1,897.05
20	124		0 & DOM - 1	F4 Solution	$1,810.83
21	200		0 & DOM - 1	Common Components	$439.75
22	317	CNTLTM	0 & DOM - 1	F7 Solution	$1,896.76
23	506		0 & DOM - 1	F6 Solution	$1,732.11
24	622		0 & DOM - 1	F2 Solution	$1,848.14
25	839		0 & DOM - 1	F8 Solution	$1,808.09
26	898		0 & DOM - 1	F3 Solution	$2,015.63
27	904		0 & DOM - 1	F1 Solution	$1,864.62
28	135	COMED	COMED - 1	Reconductor 345 kV lines 1202 & 1227 Dresden to Mulberry	$16.27
29	447		COMED - 1	Cut 345 kV L8014 Pontiac to Dresden into Mulberry	$23.59
30	532		COMED - 1	345 kV Shunt Inductor at Mulberry	$28.23
31	816		COMED - 2	Autotransformer at Itasca	$14.31
32	888		COMED - 2	Reconductor Des Plaines to Besse	$7.21
33	727	KEYATC	0	Kammer-502 Junction 765 kV Line	$292.46
34	502	MATLIT	METED	Hunterstown #2 500/230 kV Transformer	$43.09
35	146	NEETMH	0 & DOM - 1	Axton-Joshua Falls 765 kV + Joshua Falls-Mt Ida 500 kV	$2,263.76
36	294	NEETMH	ATSI	Bay Shore-Davis-Besse-Lake Ave	$257.30
37	357		ATSI	Bay Shore-Davis-Besse-Lake Ave + Lemoyne-Lake Ave 345 kV	$344.12
38	533		ATSI	Lemoyne-Lake Ave 345 kV	$202.08
39	768		0 & DOM - 1	Axton-Joshua Falls-Mt Ida	$2,191.01
40	944	NEETMH	No Cluster	Upgrades to AEP 138kV and Dominion 230 kV transmission lines	$69.14
41	992		0 & DOM - 1	Axton-Joshua Falls-Mt Ida 765 kV transmission lines + Link 500/230 kV substation	$2,256.23
42	12	PE	PECO	PECO Competitive Window Upgrades	$43.22
43	132	PEPCO	No Cluster	Dickerson H 230 kV Caps	$12.42
44	295		BGE	Marley Neck 115 kV Substation	$107.62
45	470		BGE	BGE local Mitigation Alternative	$71.96

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
46	232	POTOED	No Cluster	FirstEnergy Upgrades to Support Portfolio Proposals	$97.47
47	551		0	Woodside/Chanceford/Rocky Point Termination Swap	$13.97
48	17	PPLTO	PPL - 2	Bushkill - Kittatinny 230 kV line reconductor	$35.00
49	72		PPL - 2	Juniata-Cumberland-Williams Grove 230 kV upgrade project	$78.59
50	312		PPL - 2	Acahela 500/230 kV Substation expansion project	$116.33
51	330		PPL - 2	Juniata-Hunterstown 500 kV line	$356.70
52	386		PPL - 2	Juniata-TMIS 500 kV DCT line	$353.71
53	479		PPL - 2	Lackawanna-Paupack 230 kV line reconductor	$47.70
54	526		PPL - 2	Jenkins-Pocono 230 kV line	$60.03
55	549		PPL - 2	Susquehanna T10 Station Line Reconfiguration	$9.50
56	850		PPL - 2	Pocono 80 MVAr 230 kV capacitor bank	$4.93
57	860		PPL - 2	Face Rock T1 and T2 transformer replacement	$9.51
58	876	PPLTO	PPL - 2	Siegfried 500/230 kV Substation expansion project	$106.93
59	922		PPL - 2	Lackawanna-Siegfried-Drakestown 500 kV line project	$618.38
60	926		PPL - 2	Wescosville 2nd 500/138 kV transformer	$36.83
61	935		PPL - 2	Juniata 500 kV Substation yard reconfiguration	$22.24
62	994		PPL - 2	Juniata-Dauphin 230 kV line reconductor	$2.26
63	955	PSEGRT	PECO	230 kV Eagle Point-Penrose	$390.99
64	708	TRAIL	0	Amos-Welton Springs-Rocky Point 765 kV Line	$1,944.99
65	883		0	Amos-Welton Springs 765 kV Line	$1,274.42
66	885		0	FirstEnergy Components for Proposals 2024-W1-636, 610, 279 and 114	$52.67
67	907		0	500 kV Expansion Plan	$2,838.90
68	977		0	Belmont-Harrison 500 kV Line	$277.41
69	546	TRNSLK	PPL - 1	Pennsylvania Border-Drakestown 500 kV line (greenfield route)	$246.05
70	900		PPL - 1	Pennsylvania Border-Drakestown 500 kV line (brownfield route)	$277.00
71	81	TRNSRC	0	AEP incumbent upgrades for Portfolio #1, 2 & 3	$137.02
72	114		0 & DOM - 1	Portfolio #4B	~$3,300.00
73	262		0 & DOM - 1	Portfolio #1A	$5,497.68
74	279		0 & DOM - 1	Portfolio #4A	~$2,400.00
75	286		0	Joshua Falls-Durandal	$350.25
76	300		0	Yeat-Vontay	$381.73

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
77	350		AEP - 3/4	Jester-Hayden	$229.41
78	610		0 & DOM - 1	Portfolio #3	~$3,700.00
79	617		0	AEP incumbent upgrades for Portfolio #4	$167.35
80	636		0 & DOM - 1	Portfolio #2	~$3,900.00
81	665		0	Joshua Falls-Vontay-Morrisville South	$1,188.51
82	694		ATSI	Fostoria Central-Lake Ave. 345 kV DC	$328.37
83	759		0 & DOM - 1	Portfolio #1B	$4,827.12
84	820		0	765 kV Joshua Falls-Yeat	$1,016.90
85	24	VEPCO	DOM - 1	230 kV and 115 kV Solutions for Portfolios	$861.74
86	261		DOM - 1	Overdutied Breaker Replacement	$70.78
87	390		DOM - 1	230 kV Safety Solutions (Optional reinforcements depending on selected proposals)	$1,008.58
88	527		DOM - 1	500 kV and 230 kV Cap Bank and STATCOM Installation (Required/discretionary depending on selected proposals)	$322.00
89	761		DOM - 1	138/115 kV Safety Solutions (Optional reinforcements depending on selected proposals)	$104.07
90	781		DOM - 1	500 kV Solutions for Portfolios	$161.68
91	873		AEP - 1	Line 8 Rebuild – Bremo to Scottsville Interconnection (APCO)	$42.10
92	967	VEPCO	DOM - 1	DVP Central Area Improvement for Portfolios	$1,189.78
93	980		DOM - 1	500 kV Line #579 EOL Rebuild Septa — Yadkin	$216.78
94	983		DOM - 1	500 kV Safety Solutions (Optional reinforcements depending on selected proposals)	$2,839.36

Regional Proposal Components

Of the 94 proposals received, 31 proposals (or 33%) included components that would address the regional need(s) and were assigned to focus areas “0” or “0 & DOM – 1.” Furthermore, of those 31 proposals, 18 of the proposals (almost 20% of the total number of proposals submitted) were what PJM considers scenarios, assigned to focus area “0 & DOM – 1,” intended to address the majority of regional violations. The scenario proposals were proposed by CNTLTM (LS Power), NEETMH (NextEra) and TRNSRC (Transource). The Transource scenario joint proposals represent a collaborative effort by the incumbent TOs (Dominion, FirstEnergy and Transource), and are portfolios including several incumbent TO proposals along with the Transource greenfield component proposals. **Table 2** and **Table 3** organize the backbone proposal components into Regional Clusters.

Table 2. Regional "0" Cluster

Proposal ID	Proposing Entity	Major Components
727	KEYATC	Kammer-502 Junction 765 kV line
551	POTOED	Chanceford-Goose Creek 500 kV line
708	TRAIL	Amos-Welton Springs-Rocky Point 765 kV line
883		Amos-Welton Springs 765 kV line
885		FirstEnergy Components for Proposals 2024-W1-636, 610, 279 and 114
907		500 kV Expansion Plan
977		Belmont-Harrison 500 kV line
81	TRNSRC	AEP incumbent upgrades for Portfolio #1, 2 and 3
286		Joshua Falls-Durandal
300	TRNSRC	Yeat-Vontay
617		AEP incumbent upgrades for Portfolio #4
665		Joshua Falls-Vontay-Morrisville South
820		Joshua Falls-Yeat

Table 3. Scenario Cluster

Proposal ID	Proposing Entity	Major Components
78	CNTLTM	• Marsh 765/500/230 kV Substation • Cunningham 500 kV Substation Expansion • Axton 765 kV Substation Expansion • Joshua Falls 765 kV Substation Expansions • Axton to Joshua Falls 765 kV Transmission Line • Joshua Falls to Marsh 765 kV Transmission Line • Cunningham to Marsh 500 kV Transmission Line • Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line • Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line • Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line
124		• Rocky Ford-Stage-Piney Mountain-Marsh 765 kV Line • Piney Mountain-Cunningham 500 kV Line • Marsh-Morrisville Double Circuit 500/230 kV Line • Marsh-Vint Hill Double Circuit 230 kV Line • Turkey Creek 500 kV PAR
200		• Common components that are intended to be included in the rest of the LS Power proposals
317		• Axton-Joshua Falls-Piney Mountain 765 kV Line • Piney Mountain-Cunningham 500 kV Line • Piney Mountain-Morrisville Double Circuit 500 kV Line • Morrisville-Vint Hill Double Circuit 230 kV Line • Turkey Creek 500 kV PAR
506		• Rocky Ford 765/500 kV Substation • Stage 765/500 kV Substation • Cunningham 500 kV Substation Expansion

Proposal ID	Proposing Entity	Major Components
		• Rocky Ford to Stage 500 kV Transmission Line • Stage to Cunningham 500 kV Transmission Line • Cunningham to Morrisville #1 500 kV Transmission Line • Cunningham to Morrisville #2 500 kV Transmission Line • Morrisville to Vint Hill Double Circuit 230/230 kV Transmission Line
622	CNTLTM	• Rocky Ford 765/500 kV Substation • Stage 765/500 kV Substation • Marsh 500/230 kV Substation • Piney Mountain 500 kV Substation • Cunningham 500 kV Substation Expansion • Rocky Ford to Stage 500 kV Transmission Line • Stage to Piney Mountain 500 kV Transmission Line • Piney Mountain to Cunningham 500 kV Transmission Line • Piney Mountain to Marsh #1 500 kV Transmission Line • Piney Mountain to Marsh #2 500 kV Transmission Line • Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line • Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line • Marsh-Morrisville #2 Double Circuit 500/230 kV Circuit
839	CNTLTM	• Piney Mountain 765/500 kV Substation • Marsh 765/500/230 kV Substation • Cunningham 500 kV Substation Expansion • Axton 765 kV Substation Expansion • Joshua Falls 765 kV Substation Expansion • Axton to Joshua Falls 765 kV Transmission Line • Joshua Falls to Piney Mountain 765 kV Transmission Line • Piney Mountain to Marsh 765 kV Transmission Line • Piney Mountain to Cunningham 500 kV Transmission Line • Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line • Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line • Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line
898		• Rocky Ford 765 KV Substation • Stage 765 kV Substation • Marsh 500/230 kV Substation • Piney Mountain 765/500 kV Substation • Turkey Creek PAR Addition • Cunningham 500 kV Substation Expansion • Rocky Ford to Stage 765 kV Transmission Line • Stage to Piney Mountain 765 kV Transmission Line • Piney Mountain to Cunningham 500 kV Transmission Line • Piney Mountain to Marsh #1 500 kV Transmission Line • Piney Mountain to Marsh #2 500 kV Transmission Line • Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line • Marsh to Vint Hill Double Circuit 230 kV Transmission Line • Marsh - Morrisville #2 Double Circuit 500/230 kV Circuit
904		• Rocky Ford 765 KV Substation • Stage 765 KV Substation

Proposal ID	Proposing Entity	Major Components
		• Marsh 765/500/230 kV Substation • Turkey Creek Series Reactor • Cunningham 500 kV Substation Expansion • Rocky Ford to Stage 765 kV Transmission Line • Stage to Marsh 765 kV Transmission Line • Marsh to Morrisville #1 Double-Circuit 500/230 kV Transmission Line • Marsh to Morrisville #2 Double-Circuit 500/230 kV Transmission Line • Cunningham to Marsh 500 kV Transmission Line • Marsh to Vint Hill Double Circuit 230 kV Transmission Line
146	NEETMH	• Axton to Joshua Falls 765 • Joshua Falls to Mt Ida double circuit 500 kV • Mt Ida 500 kV substation
768		• Axton to Joshua Falls • Mt Ida 765/500 kV Substation • Joshua Falls to Mt Ida 765 kV
992		• Axton-Joshua Falls 765 kV • Joshua Falls-Mt Ida 765 kV • Mt Ida 765/500 kV substation • Mt Ida-Link (greenfield portion) • Link 500/230 substation • North Anna-Chancellor 500 kV • Morrisville-Gainesville 230 kV • Vint Hill-Link 500 kV tap • New Mt Ida-Link 500 kV (brownfield portion)
114	TRNSRC	• Durandal-Joshua Falls 765 kV Line (~45 mi) • Joshua Falls-Yeat 765 kV Line (~110 mi) • Yeat-Vontay 500 kV Line (~66 mi) • Ladysmith Substation Reconfiguration
262		• Amos-Welton Springs-Rocky Point 765 kV Line (~259 mi) • Joshua Falls-Vontay-Morrisville South 765 kV Line (~160 mi) • North Anna-Kraken-Bristers 500 kV Line (~66 mi)
279		• Durandal-Joshua Falls 765 kV Line (~45 mi) • Joshua Falls-Yeat 765 kV Line (~110 mi) • Yeat-Vontay 500 kV Line (~66 mi) • Ladysmith Substation Reconfiguration
610		• Joshua Falls-Yeat 765 kV Line (~110 mi) • North Anna-Kraken-Bristers 500 kV Line (~66 mi) • Ladysmith Substation Reconfiguration
636		• Joshua Falls-Vontay-Morrisville South 765 kV Line (~160 mi) • North Anna-Kraken-Bristers 500 kV Line (~66 mi)
759		• Amos-Welton Springs 765 kV Line (~175 mi) • Welton Springs 765/500 kV Transformation • Joshua Falls-Vontay-Morrisville South 765 kV Line (~160 mi) • North Anna-Kraken-Bristers 500 kV Line (~66 mi)

2024 RTEP Window 1 Evaluation Process

Consultation Meetings With Proposing Entities

PJM held at least two rounds of meetings with each of the proposing entities, and the discussions focused on gaining clarity on proposed developments, assumptions, rationale of proposed alternatives and variations. The first round of meetings were held shortly after the window closed, in late September 2024, and the second round commenced in early October 2024. The latter half of the discussions focused on outage scheduling, routing risk, and cost assumptions and considerations.

Scenario Development

The scenarios were evaluated based on the following principles:

- **Performance**

  Meeting the system needs of 2029 and 2032

- **Scalability**

  Scenario/development longevity – system robustness and utilization

- **Cost Validation**

  Cost evaluation using third-party benchmarking metrics

- **Risks**
  - Triggering additional costs:
    - Substation rebuilds due to extreme short-circuit levels
  - Avoid extended critical outages (Major transmission rebuilds)
  - Imposing high permitting
  - Inability to meeting 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

Further information regarding aspects related to the above bulleted impact, cost validation, risks and efficiencies are detailed in the 2024 RTEP Window 1 Reliability Analysis Report.

The proposals and scenarios were tested to first address the regional needs and 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.

Proposals Selected for Detailed Constructability Evaluations

Regional Cluster Proposals

Numerous entities submitted competitive proposals to address the Regional Cluster violations. Due to the size and complexity of the projects, and the need to distinguish the proposals, and the selected proposals for detailed constructability evaluations are provided in **Table 4** below.

Table 4. Regional Cluster Proposals for Detailed Evaluation

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
1	78	CNTLTM	Virginia	F5 Solution	$1,897.05
2	124			F4 Solution	$1,810.83
3	200			Common Components	$439.75
4	317			F7 Solution	$1,896.76
5	506			F6 Solution	$1,732.11
6	622			F2 Solution	$1,848.14
7	839			F8 Solution	$1,808.09
8	898			F3 Solution	$2,015.63
9	904			F1 Solution	$1,864.62
10	727	KEYATC		Kammer - 502 Junction 765 kV Line	$292.46
11	146	NEETMH	Virginia	Axton-Joshua Falls 765 kV + Joshua Falls-Mt Ida 500 kV	$2,263.76
12	768			Axton-Joshua Falls-Mt Ida	$2,191.01
13	944			Upgrades to AEP 138 kV and Dominion 230 kV transmission lines	$69.14
14	992			Axton-Joshua Falls-Mt Ida 765 kV transmission lines + Link 500/230 kV substation	$2,256.23
15	708	TRAIL		Amos-Welton Springs-Rocky Point 765 kV Line	$1,944.99
16	883			Amos-Welton Springs 765 kV Line	$1,274.42
17	907			500 kV Expansion Plan	$2,838.90
18	977			Belmont-Harrison 500 kV Line	$277.41
19	286	TRNSRC		Joshua Falls-Durandal	$350.25
20	300			Yeat-Vontay	$381.73
21	617			AEP incumbent upgrades for Portfolio #4	$167.35
22	665			Joshua Falls-Vontay-Morrisville South	$1,188.51
23	820			765 kV Joshua Falls-Yeat	$1,016.90
24	781	VEPCO		500 kV Solutions for Portfolios	$161.68
25	967	VEPCO	Virginia	DVP Central Area Improvement for Portfolios	$1,189.78

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
26	983			500 kV Safety Solutions (Optional reinforcements depending on selected proposals)	$2,839.36

Ohio Cluster Proposals

Three entities submitted proposals to address the Ohio Cluster violations, and the selected proposals for detailed constructability evaluations are provided in **Table 5** below.

Table 5. Ohio Cluster Proposals for Detailed Evaluation

#	ID	Proposing Entity	Focus Area	Project Title	Submitted Cost ($M)
1	605	ATSI	Ohio	ATSI 138kV Rebuild + Substation Terminal Upgrades	$265.16
2	843			Lemoyne-Lake Ave 345 kV Line	$455.04
3	294	NEETMH		Bay Shore-Davis-Besse-Lake Ave	$257.30
4	357			Bay Shore-Davis-Besse-Lake Ave + Lemoyne-Lake Ave 345 kV	$344.12
5	533			Lemoyne-Lake Ave 345 kV	$202.08
6	694	TRNSRC		Fostoria Central-Lake Ave. 345 kV DC	$328.37

CONSTRUCTABILITY ANALYSIS

Approach

PJM performs an in-depth review of the constructability of the project. This review will typically include an evaluation of project scope, complexity and constructability factors that impact the project cost and/or schedule including but not limited to ROW acquisition, land acquisition, siting and permitting requirements, project complexity, project coordination complexity, outage coordination, and project schedule. This window introduced an additional category on proposing entity experience and capability. The following is an outline of PJM and its consultants' 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 Non-Tidal Wetlands
  - Wetlands of Special State Concern
  - Subaqueous Lands
  - Total Wetlands
  - Non-Tidal (Non-Forested) Wetlands
  - Non-Tidal (Forested) Wetlands
- 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; and rare, threatened and endangered species. The assessment will result in a preliminary list of potential siting issues and permits that could impact cost and/or schedule, including estimated agency review times. 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 Department of Transportation 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

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

2 | *Transmission Line Analysis:* Review of transmission line modifications proposed based on desktop reviews investigating routing, conductor size and length, rights of way (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 eight 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

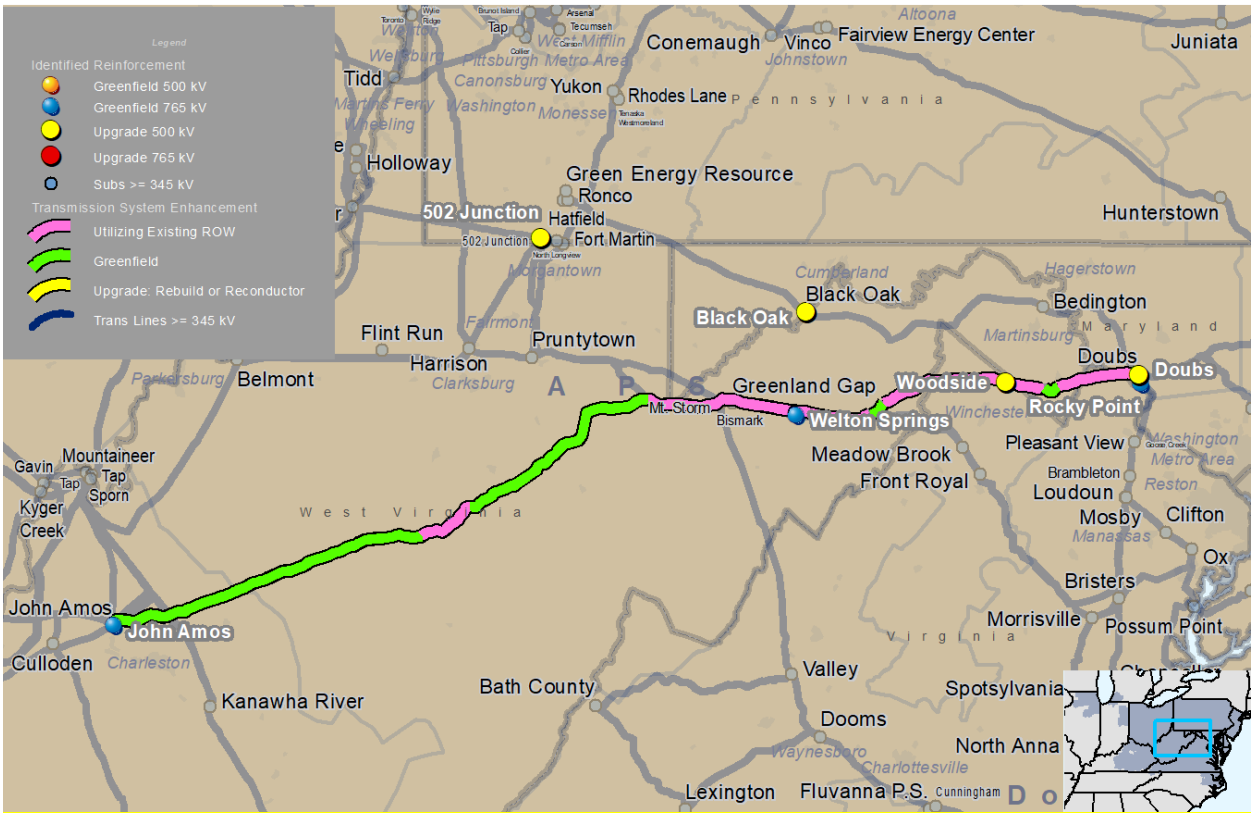
The following sections outline the results of PJM and its consultants' detailed constructability evaluations performed on select proposals and their components organized into the Regional Clusters defined by PJM. These results are also the basis for the Constructability Risk Assessment matrices that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

Regional Cluster Proposals

Proposal 708 – TRAIL (FirstEnergy)

First Energy Proposal No. 708 (**Map 2**), described as the 261-mile Amos-Welton Springs-Rocky Point 765 kV line, incorporates construction of multiple transmission lines and substation expansions to provide a robust, expandable transmission solution to address the 2024 Open Window 1 violations. This Proposal 708 is one of the major components of the joint PJM Proposal No. 262 (Portfolio 1A) submitted by Transource. This proposal has a total of nine components, including three substation upgrade components, two greenfield substation components, three greenfield transmission line components and one transmission line upgrade component.

Map 2. Proposal 708



*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

First Energy Proposal 708 includes the following components:

- Component 1: Amos Substation Upgrade
- Component 2: Amos-Welton Springs 765 kV Line
- Component 3: Welton Springs Switchyard
- Component 4: Welton Springs-Rocky Point 765 kV Line
- Component 5: Rocky Point Substation
- Component 6: Point of Rocks 500 kV Line Cut-Ins
- Component 7: Black Oak Substation
- Component 8: Loop The 502 Jct-Woodside 500 kV Line into Black Oak Substation
- Component 9: Doubs No. 1 500/230 kV Transformer Terminal Upgrades

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Amos-Welton Springs

Approximate 175-mile 765 kV line will be constructed in West Virginia from the existing Amos substation in eastern Putnam County to the proposed Welton Springs substation in northwestern Hardy County. The transmission line corridor is proposed to cross twelve counties: Putnam, Kanawha, Roane, Calhoun, Braxton, Lewis, Upshur, Barbour, Tucker, Preston, Grant and Hardy. It is assumed that the 765 kV line will parallel existing ROW for approximately 42 miles and require new ROW for approximately 133 miles.

This component would cross approximately seven railroads with Conrail Railroad, Winchester and Western Railroad, South Branch Valley Railroad, CSXT, Norfolk Southern Railway Company, Baltimore and Ohio Railroad; approximately two interstate pipelines with Dominion Transmission Co. and Columbia Gas Trans Co.; approximately four national parks and one state park; and approximately 12 transmission line crossings with the Potomac Edison Company. A significant portion of the component is parallel to the transmission lines, and approximately 121 roads/highways across six counties in West Virginia, Virginia and Maryland. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from three counties in Virginia, three counties in West Virginia and one county in Maryland. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Welton Springs-Rocky Point

Approximate 86-mile 765 kV line will be constructed from the proposed Welton Springs switchyard in Hardy County, West Virginia to the proposed Rocky Point substation in Frederick County, Maryland. The line will traverse Hardy, Hampshire and Jefferson counties in West Virginia; Frederick, Clarke and Loudoun counties in Virginia; and Frederick County, Maryland. The 765 kV line will parallel existing transmission ROW for most of the line except for deviations to avoid developed areas or other constraints.

The proposed corridor for this line attempts to minimize traversing land specifically managed for conservation value such as the Nathaniel and Short Mountain WMAs, the southernmost boundary of the Harpers Ferry National Historical Park, the Appalachian Trail and the C&O Canal Tow Path. In sensitive areas, the proposed transmission line corridor proposes to parallel existing transmission corridors and will require expansion. Coordination with USDA, USFWS, NPS and numerous state and local agencies will be required.

Welton Springs Substation

The proposing entity will contact the landowners to start discussions and negotiations when appropriate. Approximately 35 to 40 acres of usable land will be needed for the substation footprint. This does not include land needed for site development (grading, stormwater management, etc.), transmission line ROW, access roads, on-site soils management or mitigation.

Rocky Point Substation

The property is owned by the proposing entity, and no additional land acquisition is anticipated.

Overall, the transmission line components parallel existing transmission lines and uses some greenfield construction; therefore, this proposal's ROW risk is considered medium-high.

Environmental Risk Analysis

Amos-Welton Springs Line

The proposed route has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. Proposed route intersects three conservation easements. Coordination with easement holders – U.S. Forest Service; U.S. Army Corps of Engineers; WV Division of Natural Resources; Amherst Industries, Inc. – will be required.

Welton Springs-Rocky Point Line

The proposed route potentially intersects one historical district: Beverley Boundary Increase. Coordination with the WV SHPO is required to confirm the existence and significance of this feature. The proposed route has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with

the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects critical habitat for green floater. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. The proposed route intersects 32 conservation easements. Coordination with easement holders – Potomac Conservancy; Land Trust of Virginia; VA Outdoors Foundation; Loudoun County, VA; Admin State VA; Potomac Conservancy; Old Dominion Land Conservancy; Clarke Co Conservation Easement; Northern Virginia Conservation Trust; Jefferson County, WV Farmland Protection Board; WV Division of Natural Resources; Cacapon and Lost Rivers Land Trust; Admin State WV; Appalachian Trail Conservancy; Maryland Agricultural Land Preservation Foundation – will be required.

Transmission Line Risk Analysis

Amos-Welton Springs 765 kV Line

The vast majority of the work associated with this proposal is the 175-mile 765 kV line that spans across most of West Virginia. The route provided appears to be almost entirely independent of other ROW through mountainous terrain. The acquisition of this amount of ROW and gaining siting approval may take longer than the entire schedule provided.

The proposal is feasible from design and construction, but may face some major risk due to the scale of the work and the route selected being entirely independent of other alignments in the area. Additionally, the proposal is indicating the use for guyed lattice structures, which would reduce costs and allow for flying in of structures on the terrain. However, this type of design is most often used in flatter terrain. Given the grade of a lot of this route, guy lengths may be exceedingly long or infeasible altogether. This project could potentially face significant opposition that will delay it.

Welton Springs-Rocky Point 765 kV Line

Guyed V-lattice tower construction will likely not work in many locations due to terrain. Building adjacent to existing 500 kV line and 138 kV T-line ROW for some of the circuit may cause issues with long spans and many crossings.

Substation Risk Analysis

Welton Springs Substation

Construct a new switchyard (Welton Springs) with 765 kV bus, two 250 MVAR shunt capacitors and a +/-500 MVAR STATCOM. Connect the 765 kV transmission lines: Amos-Welton Springs 765 kV line and Welton Springs-Point of Rocks 765 kV line.

Rocky Point Substation

Construct a new substation called Rocky Point with a 765 kV and a 500 kV yard. Loop in the Doubs-Goose Creek 500 kV line, the Doubs-Aspen 500 kV line and the Woodside-Goose Creek 500 kV line.

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

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.

Constructability Summary

The proposal is a long set of lines crossing multiple states and has its fair share of tricky areas as any project this ambitious would. The Welton Springs to Rocky Point line segment crosses national parks like the Appalachian Trail, Harpers Ferry and the C&O Canal. PJM anticipates that permitting and land acquisition will be notable risks for this project. A high risk was assessed for constructability.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 6**.

Table 6. Proposal 708 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Amos Substation Upgrade	30.87	30.87
2	Amos-Welton Springs 765 kV Line	875.00	990.73

3	Welton Springs Switchyard	213.82	264.01
4	Welton Springs-Rocky Point 765 kV Line	430.00	486.87
5	Rocky Point Substation	375.64	458.34
6	Rocky Point 500 kV Line Cut-Ins	0.00	22.55
7	Black Oak Substation	0.00	20.21
8	Loop The 502 Jct-Woodside 500 kV Line into Black Oak Substation	19.23	14.97
9	Doubs No. 1 500/230 kV Transformer Terminal Upgrades	0.43	0.43
	Total	**1,944.99**	**2,288.97**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

The proposed in-service date of December 2029 is deemed very aggressive for the proposed scope of the project, considering the significant permitting, engineering and construction, and land acquisition risks associated with the greenfield routing with a total of 261 miles of 765 kV construction. The scheduling risk is assessed as high.

Proposing Entity Experience and Capability Review

FirstEnergy, including its participation in the joint venture, has significant experience with the proposed equipment and the capabilities to construct Proposal 708 as submitted. The proposing entity experience and capability risk is considered low.

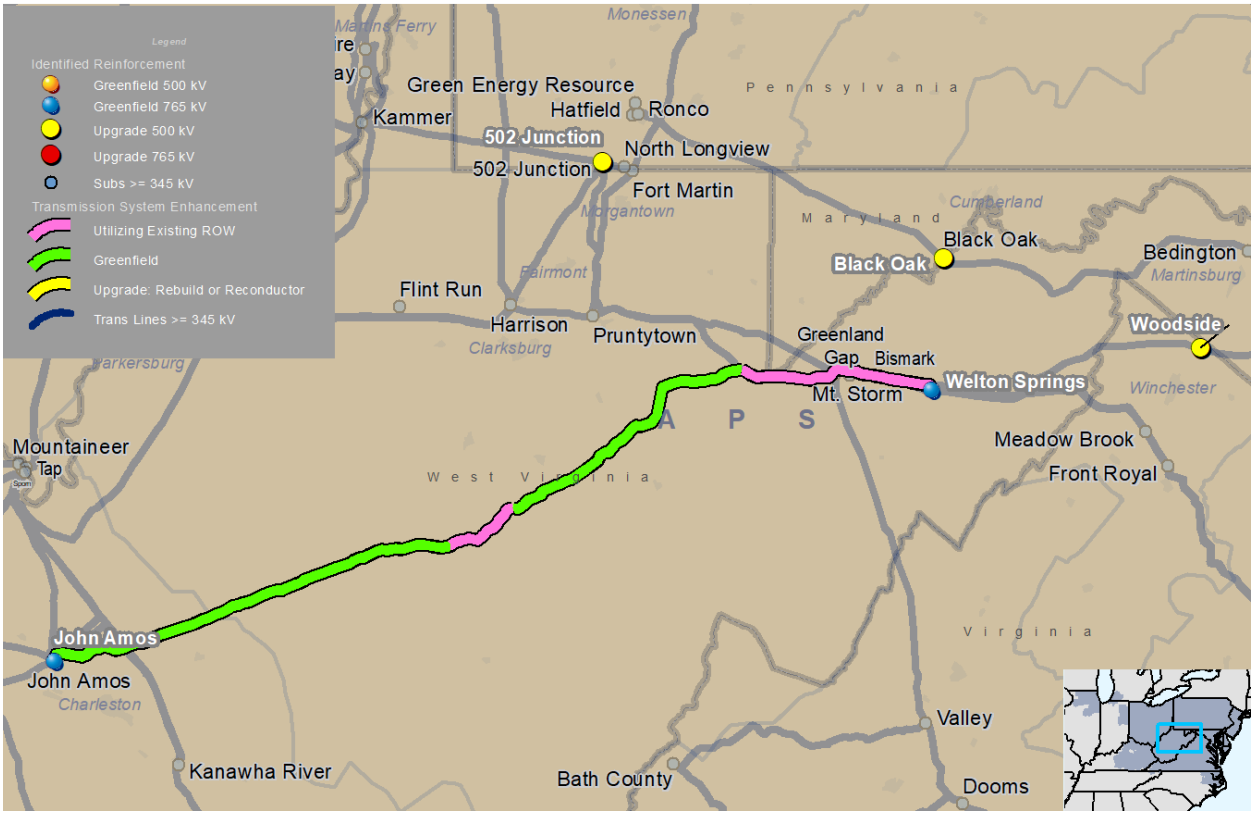
Proposal 883 – TRAIL (FirstEnergy)

First Energy Proposal No. 883 (

), described as Amos-Welton Springs 765 kV line, incorporates construction of multiple transmission lines and substation expansions to provide a robust, expandable transmission solution to address the 2024 Open Window 1 violations. This Proposal 883 is one of major components of the joint PJM Proposal No. 759 (Portfolio 1B) submitted by Transource.

First Energy Proposal No. 883 has a total of seven components with one greenfield substation component, three substation upgrade components, two greenfield transmission line components and one transmission line upgrade component.

Map 3. Proposal 883



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

First Energy Proposal 883 includes the following components:

- Component 1: Amos Substation Upgrade
- Component 2: Amos-Welton Springs 765 kV Line
- Component 3: Welton Springs Substation
- Component 4: Welton Springs 500 kV Line Cut-Ins
- Component 5: Black Oak Substation
- Component 6: Loop the 502 Jct-Woodside 500 kV Line into Black Oak Substation
- Component 7: Double Toll Gate-Millville 138 kV Line Terminal Upgrades

Constructability Review

Right of Way/Land Usage Risk Analysis

Amos-Welton Springs 765 kV Line

This new approximate 175-mile 765 kV line will be constructed in West Virginia from the existing Amos substation in eastern Putnam County to the proposed Welton Springs substation in northwestern Hardy County.

This component would cross approximately seven railroads with Conrail Railroad, Winchester And Western Railroad, South Branch Valley Railroad, CSXT, Norfolk Southern Railway Company, Baltimore and Ohio Railroad; approximately two interstate pipelines with Dominion Transmission Co. and Columbia Gas Trans Co.; approximately four national parks and one state park; and approximately 12 transmission line crossings with the Potomac Edison Company. A significant portion of the component is parallel to the transmission lines and approximately 121 roads/highways across six counties in West Virginia, Virginia and Maryland. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from three counties in Virginia, three counties in West Virginia and one county in Maryland. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Welton Springs 500 kV Line Cut-Ins

There are two existing 500 kV lines located south of the proposed Welton Springs substation site.

These two 500 kV lines, the Greenland Gap-Meadow Brook and Meadow Brook-Mount Storm.

500 kV lines will be cut and looped into the proposed Welton Springs substation. The length of each individual single circuit line will be approximately 0.5 miles.

Overall, the transmission line components parallel existing transmission lines and uses some greenfield construction, this proposal's ROW risk is considered medium-high.

Environmental Risk Analysis

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the

proposed project will have effects on protected species. Proposed route intersects three conservation easements. Coordination with easement holder – WV Division of Natural Resources – will be required.

Transmission Line Risk Analysis

Amos-Welton Springs 765 kV Line

The vast majority of the work associated with this proposal is the 175-mile 765 kV line that spans across most of West Virginia. The route provided appears to be almost entirely independent of other ROW through mountainous terrain. The acquisition of this amount of ROW and gaining siting approval may take longer than the entire schedule provided.

The proposal is feasible from design and construction, but may face some major risk due to the scale of the work and the route selected being entirely independent of other alignments in the area. Additionally, the proposal is indicating the use for guyed lattice structures, which would reduce costs and allow for flying in of structures on the terrain. However, this type of design is most often used in flatter terrain. Given the grade of a lot of this route, guy lengths may be exceedingly long or infeasible altogether. This project could potentially face significant opposition that will delay it.

Substation Risk Analysis

Welton Springs Substation

Construct a new substation (Welton Springs) with 765 kV and 500 kV yards. Add one +/- 500 MVAR STATCOM and two 250 MVAR switched shunt capacitor banks. Add two new 765/500 kV transformers and interconnect the 765 kV and 500 kV transmission lines. Loop in the 500 kV lines from Greenland Gap-Meadow Brook and Mt. Storm-Meadow Brook into Welton Springs substation.

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

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.

Constructability Summary

Proposal 883 represents a subset of Proposal 708, with only the 175-mile segment from Amos-Welton Springs included. Medium-high risks were assessed for the line route due to its combination of greenfield and paralleling existing ROWs for the entirety of the route. As this proposal did not involve the higher risk Welton Springs-Rocky Point segment that cross the

national parks, PJM assessed medium-high constructability risks for the environmental and land acquisition risks for the 175-mile route.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 7**.

Table 7. Proposal 883 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Amos Substation Upgrade	30.87	30.87
2	Amos-Welton Springs 765 kV Line	875.00	990.73
3	Welton Springs Substation	326.88	395.56
4	Welton Springs 500 kV Line Cut-Ins	20.68	27.64
5	Black Oak Substation	0.00	20.21
6	Loop the 502 Jct-Woodside 500 kV Line into Black Oak Substation	19.23	15.06
7	Double Toll Gate-Millville 138 kV Line Terminal Upgrades	1.76	1.76
	Total	**1,274.42**	**1481.83**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

The proposed in-service date of December 2029 is aggressive for the proposed scope of the project, considering the significant permitting, engineering and construction and land acquisition risks associated with this long 765 kV line. A medium-high schedule risk is assessed.

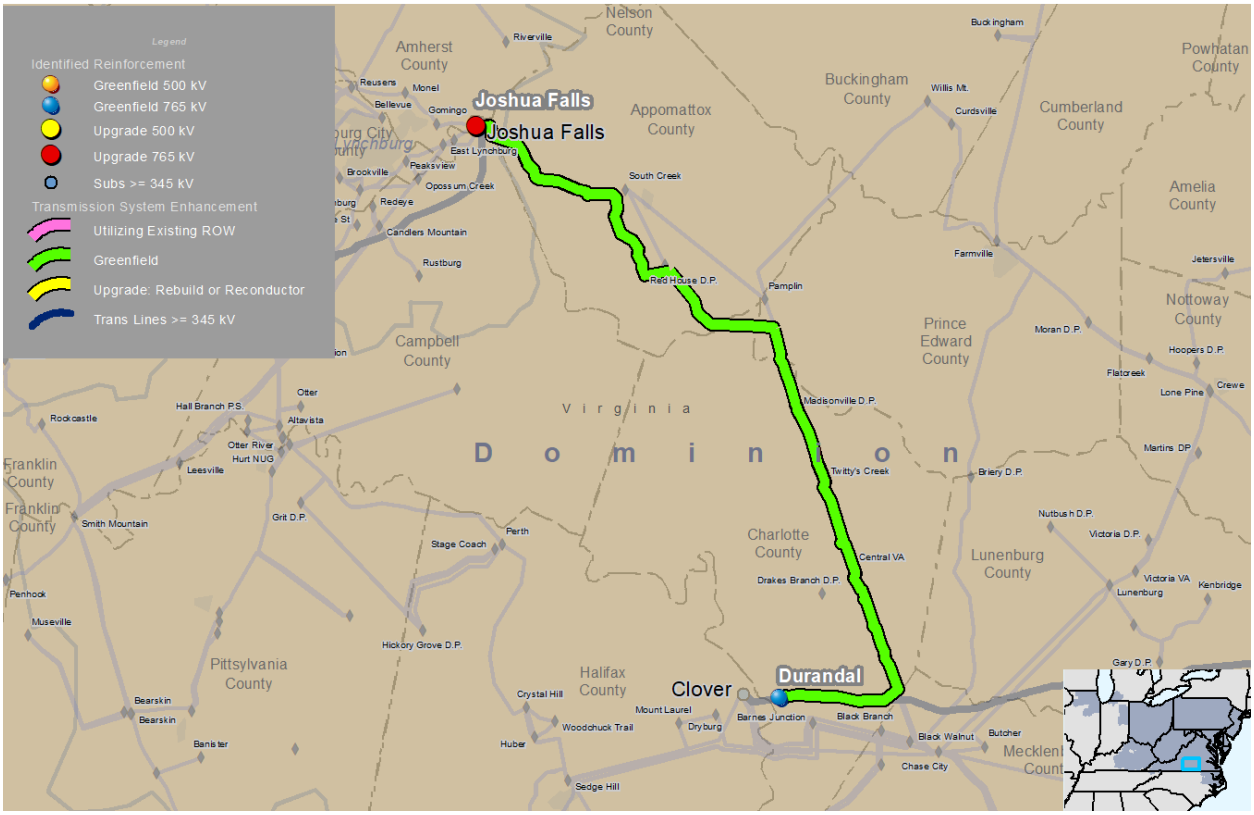
Proposing Entity Experience and Capability Review

FirstEnergy, including its participation in the joint venture, has significant experience with the proposed equipment and the capabilities to construct Proposal 883 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 286 – TRNSRC

TRNSRC Proposal No. 286 (**Map 4Error! Reference source not found.**), described as 64-mile 765 kV Joshua Falls-Durandal, is one of the major components of the PJM joint Proposals No. 279 &114 (Portfolios 4A & 4B). It has a total of four components, including two 765 kV greenfield transmission line components, one 765/500 kV greenfield substation component and one 765 kV substation upgrade component.

Map 4. Proposal 286



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

TRNSRC Proposal 286 components selected for evaluation are as follows:

- Component 1: Joshua Falls-Durandal 765 kV line
- Component 2: Joshua Falls Upgrade
- Component 3: Durandal Station
- Component 4: Durandal Cut-In Lines

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Joshua Falls-Durandal 765 kV Line

This component of the proposal is approximately 43 miles of greenfield line through five counties (Campbell, Appomattox, Prince Edwards, Charlotte and Halifax) in Virginia. The 765 kV line exits the existing Joshua Falls substation from the south, then travels in a predominantly southeast direction until it reaches the greenfield Durandal substation from the west. The total route is 64 miles, with 62.6% (40 miles) paralleling existing ROWs, 60% (38 miles) paralleling Dominion ROW, and 2.6% (2 miles) paralleling interstate highway.

This component would cross approximately one railroad with NS; approximately five transmission lines with Virginia Electric & Power Co, Appalachia Electric and unknown owners; approximately three pipelines with Colonial Pipeline Co, Kinder Morgan and Transcontinental Gas PL; and approximately 53 roads/highways in Charlotte County, Hampden County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC Approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Durandal Cut-In Lines

The 500 kV tie-ins will be approximately one mile for each leaving the proposed Durandal substation in Charlotte County, Virginia.

Land use for the new Durandal substation is flat, rural landscape in the vicinity of the Clover Power station. The substation will lie adjacent and outside FEMA-mapped floodplains and/or floodways and NWI-mapped wetlands primarily adjacent to streams and low-lying areas.

Overall, the ROW risk for this component is medium-high due to the combination of greenfield and paralleling existing rights-of-way for the proposed Joshua Falls-Durandal 765 kV line route.

Environmental Risk Analysis

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – VA Outdoors Foundation – will be required.

Transmission Line Risk Analysis

Joshua Falls-Durandal 765 kV Line

There are certain line crossings involve other transmission lines, bodies of water, roadways, railroads, etc. Some transmission lines will intersect floodplains, which impact the design of the structures in these areas. Lines paralleling existing transmission lines may also pose a risk in limiting the ability for future expansion considerations. The majority of the terrain is hilly and forested, which may require alternative construction methods and/or excessive tree clearing.

Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates.

Substation Risk Analysis

Joshua Falls 765 kV Station

Add two 765 kV breakers at Joshua Falls based on assumption of Proposal 820 (Joshua Falls-Yeat 765 kV line) is in place; the substation components of this proposal focus primarily on adding line position within existing bay (if Proposal 820 in place). Due to the mountainous terrain for Joshua Falls substation, any expansion of the substation to permit new line terminations will require significant civil work and costs.

Durandal 765/500 kV Substation

Construct new Durandal 765/500 kV station near Clover 500 kV substation, which includes one 765 kV, 50 KA line circuit breaker; one 765 kV, 50 kA reactor circuit breaker; 15 765 kV, one phase, motor-operated disc. sw. & steel str.; 12 765 kV arresters & steel str.; six 765 kV CCVTs and steel str.; three 765 KV, 50 MVAR, one phase line shunt reactors; three 765/500 kV, 750 MVA, one phase autotransformers.

Procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally,

regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs.

Constructability Summary

Other than the land acquisition risks for the proposed greenfield line, there are limited environmental constraints assessed for the line route, resulting in an overall medium risk assessment for constructability.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 8**.

Table 8. Proposal 286 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Joshua Falls-Durandal 765 kV	219.30	243.44
2	Joshua Falls Upgrade	16.58	16.58
3	Durandal Station	105.77	175.55
4	Durandal Cut-in lines	8.60	8.60
	Total	**350.25**	**444.17**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

With a total length shorter than some of the other projects reviewed in this window, as well as the medium constructability risks assessed, Proposal 286's scheduling risk is assessed as medium.

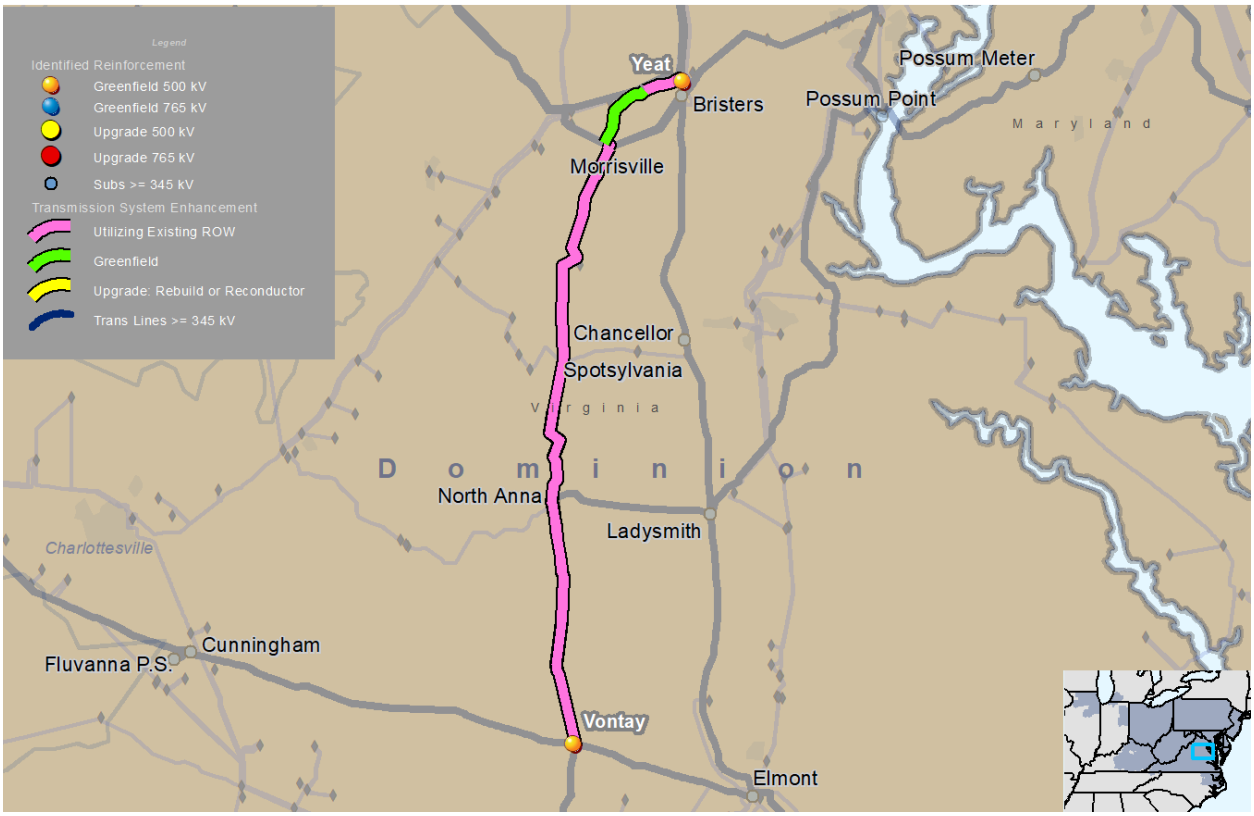
Proposing Entity Experience and Capability Review

Transource has significant experience with the proposed equipment and the capabilities to construct Proposal 286 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 300 – TRNSRC

TRNSRC Proposal No. 300 (**Map 5**), described as 64-mile 500 kV Yeat to Vontay, is one of the major components of the PJM joint Proposals No. 279 &114 (Portfolios 4A & 4B). The proposal includes total four components: one 765 kV greenfield substation component, one substation upgrade component and two greenfield transmission line components.

Map 5. Proposal 300



*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

TRNSRC Proposal 300 components selected for evaluation are as follows:

- Component 1: Vontay Greenfield 500 kV Switching Station
- Component 2: Vontay 500 kV Cut-In Lines

- Component 3: Yeat-Vontay 500 kV Line
- Component 4: Existing Yeat Station

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Yeat-Vontay 500 kV Line

This component of the proposal is the new Yeat–Vontay 500 kV line (built to 765 kV standards).The approximate 64-mile line will be constructed from the existing proposed Yeat station to proposed Vontay station. The line will traverse six counties (Hanover, Louisa, Spotsylvania, Orange, Culpeper and Fauquier) in Virginia. Around 87.5% (56 miles) is either paralleling or using existing ROW; 84.4% (54 miles) is rebuilt within existing Dominion ROW (existing Morrisville-Spotsylvania-North Anna Midlothian 500 kV); 3% (two miles) is paralleling Dominion ROW.

Vontay 500 kV Cut-In Lines

The 500 kV tie-ins will be approximately 0.1 mile for each leaving the proposed Vontay substation in Hanover County, Virginia.

Land use for greenfield Vontay substation is flat, rural, forested/timber landscape. The substation will lie adjacent and outside FEMA-mapped floodplains and/or floodways and NWI-mapped wetlands primarily adjacent to streams and low-lying areas. The proposed greenfield Vontay substation will be 43 acres in size and located on undeveloped flat forested/timber land in rural Hanover County, Virginia, and will be purchased in fee.

Overall risk is assessed based primarily on the Yeat-Vontay 500 kV line (built to 765 kV standard) component, for which the ROW risk is considered low-medium due to the significant use of brownfield routing for the proposed line.

Environmental Risk Analysis

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with easement holders – VA Outdoors Foundation, Land Trust of Virginia, VA Dept. of Forestry – will be required.

Transmission Line Risk Analysis

It is observed that a number of line crossings include other transmission lines, bodies of water, roadways, railroads, etc. Some transmission lines will intersect floodplains, which impact the design of the structures in these areas. Where lines are paralleling existing transmission lines, this

may pose a risk in limiting the ability for future expansion considerations. The majority of the terrain is hilly and forested, which may require alternative construction methods and/or excessive tree clearing. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in service dates.

Substation Risk Analysis

New Vontay 765/500 kV Greenfield Substation

The Vontay substation is a proposed new 765/500 kV substation at Palmyra junction (Vontay substation) using redundant-breaker scheme (Dominion already owns the land). This component includes installing one 765/500 kV transformer bank at Vontay substation and tie the two existing 500 kV lines from North Anna-Midlothian and Cunningham-Elmont into the new Vontay substation.

Greenfield EHV substation work may be complex in terms of access road modification and geotechnical conditions. Procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs.

Constructability Summary

With similarities to Proposal 286 in length, Proposal 300 includes the primary component of the 64-mile Yeat-Vontay 500 kV line, which will be built to 765 kV standards. About 85% is brownfield construction (sited within existing Dominion ROW) adding up to an overall medium risk for constructability.

Outage Review

Rebuilding of the 500 kV ROWs into double circuit towers carries a medium outage risk in the case of the affected facilities as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 9**.

Table 9. Proposal 300 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Vontay Station Greenfield Station	51.13	50.13
2	Vontay Cut-in lines	8.60	8.60
3	Yeat-Vontay 500 kV line	315.00	396.29
4	Yeat Station	7.00	7.00
	Total	**381.73**	**462.02**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

With a total length shorter than some of the other projects reviewed in this window, as well as the expected reasonable ROW/land acquisition process due to the route, Proposal 300's scheduling risk is assessed as medium.

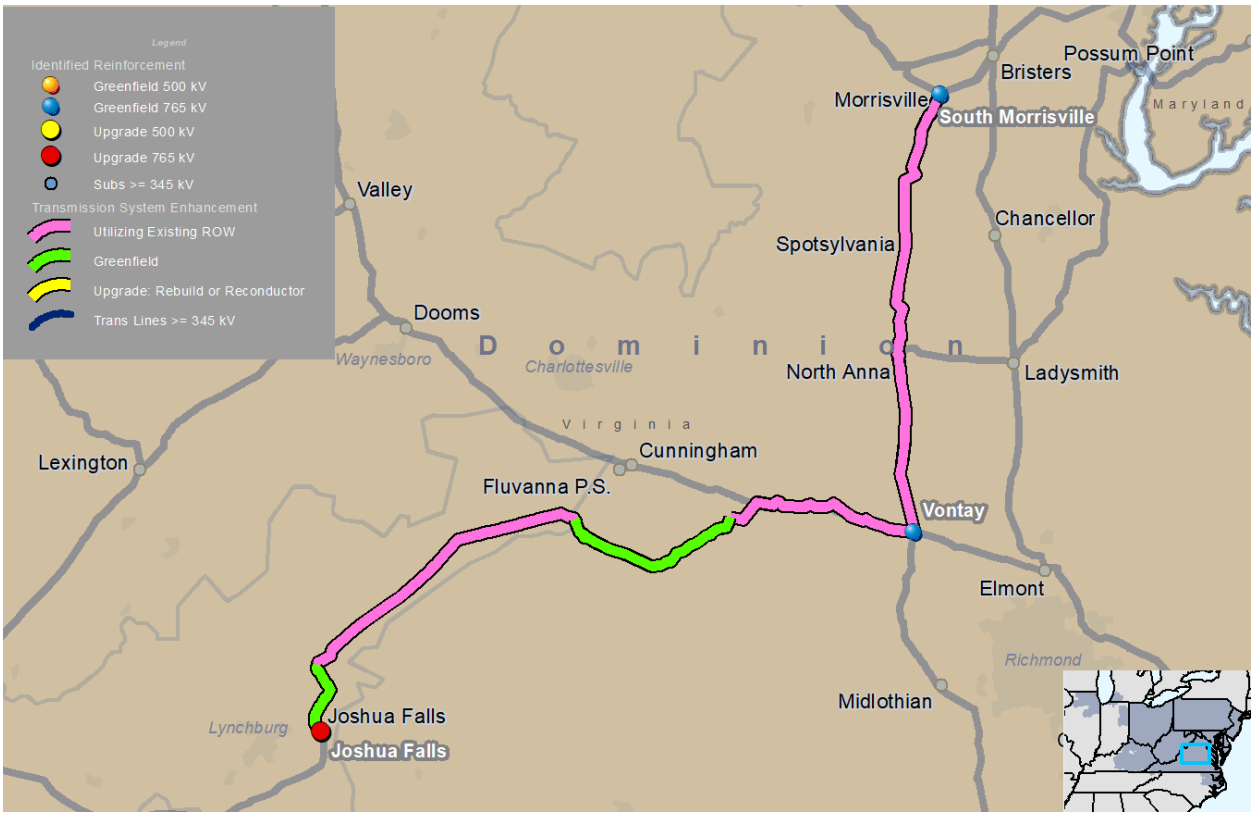
Proposing Entity Experience and Capability Review

Transource has significant experience with the proposed equipment and the capabilities to construct Proposal 300 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 665 – TRNSRC

Proposal No. 665 (**Map 6**), described as 146-mile 765 kV Joshua Falls-Vontay-Morrisville South, is one of the major components of the PJM joint Proposal Nos. 262, 759 & 636 (Portfolios 1A, 1B & 2) to address the Regional Cluster solution. The project consists of a total of seven components including four greenfield transmission line components, two greenfield substation components and one substation upgrade component.

Map 6. Proposal 665



*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. 665 includes seventeen components, representing solution proposed by TRNSRC.

These components are as follows:

- Component 1: Joshua Falls-Vontay 765 kV Line
- Component 2: Vontay Station Greenfield Station
- Component 3: Vontay-South Morrisville 765 kV
- Component 4: Vontay Cut-In Lines
- Component 5: Joshua Falls Upgrade

- Component 6: South Morrisville Station
- Component 7: South Morrisville Cut-Ins

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Joshua Falls-Vontay New 765 kV Line

This component of the proposal is approximately 92 miles of greenfield 765 kV transmission line that exits the existing Joshua Falls substation from the north, then travels in a northeastern direction, utilizing 19.8 miles of existing ROW and paralleling 41.8 miles of existing transmission line, to its connection with the greenfield Vontay substation from the west.

Vontay-South Morrisville New 765 kV Line

This component of the proposal is approximately 54 miles of greenfield line. The 765 kV line exits the greenfield Vontay substation from the east, then travels in a predominantly northerly direction, utilizing 53.8 miles of existing ROW until it reaches the South Morrisville substation from the southwest.

The total route is 146 miles with 79% (116 miles) either paralleling or using existing ROW, 17.5% (26 miles) paralleling AEP ROW, 13.5% (20 miles) in existing AEP ROW, 9.4% (14 miles) paralleling Dominion ROW, 37% (54 miles) in existing Dominion ROW, and 1.9% (3 miles) paralleling interstate. Existing 69 kV (AEP) ROW from Amherst-Clifford will be utilized, which is being removed and provides some existing ROW needed to be expanded. Existing 500 kV (Dominion) ROW (235 ft.) will be expanded from the North Anna-Midlothian 500 kV line.

The ROW risk for this proposal is medium. This component would cross approximately four railroads with CSXT; approximately nine transmission lines with Virginia Electric & Power Co; approximately five pipelines with Colonial Pipeline Co and Transcontinental Gas PL; and approximately 38 roads/highways in Fluvanna County, Buckingham County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC Approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Environmental Risk Analysis

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with easement holders – VA Outdoors Foundation, Land Trust of Virginia, VA Department of Forestry – will be required.

Transmission Line Risk Analysis

It is observed that a number of lines crossings include other transmission lines, bodies of water, roadways, railroads, etc. Some transmission lines will intersect floodplains, which impact the design of the structures in these areas. Where lines are paralleling existing transmission lines, this may pose a risk in limiting the ability for future expansion considerations. The majority of the terrain is hilly and forested, which may require alternative construction methods and/or excessive tree clearing. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in service dates.

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.

Substation Risk Analysis

New Vontay 765/500 kV Greenfield Substation

The Vontay substation is a proposed new 765/500 kV substation at Palmyra junction (Vontay substation) using redundant-breaker scheme (Dominion already owns the land). This component includes installing one 765/500 kV transformer bank at Vontay substation and tie the two existing 500 kV lines from North Anna-Midlothian and Cunningham-Elmont into the new Vontay substation.

The Vontay substation 765 kV, 450 MVAR STATCOM is specialty equipment that will require consideration for the balance of plant integration and a lead time extending multiple years.

New Morrisville South Greenfield Station

Construct a new 765 kV/500 kV Morrisville South substation using a redundant-breaker scheme including the following components:

- Six 765/500 kV Single Phase Transformer Banks
- Two 765 kV, Circuit Breakers
- Six 765 kV Motor Operated Double End Break Switches
- Five 765 kV Coupling Capacitor Voltage Transformers, Relay Accuracy
- Nine 476 kV MCOV Station Class Surge Arresters
- One 765 kV Backbone Structure (by Transmission)
- Eight 500 kV Circuit Breakers
- Ten 500 kV Double End Break Switches
- Eight 500 kV Coupling Capacitor Voltage Transformers, Relay Accuracy
- Thirteen 396 kV Station Class Surge Arresters
- Two 500 kV Backbone Structures

There are currently long lead times of two to three years for tower and substation equipment procurement for 765 kV and 500 kV. Therefore, the procurement poises to a medium risk. So if selected, it will be critical that detailed and strategic project procurement plans be developed and implemented as soon as possible for all projects.

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.

Constructability Summary

Proposal 665's ROW has about 50% involving brownfield construction (sited within Dominion and AEP incumbent ROW with some expansion required), with the remaining portion more paralleling than greenfield. This proposal earns an overall medium constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 10**.

Table 10. Proposal 665 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Joshua Falls-Vontay 765 kV Line	480.00	520.84
2	Vontay Station Greenfield Station	158.74	186.25
3	Vontay-South Morrisville 765 kV	250.00	304.58
4	Vontay Cut-in lines	8.60	8.60
5	Joshua Falls Upgrade	99.19	99.19
6	South Morrisville Station	179.62	315.64
7	South Morrisville Cut-ins	12.36	12.36
	Total	**1,188.51**	**1,447.46**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

The proposed in-service date of December 2029 is considered aggressive due to the amount and style of 765 kV being constructed. A schedule risk of medium-high is assessed.

Proposing Entity Experience and Capability Review

Transource has significant experience with the proposed equipment and the capabilities to construct Proposal 665 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 820 – TRNSRC

Proposal No. 820 (**Map 7**), described as the 138-mile 765 kV Joshua Falls-Yeat (Dominion), is one of the major components of the PJM joint Proposal Nos. 610, 279 & 114 (Portfolios 3, 4A & 4B). It consists of a total of five components, including three greenfield transmission line components, one greenfield substation component and one substation upgrade component.

Map 7. Proposal 820

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. 820 includes five components, all of which are selected for the detailed evaluations.

- Component 1: Joshua Falls-Yeat 765 kV line
- Component 2: Yeat Station Greenfield Station
- Component 3: Yeat Station 500 kV Greenfield Cut-In Lines
- Component 4: Joshua Falls Substation Upgrade
- Component 5: Yeat Station 230 kV Greenfield Cut-In Lines

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Joshua Falls-Yeat 765 kV Line

New Joshua Falls-Yeat 765 kV line is approximately 138 miles and will be constructed from the existing Joshua Falls station in Campbell County, Virginia, to the proposed Yeat substation in Fauquier County. The line will traverse 11 counties (Albemarle, Amherst, Buckingham, Campbell, Culpeper, Fauquier, Fluvanna, Louisa, Nelson, Orange and Spotsylvania) in Virginia.

The total route is 138 miles, with 66% (91 miles) either paralleling or using existing ROW, 18.5% (26 miles) paralleling AEP ROW, 14.3% (20 miles) in existing AEP ROW, 23.9% (33 miles) paralleling Dominion ROW, and 8.9% (12 miles) paralleling gas pipelines. Existing 69 kV (AEP) ROW from Amherst-Clifford will be utilized. This line is being removed and provides some existing ROW that will need to be expanded.

Yeat 500 Cut-In Lines Greenfield Transmission Line

The proposal includes approximately 1.5 miles for each leaving the proposed Yeat station to the existing Bristers-Ox 500 kV (1.03 miles) and Meadowbrook-Vint Hill 500 kV (0.5 mile) lines in Fauquier County, Virginia, which will parallel/cross existing ROWs to include interstates, roads, railroads, existing transmission lines/utilities, existing pipelines and best minimizes potential impacts to the natural and human environments.

Yeat 230 kV Cut-In Lines Greenfield Transmission Line

The component is a less than one-mile 230 kV new tie-in leaving the proposed Yeat station to the existing Vint Hill-Elk Run lines in Fauquier County, Virginia. The 230 kV greenfield tie-in routes will be paralleling/crossing existing ROWs to include interstates, roads, railroads, existing transmission lines/utilities, existing pipelines and best minimizes potential impacts to the natural and human environments. Overall, the ROW risk for this proposed component is medium. This component would cross approximately five railroads owned by Buckingham Branch Railway and CSX Transportation; approximately 118 roads/highways in Fauquier, Culpeper, Orange, Spotsylvania, Louisa, Fluvanna, Buckingham, Albemarle, Nelson and Amherst counties; approximately 12 transmission lines owned by Appalachian Power Co and an unknown owner; and approximately six pipelines owned by Colonial Pipeline and Transcontinental Gas Pipeline. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC Approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Yeat Substation

The proposed Yeat station will be 65 acres in size and located on undeveloped agricultural land in rural Fauquier County, Virginia. The proposed station will be purchased in fee.

Overall, the transmission line components parallel existing transmission lines and use some greenfield construction. This proposal's ROW risk is considered medium-high.

Environmental Risk Analysis

Joshua Falls-Yeat 765 kV line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – Team Green – will be required.

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.

Substation Risk Analysis

Yeat Substation

Yeat station will include two new 765/500 transformers in parallel, one new 500/230 kV transformer and one new 500 MVAR, 500 kV cap bank, one new 765 kV breaker, 10 new 500 kV breakers and three new 230 kV breakers.

Joshua Falls Upgrade

This component is to add two 765 kV breakers at Joshua Falls. Due to the mountainous terrain for Joshua Falls substation, any expansion of the substation to permit new line terminations will require significant civil work and costs.

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

Constructability Summary

Proposal 820 has about 34% of its 138-mile run of 765 kV as greenfield construction, and the remainder mostly paralleling existing ROW. The anticipated challenges for land acquisition, combined with some of the environmental and local county features as a part of its proposed route, results in a medium-high risk assessment for constructability.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 11**.

Table 11. Proposal 820 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Joshua Falls-Yeat 765 kV line	675.00	781.26
2	Yeat Station Greenfield Station	226.90	347.76
3	Yeat 500 cut in-lines Greenfield Transmission Line	8.60	8.60
4	Joshua Falls Upgrade	99.19	99.19
5	Yeat 230 kV cut in-lines Greenfield Transmission Line	7.20	7.20
	Total	**1,016.90**	**1,244.01**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

Proposal 820 has a notable amount of 765 kV greenfield construction. There are environmental and local county issues expected as a part of its routing process. A medium-high schedule risk is assessed.

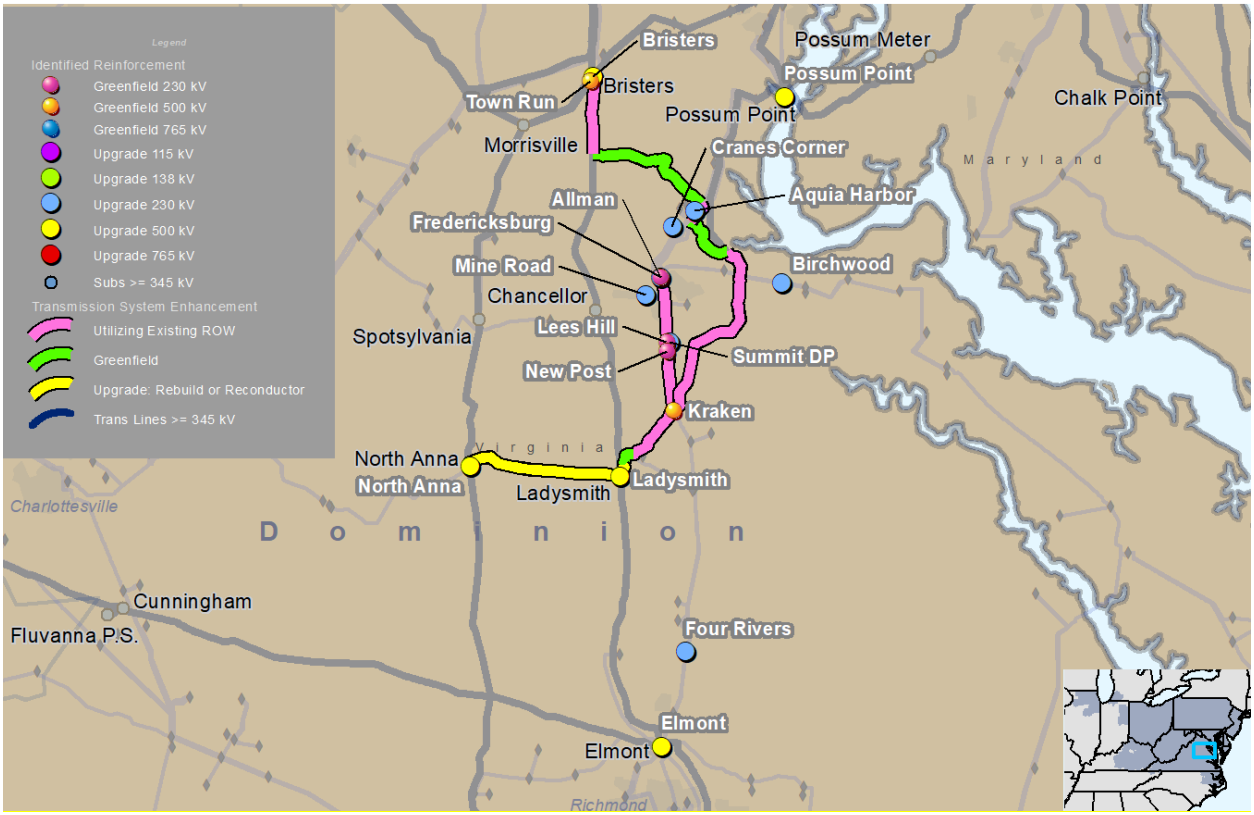
Proposing Entity Experience and Capability Review

Transource has significant experience with the proposed equipment and the capabilities to construct Proposal 820 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 967 – VEPCO (Dominion)

Dominion Proposal No. 967 (**Map 8**), described as DVP Central Area Improvement, is one of the major components of the PJM joint Proposal Nos. 262, 759, 636 & 610 (Portfolios 1A, 1B, 2 & 3) to address the Regional Cluster solution. The Proposal No. 967 consists of a total of 38 components that include five greenfield transmission line components, nine transmission line upgrade components, three greenfield substation components and 21 substation upgrade components, adding up to 67 miles of 500 kV transmission lines.

Map 8. Proposal 967



*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 Proposal 967 includes the following components:

- Component 1: New 500 kV Line – North Anna to Kraken to Town Run (993455)
- Component 2: Kraken Substation Upgrade (993455)
- Component 3: North Anna Substation Upgrade (993455)
- Component 4: Town Run Substation Upgrade (993455)
- Component 5: Bristers Substation Upgrade (99-3454)
- Component 6: Morrisville Substation Upgrade (99-3454)
- Component 7: New 500 kV switching station – Town Run (99-3454)
- Component 8: Four Rivers Substation Relay Reset (99-3387)
- Component 9: Fredericksburg Substation Relay Reset (99-3387)
- Component 10: Kraken 500/230 kV Switching Station (99-3387)
- Component 11: Ladysmith Substation Relay Reset (99-3387)
- Component 12: Ladysmith CT Substation Relay Reset (99-3387)
- Component 13: Possum Point Substation Relay Reset (99-3387)
- Component 14: Lines 2090 (Future Line 2301) Rebuild – Lee's Hill to Fredericksburg (99-3376)
- Component 15: Line 545 – Town Run Substation Cut-in (993454)
- Component 16: Line 569 – Town Run Substation Cut-in (993454)
- Component 17: New 230 kV Line – Ladysmith to Kraken to New Post to Lees Hill (Temp Lines 9437/9438) (99-3315)
- Component 18: Ladysmith Substation Terminal Equipment Upgrade (99-3315)
- Component 19: Ladysmith CT Substation Terminal Equipment Upgrade (99-3315)
- Component 20: Lees Hill Substation Terminal Equipment Upgrade (99-3315)
- Component 21: New Post Substation Terminal Equipment Upgrade (99-3315)
- Component 22: Line 2083 Cut-In to Allman Substation (99-3192)
- Component 23: Line 2157 Cut-In to Allman Substation (99-3192)
- Component 24: Line 2305 Cut-In to Allman Substation (99-3192)
- Component 25: Line 256 / Line 2XX Cut-In to Kraken Substation (99-3387)
- Component 26: Line 568 / Line 5XXX Cut-In to Kraken Substation (99-3387)
- Component 27: Line 2090 / Line 2XXX Cut-In to Kraken Substation (99-3387)
- Component 28: New 230 kV Line (2XXX1) – Kraken to New Post (99-3446)
- Component 29: New 230 kV Line (2XX2) – New Post to Lee's Hill (99-3446)
- Component 30: New 230 kV Line (2XX3) – Lee's Hill to Allman (99-3446)
- Component 31: New 230 kV Switching Station – Allman (99-3192)
- Component 32: Aquia Harbor Substation Upgrade (99-3192)
- Component 33: Birchwood Substation Upgrade (99-3192)

- Component 34: Cranes Corner Substation Upgrade (99-3192)
- Component 35: Fredericksburg Substation Upgrade (99-3192)
- Component 36: Elmont Substation Terminal Equipment Upgrade (99-3337)
- Component 37: Ladysmith Substation Expansion (99-3375)
- Component 38: Fredericksburg Substation Terminal Equipment Upgrade (99-3376)

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New 500 kV Line – North Anna to Kraken to Town Run (993455)

This project is further divided into six different sections outlined below, and the combined total length of lines 5XX1 and 5XX2 is approximately 67.13 miles.

1 | From North Anna substation to Ladysmith substation, new 500 kV steel lattice tower structures on foundations shall be constructed within existing 275'-wide ROW adjacent to existing line 575. Based on the operating one line for line 575, this section of line 5XX1 is approx. 14.53 miles long and will be constructed on the vacant south side of the existing ROW.

2 | From Ladysmith substation to Kraken substation, new 500 kV steel lattice tower structures on foundations shall be constructed in a 100' expanded ROW, on the west side of the existing ROW, adjacent to existing lines 568 and 2089. This section of line 5XX1 is approx. 7.79 miles long. Included in this section is a brief 2.1-mile segment of greenfield 150' ROW. This section branches off the existing ROW near structure 568/251 and back on the existing ROW near 568/243.

3 | From Kraken to existing structure 568/117, new 500 kV steel lattice tower structures on foundations shall be constructed in a 25' expanded ROW, to the northwest side of the existing ROW, adjacent to existing line 568. Based on Google earth measurements, this section of line 5XX2 is approximately 18.80 miles long.

4 | From existing structure 568/117 to approx. 0.80 miles east of Garrisonville substation, new 500 kV steel lattice tower structures on foundations shall be constructed in a greenfield 150' ROW. Based on Google earth measurements, this section of line 5XX2 is approx. 12.71 miles long.

5 | From approx. 0.80 miles east of Garrisonville substation to existing structure 552/168 within the corridor between Bristers substation and Chancellor substation, new structures shall be constructed within an existing corridor. These structures will be 500 kV steel lattice towers on foundations. Based on Google earth measurements, this section of line 5XX2 is approx. 6.63 miles long. The existing corridor will need to be cleared of vegetation.

6 | From existing structure 552/168 to Town Run substation, new 500 kV steel lattice tower structures on foundations shall be constructed in a 35' expanded ROW, on the east side of the existing ROW, adjacent to existing line 552. This section of line 5XX2 is approx. 6.67 miles long.

New 230 kV Line – Ladysmith to Kraken to New Post to Lees Hill (Temp Lines 9437/9438) (99-3315)

The line facing west of the corridor going north from Ladysmith substation (Temp Line # 9437/9438) will be rerouted at structure 2089/17 to continue north along the ROW toward the Elmont/Fredericksburg Junction. A vertical configuration monopole line will be installed on the west side of the ROW, next to the existing 2090 & 256 tower line. At the Elmont/Fredericksburg Junction, line Temp Line # 9437/9438 will turn north and join line 2090 from structures 2090/106, terminating at New Post and Lees Hill substations. Line 2090 structures along the Elmont/Fredericksburg Junction to Lees Hill will be replaced.

New 230 kV line (2XXX1) – Kraken to New Post (99-3446); New 230 kV line (2XX2) – New Post to Lee's Hill (99-3446); New 230 kV line (2XX3) – Lee's Hill to Allman (99-3446)

New structures shall be placed in expanded ROW adjacent to existing line 2090 using primarily custom engineered double circuit 230 kV steel structures on concrete foundations.

New Greenfield Substations – Kraken, Town Run and Allman

Dominion will pursue all required permitting/land acquisition for all the greenfield substation projects including new 500 kV switching station – Town Run (99-3454), Kraken 500/230 kV switching station (99-3387) and new 230 kV switching station – Allman (99-3192).

Overall, the ROW risk for Proposal No. 967 is assessed as low-medium based on the routing of the 500 kV line from North Anna-Kraken-Town Run, the majority of which is to be performed as brownfield construction.

Environmental Risk Analysis

New 500 kV Line – North Anna to Kraken to Town Run (993455)

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 12 conservation easements. Coordination with easement holders – The Nature Conservancy; Virginia Dept. of Historic Resources; Fauquier County, Virginia; Northern Virginia Conservation Trust; Virginia Outdoors Foundation – is required.

New 230 kV Line – Ladysmith to Kraken to New Post to Lees Hill (Temp Lines 9437/9438) (99-3315)

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route does not intersect any conservation easements.

New 230 kV Line (2XX2) – New Post to Lee's Hill (99-3446)

The proposed component has the potential to impact environmental resources including streams and 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 & Endangered Species. Impacts to these resources will require coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Transmission Line Risk Analysis

There are significant transmission line and infrastructure crossings and potential impacts to residences in greenfield portions of the North Anna to Kraken to Town Run 500 kV line. The majority of the terrain is hilly and forested, which may require alternative construction methods and/or excessive tree clearing. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates.

Substation Risk Analysis

New Kraken 500/230 kV Switching Station

Construct a new 500/230 kV switching station to accommodate the new 230 kV and 500 kV transmission lines proposed in this solution. The 500 kV, 5000 Amps ring bus will be set up for redundant breaker configuration. The 230 kV, 4000 Amps bus will be set up for six rows of breaker-and-a-half configuration. Two 1400 MVA, 500-230 kV transformers will be installed at the proposed substation.

New Town Run 500 kV Switching Station

Build a new 500 kV switching station, Town Run, with an ultimate setup of three rows of a breaker-and-a-half scheme in ring bus configuration with a redundant breaker configuration.

New 230 kV Switching Station – Allman

Construct a new 230 kV Allman switching station just north of Fredericksburg substation. The substation scope includes the installation of a 230 kV breaker-and-a-half bus GIS system. This component was part of the project presented in August 2024 TEAC (DOM-2024-0035).

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

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.

Constructability Summary

Proposal 967 has 67 miles of 500 kV along with a number of stations upgrades and a couple of well-placed new substations. This project is assessed a medium risk for its overall constructability due to the majority of brownfield construction for the intended scope, along with some challenges anticipated for the greenfield portion of the 500 kV line route.

Outage Review

A significant amount of line and substation upgrade components normally trigger the need for complex outage/construction sequences that require significant outage coordination, further increasing the risk of ISD delay.

It is estimated there may be tricky outages with Proposal 967, not the least of which involves coordinating with nuclear generation for required outages. A medium outage risk is assessed.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 12**.

Table 12. Proposal 967 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	New 500 kV Line – North Anna to Kraken to Town Run (993455)	565.38	409.95
2	Kraken Substation Upgrade (993455)	14.41	14.41
3	North Anna Substation Upgrade (993455)	9.12	9.12
4	Town Run Substation Upgrade (993455)	9.12	9.12
5	Bristers Substation Upgrade (99-3454)	0.04	0.04
6	Morrisville Substation Upgrade (99-3454)	0.07	0.07
7	New 500 kV switching station – Town Run (99-3454)	49.69	52.89
8	Four Rivers Substation Relay Reset (99-3387)	0.04	0.04
9	Fredericksburg Substation Relay Reset (99-3387)	0.04	0.04
10	Kraken 500/230 kV Switching Station (99-3387)	147.62	232.64
11	Ladysmith Substation Relay Reset (99-3387)	0.04	0.04
12	Ladysmith CT Substation Relay Reset (99-3387)	0.07	0.07
13	Possum Point Substation Relay Reset (99-3387)	0.04	0.04
14	Lines 2090 (Future Line 2301) Rebuild – Lee's Hill to Fredericksburg (99-3376)	38.65	25.38
15	Line 545 – Town Run Substation Cut-in (993454)	3.80	3.80
16	Line 569 – Town Run Substation Cut-in (993454)	3.80	3.80
17	New 230 kV Line – Ladysmith to Kraken to New Post to Lees Hill (Temp Lines 9437/9438) (99-3315)	35.49	29.09
18	Ladysmith Substation Terminal Equipment Upgrade (99-3315)	4.29	4.29
19	Ladysmith CT Substation Terminal Equipment Upgrade (99-3315)	2.38	2.38
20	Lees Hill Substation Terminal Equipment Upgrade (99-3315)	2.44	2.44
21	New Post Substation Terminal Equipment Upgrade (99-3315)	2.70	2.70
22	Line 2083 Cut-in to Allman Substation (99-3192)	3.32	3.32
23	Line 2157 Cut-in to Allman Substation (99-3192)	3.32	3.32
24	Line 2305 Cut-in to Allman Substation (99-3192)	3.32	3.32
25	Line 256 / Line 2XX Cut-In to Kraken Substation (99-3387)	5.40	5.40
26	Line 568 / Line 5XXX Cut-In to Kraken Substation (99-3387)	7.20	7.20
27	Line 2090 / Line 2XXX Cut-In to Kraken Substation (99-3387)	5.40	5.40

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
28	New 230 kV Line (2XXX1) – Kraken to New Post (99-3446)	54.29	40.84
29	New 230 kV Line (2XX2) – New Post to Lee's Hill (99-3446)	13.57	6.68
30	New 230 kV Line (2XX3) – Lee's Hill to Allman (99-3446)	67.87	43.81
31	New 230 kV Switching Station - Allman (99-3192)	117.29	118.03
32	Aquia Harbor Substation Upgrade (99-3192)	0.04	0.04
33	Birchwood Substation Upgrade (99-3192)	0.04	0.04
34	Cranes Corner Substation Upgrade (99-3192)	0.04	0.04
35	Fredericksburg Substation Upgrade (99-3192)	0.11	0.11
36	Elmont Substation Terminal Equipment Upgrade (99-3337)	8.90	8.90
37	Ladysmith Substation Expansion (99-3375)	8.24	8.24
38	Fredericksburg Substation Terminal Equipment Upgrade (99-3376)	2.19	2.19
	Total	**1,189.78**	**1,059.23**

The total proposal cost estimate is 10% greater than the independent cost estimate and is considered low risk.

Schedule Review

The proposed in-service date of December 2029 is reasonable for the proposed scope of the project, considering the permitting, engineering and construction and land acquisition risks associated with it. There may be some opportunity for outage related delays at play here as well, leading to a schedule risk of medium being assessed.

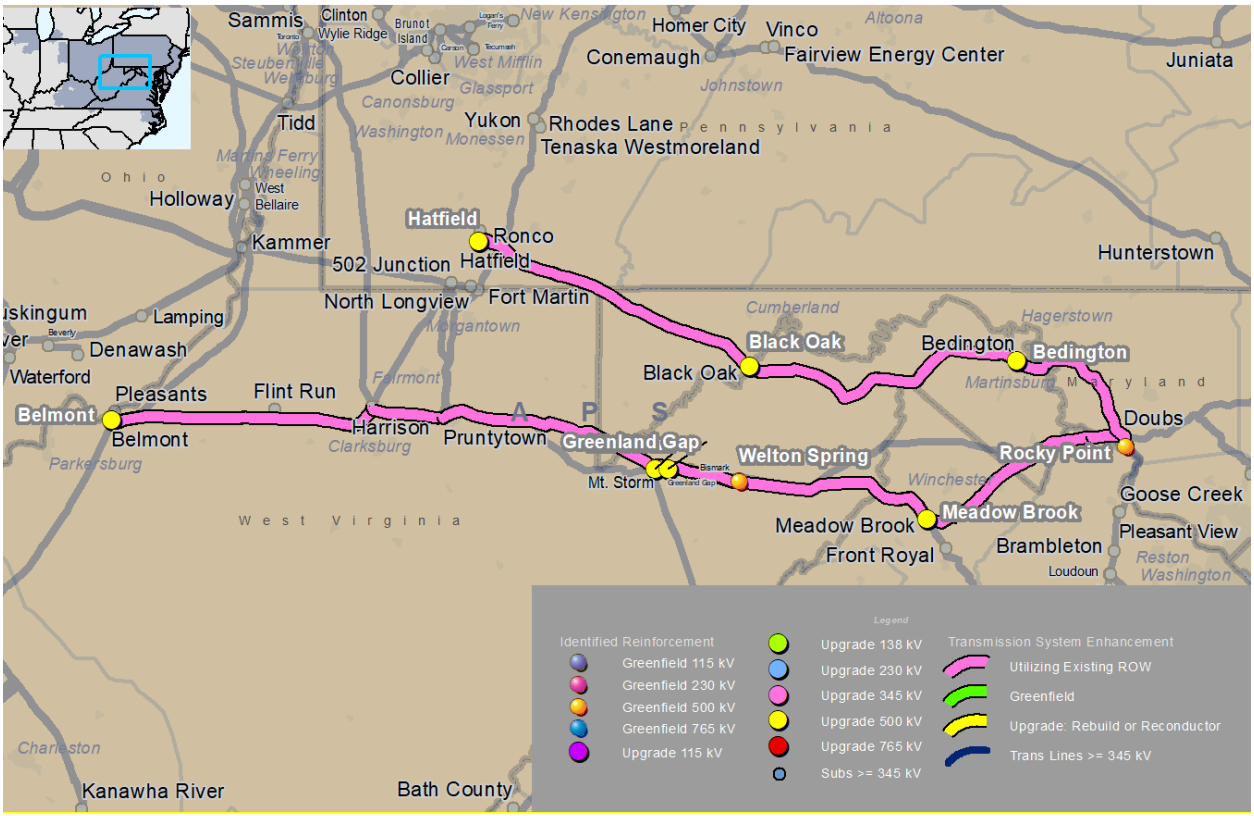
Proposing Entity Experience and Capability Review

Dominion has significant experience with the proposed equipment and the capabilities to construct Proposal 967 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 907 – TRAIL (FirstEnergy)

First Energy Proposal No. 907 (**Map 9**) describes expanding the 500 kV transmission network by 396 miles in Pennsylvania, West Virginia, Virginia and Maryland; constructing two new substations; expanding four existing substations; and constructing five new 500 kV transmission lines. This proposal was submitted by FirstEnergy as a 500 kV alternative to the major 765 kV developments in the joint scenario proposals from FirstEnergy, Dominion and Transource. First Energy Proposal No. 907 has a total of twelve components, which includes two greenfield substation components, three substation upgrade components, five greenfield transmission line components and two transmission line upgrade components.

Map 9. Proposal 907



*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

First Energy Proposal 907 includes the following components:

- Component 1: Rocky Point 500 kV Substation
- Component 2: Welton Springs 500 kV Substation
- Component 3: Black Oak Substation Expansion
- Component 4: Bedington Substation Rebuild

- Component 5: Mt. Storm-Meadow Brook 500 kV Line Loop into Welton Springs
- Component 6: Greenland Gap-Meadow Brook 500 kV Line Loop into Welton Springs
- Component 7: Belmont Substation Expansion
- Component 8: Belmont-Welton Springs 500 kV Line
- Component 9: Welton Springs-Rocky Point 500 kV Line
- Component 10: Hatfield-Black Oak No. 2 500 kV Line
- Component 11: Bedington-Black Oak No. 2 500 kV Line
- Component 12: Bedington-Rocky Point 500 kV Line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Belmont-Welton Springs 500 kV Line

The new line will be approximately 140 miles, and a new ROW will be required to expand the existing transmission corridor. The new transmission line will parallel the existing 500 kV corridor from Belmont substation toward Flint Run and Mt. Storm substations.

Welton Springs-Rocky Point 500 kV Line

Approximately 91 miles of new ROW will be required to expand the existing transmission corridors. The new transmission line will parallel the existing transmission corridors: Greenland Gap-Meadow Brook 500 kV line, Doubs-Bismark 500 kV line, Double Toll Gate-Meadow Brook 138 kV line, Double Toll Gate-Millville 138 kV line, Doubs-Millville 138 kV line, and Doubs-Dickerson 230 kV line.

Hatfield-Black Oak No. 2 500 kV Line

Approximately 62 miles of new ROW will be required adjacent to the existing Hatfield-Black Oak 500 kV line.

Bedington-Black Oak No. 2 500 kV Line

Approximately 60 miles of new ROW will be required adjacent to the existing Bedington-Black Oak 500 kV line.

Bedington-Rocky Point 500 kV Line

Approximately 40 miles of new ROW will be required. The new line will parallel existing ROW for the entirety of the line.

Overall, the ROW risk is considered as medium-high due to the mix of greenfield and brownfield with the majority of the risk due to the amount of the greenfield challenges with possible new ROW and land acquisition.

Environmental Risk Analysis

Belmont-Welton Springs 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. Proposed route intersects designated critical habitat for the following species: round hickorynut, salamander mussel and longsolid. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects three conservation easements. Coordination with easement holders – Maryland Agricultural Land Preservation Foundation, Pruntytown State Farm and WV Division of Natural Resources – is required.

Welton Springs-Rocky Point 500 kV Line

The proposed route intersects with the following recorded historical sites/structures/districts: Chapel Rural Historic District. Coordination with the VA SHPO is required. The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects 47 conservation easements. Coordination with easement holders – Clarke County, VA; U.S. National Park Service; U.S. NRCS; Loudon County, VA; Potomac Conservancy; Northern Virginia Conservation Trust; Old Dominion Land Conservancy; Virginia Outdoors Foundation; Virginia Dept. of Conservation & Recreation; Clarke County Conservation Easement Authority (VA); Appalachian Trail Conservancy – is required. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. Proposed route intersects designated critical habitat for the following species: green floater. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Hatfield-Black Oak No. 2 500 kV Line

The proposed component has the potential to impact environmental resources including streams, lakes, and wetlands subject to USACE Section 404 and/or Section 10 permitting. Proposed route intersects 24 FEMA high-risk flood zones (100-year floodplain). Coordination with the floodplain administrator from the following jurisdictions will be required: PA Greene, PA Fayette, MA Garrett, and MA Allegany. In addition, the proposed component intersects woodlands with the potential to serve as suitable habitat for federally listed Threatened & Endangered Species and/or birds protected by the Migratory Bird Treaty Act (MBTA). Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 10 conservation easements. Coordination with the following easement holder(s) – Maryland Rural Legacy Program; Fayette County, Pennsylvania; Maryland Agricultural Land Preservation Foundation; MD Department of Natural Resources; PA Bureau of Forestry; and PA Game Commission – is required. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. The proposed route intersects Natural Areas/Reserves/Wildlife Refuge(s): Bear Pen Headwaters Heritage Conservation and Bear Creek Hatchery Fish Management Area. Coordination with the following agency – MD Department of Natural Resources – is required.

Bedington-Black Oak No. 2 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects designated critical habitat for the following species: green floater. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects seven conservation easements. Coordination with easement holders – NRCS - Admin State WV; Hampshire County Farmland Protection Board, West Virginia; Land Trust of the Eastern Panhandle; Open Space Institute - Resilient Landscapes Initiative; WV Division of Natural Resources – is required.

Bedington-Rocky Point 500 kV Line

The proposed route intersects with the following recorded historical sites/structures/districts: Scrabble Historic District (West Virginia) and Turner's and Fox's Gaps Historic District (Maryland). Coordination with the WV SHPO and MD SHPO is required. The proposed component has the potential to impact environmental resources including FEMA floodplains,

streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 14 conservation easements. Coordination with the following easement holders – NRCS - Admin State WV; Berkeley County Farmland Protection Board, WV; Maryland Environmental Trust; Maryland Rural Legacy Program; Maryland Agricultural Land Preservation Foundation; Washington County, PA – is required.

Transmission Line Risk Analysis

The vast majority of the work associated with this proposal are the 500 kV greenfield lines, which span across four states. Construction of 500 kV greenfield lines is not a unique engineering or construction challenge. Outage limitations will dictate the level of offset required for construction. Various crossings are present that may require reconfiguration of existing lines to allow the new circuits through the areas without excessively tall structures.

Overall, the proposed transmission line work is feasible and the major risk to the project is the scale of the work proposed. There are benefits to following existing facilities rather than attempting entirely new routes. But the volume of work does not seem feasible from a schedule perspective, assuming the proposed schedule is accurate. Other than the volume to be performed in the time outlined, the project seems feasible and without any major issues on the engineering and construction aspects.

Substation Risk Analysis

Rocky Point 500 kV Substation:

Construct the new Rocky Point 500 kV substation and loop in the Doubs-Goose Creek 500 kV line, Doubs-Aspen 500 kV line and Woodside-Goose Creek 500 kV line. This substation will be constructed in a breaker-and-a half configuration. The installation will include switched capacitors and a STATCOM for reactive support. This substation will be constructed to accommodate the interconnection of the proposed Welton Springs-Rocky Point 500 kV line and the Bedington-Rocky Point 500 kV line as well. The location of this substation does not require property acquisition and is strategically located adjacent to the Doubs-Goose Creek transmission corridor.

Welton Springs 500 kV Substation:

Construct the new Welton Springs 500 kV substation. This yard will be constructed in a breaker-and-a-half configuration. Equipment to be installed will include installation of switched capacitors and a STATCOM for reactive support. This substation will be constructed to accommodate the connection of the Greenland Gap-Meadow Brook 500 kV line, the Mt. Storm-Meadow Brook 500 kV line, the proposed Belmont-Welton Springs 500 kV line, and the proposed Rocky Point-Welton Springs 500 kV line. The proposed substation is strategically located ~0.5 miles north of the Greenland Gap-Meadow Brook 500 kV line and the Mt. Storm-Meadow Brook 500 kV line, and ~0.5 miles south of the Bismarck-Doubs 500 kV line, allowing for future expansion. Refer to Executive Abstract provided by Transource, Dominion and FirstEnergy. The construction responsibility for this proposal is Dominion High Voltage MidAtlantic Inc., the appropriate FirstEnergy affiliate and Transource.

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

The above major greenfield substation components are feasible from a design perspective. The risks to the project are the scale of the EHV work being 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. However, procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs.

Constructability Summary

Proposal 907 illustrates some of the issues associated with trying to build the upgrades required using only 500 kV rather than new 765 kV lines. This proposal adds up to nearly 400 miles of 500 kV facilities. This amount of coordinated work in the same total time frame leads to a high constructability risk.

Outage Review

There’s a significant amount of work in and around numerous key transmission substations. It can be tough to schedule even short outages in these very important facilities, and some of the outages at play here may not be of very short duration. Medium-high outage risk assessed.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 13**.

Table 13. Proposal 907 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Point of Rocks 500 kV Switchyard	229.39	272.86
2	Welton Springs 500 kV Switchyard	177.80	246.01
3	Black Oak Substation Expansion	37.30	37.30
4	Bedington Substation Rebuild	74.78	74.78
5	Mt. Storm-Meadow Brook 500 kV Line Loop into Welton Springs	10.53	13.80
6	Greenland Gap-Meadow Brook 500 kV Line Loop into Welton Springs	10.24	14.86
7	Belmont Substation Expansion	91.59	91.59
8	Belmont-Welton Springs 500 kV Line	799.31	752.41
9	Welton Springs-Point of Rocks 500 kV Line	497.02	489.07
10	Hatfield-Black Oak No. 2 500 kV Line	341.69	333.21
11	Bedington-Black Oak No. 2 500 kV Line	364.04	322.46
12	Bedington-Point of Rocks 500 kV Line	205.21	214.97
	Total	**2,838.90**	**2,863.33**

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

Schedule Review

This proposal adds up to nearly 400 miles of 500 kV facilities. Due to this, the proposed in-service date of December 2029 is considered aggressive for this very significant scope. The permitting, engineering and construction and land acquisition risks associated with the extensive work leave plenty of opportunities for delays. A schedule risk of high is assessed.

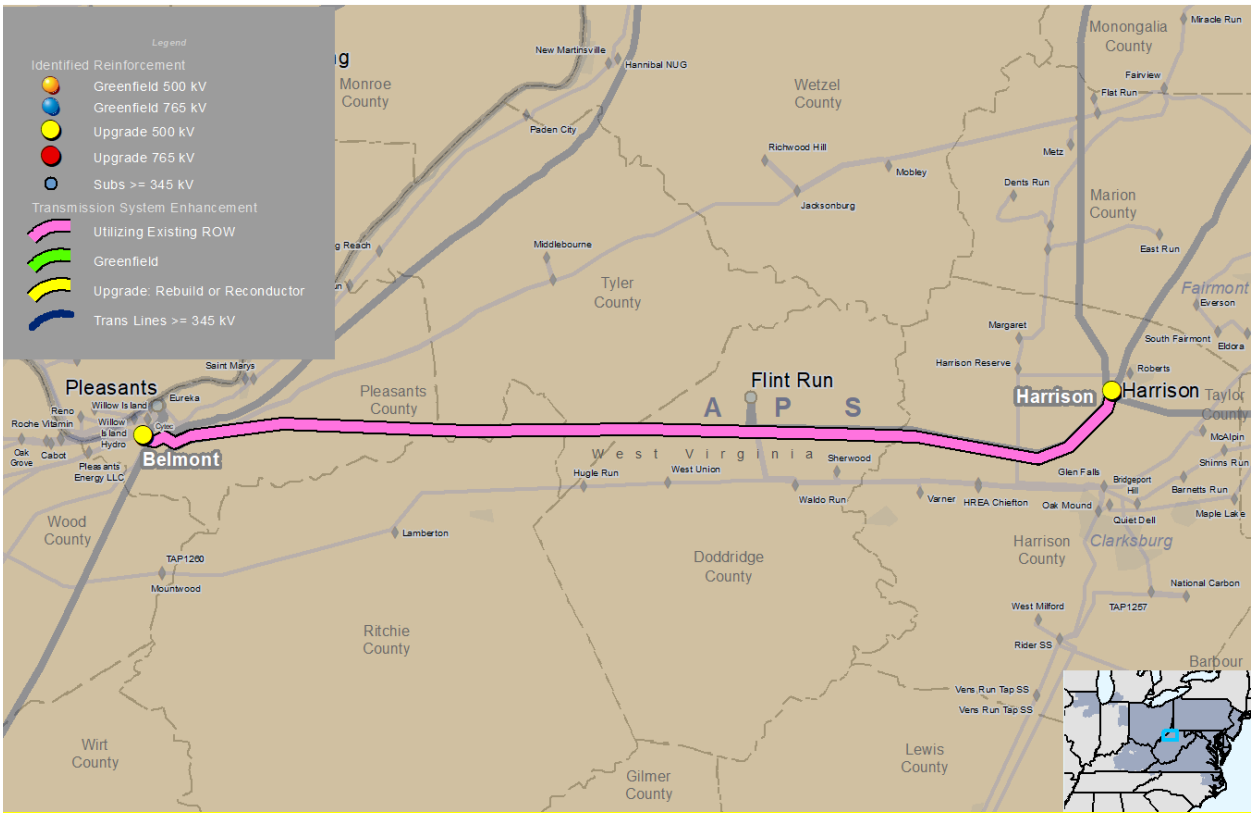
Proposing Entity Experience and Capability Review

FirstEnergy has significant experience with the proposed equipment and the capabilities to construct Proposal 907 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 977 – TRAIL (FirstEnergy)

First Energy Proposal No. 977 (**Map 10**), described as Belmont-Harrison 500 kV line (approximately 56 miles), is one of two optional components (the other is Proposal No. 727) of the PJM joint Proposal Nos. 636, 610 & 279 & 114 (Portfolios 2, 3, 4A & 4B) to address the Regional Cluster solution. First Energy Proposal No. 977 has a total of three components with one greenfield transmission line component and two substation upgrade components.

Map 10. Proposal 977



*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

First Energy Proposal 977 includes the following components:

- Component 1: Belmont-Harrison 500 kV Line
- Component 2: Belmont Substation-New 500 kV Line Terminal
- Component 3: Harrison Substation-New 500 kV Line Terminal

Constructability Review

Right-of-Way/Land Usage Risk Analysis

The new Belmont-Harrison 500 kV line is approximately 56 miles and will be constructed parallel to the existing Belmont-Flint Run and Flint Run-Harrison 500 kV lines.

Since the project route crosses the multiple Section 10 Navigable Waters, a USACE Section 10 Permit will likely be required. The project will likely require a NEPA review, FERC review, and Section 7 Consultation with the USFWS due to federal involvement from the Section 10 Permit. The Ruth FLD airport is mapped 0.3 miles south of transmission line. It may require FAA notice filing depending on the final height and proximity to the airport of the project. Due to the presence of critical habitat for rare species within the study area, federal review may be more intensive and have longer timelines. A West Virginia CPCN will likely be required to permit the project. This may take 8–16 months to complete.

Overall, the ROW risk is medium with the proposed route paralleling and requiring expansion to the existing transmission line ROW.

Environmental Risk Analysis

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. The federally endangered Indiana bat, northern long-eared bat, clubshell, fanshell, northern riffleshell, pink mucket, purple cat's paw and snuffbox mussel; the federally threatened longsolid and round hickorynut; the federally proposed endangered tricolored bat and salamander mussel; and the candidate for listing monarch butterfly were identified as potentially occurring within the project area. The IPaC also recommended further coordination with the USFWS West Virginia field office regarding the Indiana bat, pink mucket, purple cat's paw and the snuffbox mussel.

Transmission Line Risk Analysis

The region that is being traversed is extremely mountainous and will cause certain spans to be considerably longer, thus increasing the size and complexity of the supporting structures. Midway through the line there will need to be an excessively tall crossing, as the adjacent 500 kV line it parallels has an interconnection to navigate.

There are no major concerns with the engineering and construction of this project. A 500 kV greenfield line on monopoles is a typical approach and there is nothing overly complex with this design, but greenfield lines are subject to the typical risks associated with relevant landowners that protest the project moving forward. This particular route parallels an existing 500 kV line in

a rural area. The terrain will limit opportunities for optimized pole spotting, but it will likely follow structure for structure with the existing line.

Substation Risk Analysis

Belmont Substation – New 500 kV Line Terminal:

Install a new 500 kV circuit breaker, disconnect switches, relaying and associated equipment.

Harrison Substation – New 500 kV Line Terminal:

Install a new 500 kV circuit breaker; disconnect switches, relaying and associated equipment.

Above substation components are feasible from a design and schedule perspective. There are no major risks foreseen with these substation components.

Constructability Summary

Proposal 977 is assessed a medium constructability risk due to the combination of land acquisition, engineering and construction risks assessed for the new 56-mile 500 kV line.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 14**.

Table 14. Proposal 977 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Belmont-Harrison 500 kV Line	277.41	300.96
2	Belmont Substation – New 500 kV line terminal	0.00	0.00
3	Harrison Substation – New 500 kV line terminal	0.00	0.00
	Total	**277.41**	**300.96**

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 2029 is reasonable for the proposed scope of the project considering the permitting and land acquisition involved. Overall, the schedule risk is assessed as medium.

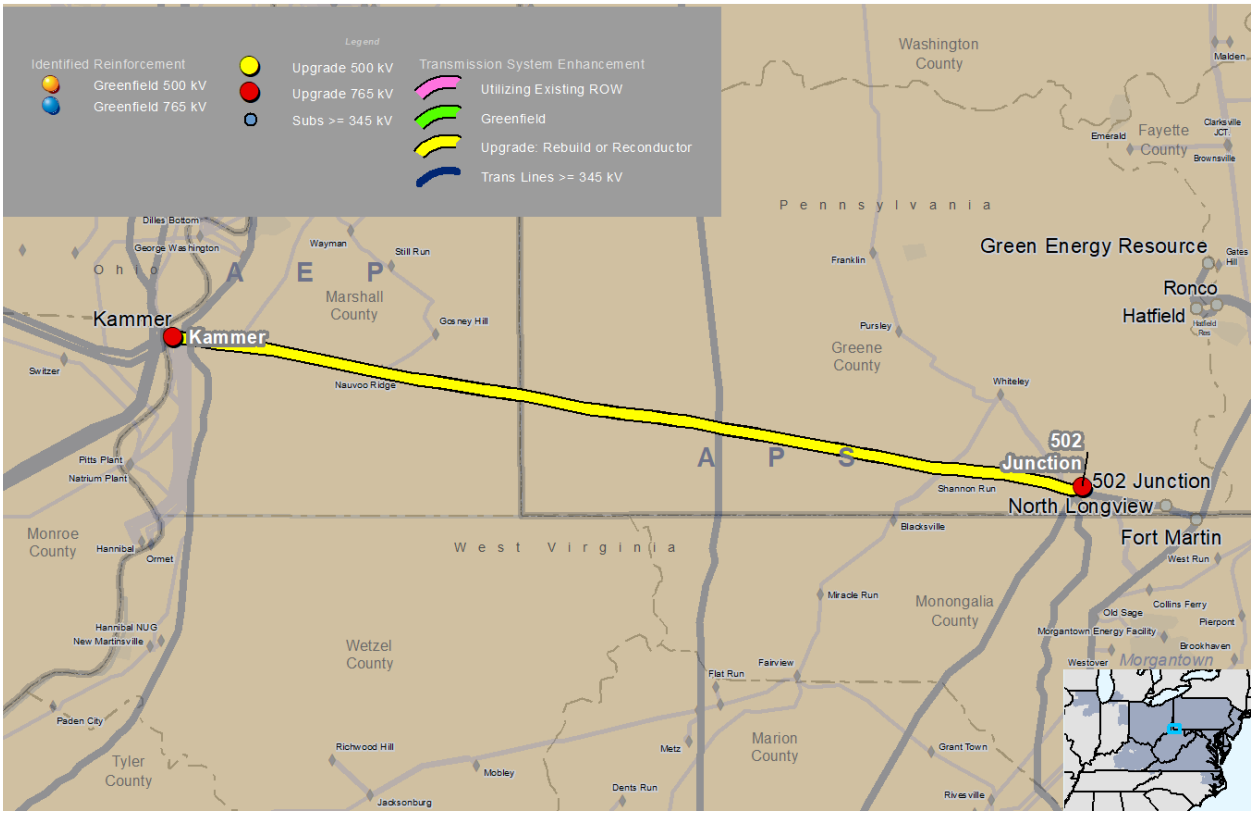
Proposing Entity Experience and Capability Review

FirstEnergy has significant experience with the proposed equipment and the capabilities to construct Proposal 977 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 727 – KEYATC (FirstEnergy)

First Energy Proposal No. 727 (**Map 11**), described as Kammer-502 Junction 765 kV line (approximately 41.9 miles), is one of two optional components (the other is Proposal No. 977) of the PJM joint Proposal Nos. 636, 610, 279 and 114 (Portfolios 2, 3, 4A & 4B) to address the Regional Cluster solution. First Energy Proposal No. 727 has a total of three components and includes one transmission line upgrade component and two substation upgrade components.

Map 11. Proposal 727



*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

First Energy Proposal 727 includes the following components for the West cluster:

- Component 1: Kammer-502 Junction 765 kV Line
- Component 2: 502 Junction Substation Expansion
- Component 3: Kammer 765/500 kV Transformer Relocation

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Kammer-502 Junction 765 kV Line

Convert the Kammer-502 Junction 500 kV line to a 765 kV line. This will require a complete rebuild of the existing Kammer-502 Junction 500 kV line and construction of a new Kammer-502 Junction 765 kV line. No new ROW will be required, as the new 765 kV line will be constructed in the existing Kammer-502 Junction 500 kV line corridor.

Overall, the ROW risk is low, as all the line components are pure brownfield and proposal is to rebuild within an existing ROW.

Environmental Risk Analysis

One-hundred-year floodplains are present within the study area, which may impact the ease of access due to a need for permitting at the county and municipal level. Individual 401 Water Quality Certifications (WQC) may be required, as well as stormwater best management practices. Wetlands will require further studies to determine location and necessary permitting. Multiple sensitive species were identified; the largest potential issues would come from the possible need for extensive bat surveys.

Transmission Line Risk Analysis

The project replaces and existing 500 kV line within the existing ROW, with no need to expand the width of that ROW. Overall, the component of this project is feasible from an engineering and construction prospective and does not pose any significant risks to successfully implementing the proposed work. The only risk is more of associated with the availability of outages (see below Outage Review) on the 500 kV existing line; the new line would have to be offset if there is a constraint on the outage window, which could possibly change the original project outlooks.

Substation Risk Analysis

502 Junction Substation Expansion

Expand 502 Junction substation to accommodate the installation of a new 765 kV substation and 765/500 kV transformer. Relocate the existing Kammer 765/500 kV transformer to 502 Junction substation. Install a new 765/500 kV transformer at 502 Junction substation.

Kammer 765/500 kV Transformer Relocation

Relocate the existing 765/500 kV transformer at Kammer substation to 502 Junction substation.

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. However, procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur.

Constructability Summary

Rebuilding an existing line, even a 500 kV as a 765 kV, using the same area is relatively lower risk than many of the other projects evaluated as a part of this window. Low-medium risk assessed for overall constructability.

Outage Review

Proposal 727 replaces an important 500 kV facility, the 42-mile Kammer to 502 Junction with a 765 kV version. Inherent to that plan is the unavailability of that important connection during the work, leading to a medium-high outage risk.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 15**.

Table 15. Proposal 727 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Kammer-502 Junction 765 kV Line	201.60	237.21
2	502 Junction Substation Expansion	85.86	85.86
3	Kammer 765/500 kV Transformer Relocation	5.00	5.00
	Total	**292.46**	**328.07**

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 2029 is reasonable for the proposed scope of the project considering the permitting and land acquisition involved. Overall, the schedule risk is assessed as medium.

Proposing Entity Experience and Capability Review

FirstEnergy has significant experience with the proposed equipment and the capabilities to construct Proposal 727 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 781 – VEPCO (Dominion)

Dominion Proposal No. 781 (**Map 12**), described as 500 kV Solutions Portfolios, includes the following projects: 1. 99-3459-Goose Creek 500/230 kV TX uprate; 2. 99-3462-line 576 rebuild-North Anna to Vontay; 3. Remove Vint Hill sub termination from new Wishing Star-Vint Hill-Morrisville 500 kV line; 4. Aspen-Brambleton line #558 terminal uprate to 5,000 amps. Proposal 781 is a required component in all of the joint proposals (Nos. 262, 759, 636, 610, 279 & 114 or Portfolios 1A, 1B, 2 , 3, 4A & 4B) submitted by Dominion, Transource and FirstEnergy to address the Regional Cluster solution.

Dominion Proposal No. 781 consists of a total of seven components, which include five substation upgrade components and two transmission line upgrade components.

Map 12. Proposal 781

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 Proposal 781 includes the following components for the West cluster:

- Component 1: Goose Creek 500/230 kV Transformer Upgrade (99-3459)
- Component 2: Line 576 Rebuild – North Anna to Vontay (99-3462)
- Component 3: North Anna Substation Upgrade (99-3462)
- Component 4: Vontay Substation Relay Reset (99-3462)
- Component 5: Vint Hill Substation Termination Removal - Wishing Star to Vint Hill to Morrisville 500 kV Line
- Component 6: Vint Hill Substation Terminal Equipment Removal
- Component 7: Brambleton 500 kV Uprate

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Proposal No. 781 is located within Hanover, Loudon, Louisa and Prince William counties, Virginia. The project includes a transformer upgrade, transmission line rebuild, substation upgrade, substation relay reset and substation termination removal. A majority of the components will be developed within existing ROWs.

Line 576 Rebuild – North Anna to Vontay (99-3462)

Rebuild approximately 21 miles of 500 kV line 576 from North Anna substation to the proposed Vontay substation. The existing structures shall be replaced one for one within the existing ROW using primarily 500/230 kV lattice towers and 500/230 kV three-pole dead-end structures.

Vint Hill Substation Termination Removal – Wishing Star to Vint Hill to Morrisville 500 kV Line

Remove the 500 kV conductor previously planned to terminate into the Vint Hill 500 kV substation and extend approximately 0.2 miles of conductor to fly over the site.

Overall, the ROW risk is low; as all the line components are pure brownfield rebuild/reconductor within existing ROW, the ROW risk of this type is considered as low.

Environmental Risk Analysis

A review of several environmental factors indicates that the construction of the project is feasible but may be a lengthy process due to necessary permits and potential access issues. 100- and 500-year floodplains are present within the study area, which may increase the price and ease of access due to a need for permitting at the county and municipal level. Additionally, at least one navigable water was mapped within the study area, which will require further review by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE). USACE permitting may take an extended period if impacts exceed 0.5 acre.

Wetlands will require further studies to determine location and necessary permitting. Individual 401 Water Quality Certifications (WQCs) may be required, as well as stormwater best management practices.

Multiple sensitive species were identified; the largest potential issues would come from the possible need for extensive bat and bald eagle surveys. A Federal Energy Regulatory Commission (FERC) National Corridor appears to be located within or near the study area, which may provide an alternative permitting pathway. No major issues are expected in getting permit approvals. Overall environmental risk is low-medium.

Transmission Line Risk Analysis

The transmission line components in Dominion proposal No. 781 are feasible from a design and schedule perspective and do not pose any significant risks. As a rebuild of an existing 500 kV line, there is limited risk for ROW. Most of the terrain is forgiving and in rural areas with limited residences. Toward the northern end of the line, the route crosses through affluent neighborhoods of the Lake Anna area that will likely show opposition to the project depending on size. But this is common for rebuild projects and likely not going to stop the effort. This scope does require three structures to be placed within Lake Anna, which will likely require some permitting and will require unique foundations and construction methods.

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.

Constructability Summary

Proposal 781 carries with it relatively few constructability risks due primarily to its reasonable ROW and land usage combined with a realistic schedule. Low-medium overall constructability risk assessed.

Outage Review

Proposal 781 has some outages that will require coordination, including coordination with a nuclear station. Medium outage risk assessed.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 16**.

Table 16. Proposal 781 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	Goose Creek 500/230 kV Transformer Upgrade (99-3459)	34.01	34.01
2	Line 576 Rebuild – North Anna to Vontay (99-3462)	125.21	110.83
3	North Anna Substation Upgrade (99-3462)	2.44	2.44
4	Vontay Substation Relay Reset (99-3462)	0.02	0.02
5	Vint Hill Substation Termination Removal – Wishing Star to Vint Hill to Morrisville 500 kV Line	0.00	0.20
6	Vint Hill Substation Terminal Equipment Removal	0.00	1.03
7	Brambleton 500 kV Uprate	0.00	0.32
	Total	**161.68**	**148.85**

The total proposal cost estimate is 10% greater than the independent cost estimate and is considered low risk.

Schedule Review

The proposed in-service date of December 2029 is very reasonable for the proposed scope of the project considering the permitting and land acquisition challenges associated with the proposed components. The work involved is still of a notable size and scale, and the schedule risk is assessed as low-medium.

Proposing Entity Experience and Capability Review

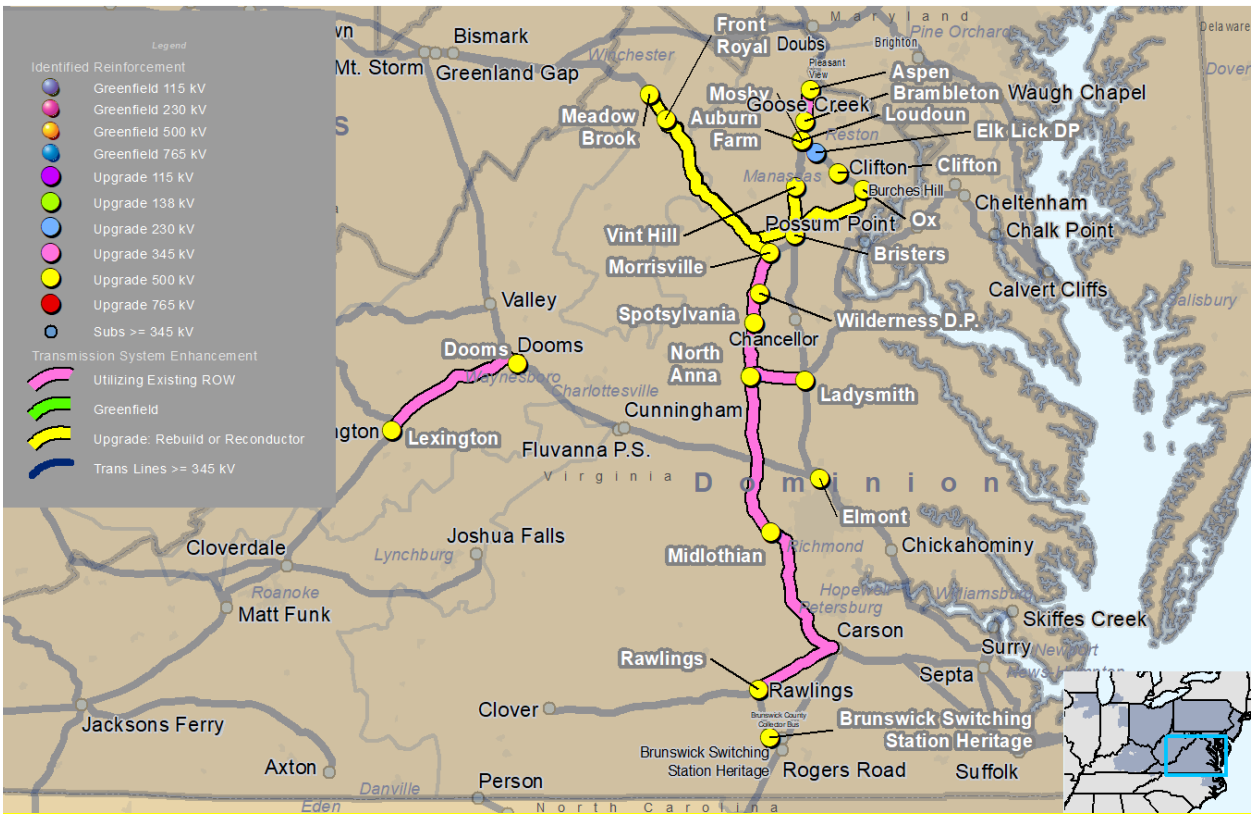
Dominion has significant experience with the proposed equipment and the capabilities to construct Proposal 781 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 983 – VEPCO (Dominion)

Dominion Proposal No. 983 (**Map 13**), described as 500 kV Safety Solutions, includes a number of 500 kV projects that are intended to provide optional solutions in the Dominion zone to support the regional joint scenario proposals submitted by Dominion, First Energy and Transource.

Dominion Proposal No. 983 has total 50 components, which include six greenfield transmission line components, 12 transmission line upgrade components, 31 substation upgrade components and one greenfield substation component.

Map 13. Map 1: Proposal 983



*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 Proposal 983 includes the following components for the West cluster:

- Component 1: North Anna-Ladysmith 500 kV Line (99-3149)
- Component 2: North Anna Substation (99-3149)
- Component 3: Ladysmith Substation (99-3149)
- Component 4: New 500 kV Line (North Anna-Spotsylvania) (993169)

- Component 5: North Anna Equipment Uprate (993169)
- Component 6: Spotsylvania Equipment Uprate (993169)
- Component 7: Vint Hill to Meadow Brook Uprate (99-3227)
- Component 8: Vint Hill Substation Relay Reset (99-3227)
- Component 9: Line 573 Rebuild – North Anna to Spotsylvania (99-3405)
- Component 10: North Anna Substation Terminal Equipment Uprate (99-3405)
- Component 11: Spotsylvania Substation Terminal Equipment Uprate (99-3405)
- Component 12: Line 594 Rebuild – Spotsylvania to Morrisville (99-3406)
- Component 13: Morrisville Substation Terminal Equipment Uprate (99-3406)
- Component 14: Spotsylvania Substation Terminal Equipment Uprate (99-3406)
- Component 15: Line 576 Rebuild – North Anna to Midlothian (99-3410)
- Component 16: North Anna Terminal Equipment Uprate (993410)
- Component 17: Midlothian Substation Terminal Equipment Uprate (99-3410)
- Component 18: Line 37 Rebuild – Spotsylvania-Wilderness D.P. (99-3420)
- Component 19: New 500 kV Line – Spotsylvania to Morrisville (99-3420)
- Component 20: Spotsylvania Substation Terminal Equipment Uprate (99-3420)
- Component 21: Vint Hill Substation Relay Reset (99-3420)
- Component 22: New 500 kV Line – Lexington to Dooms (99-3177)
- Component 23: Dooms Substation Terminal Equipment Upgrade (99-3177)
- Component 24: Lexington Substation Terminal Equipment Upgrade (99-3177)
- Component 25: Line 541 Rebuild – Front Royal to Morrisville (99-3226)
- Component 26: Front Royal Substation Terminal Equipment Upgrade (99-3226)
- Component 27: Morrisville Substation Terminal Equipment Upgrade (99-3226) 2024-W1-983 2
- Component 28: New 500 kV Line – North Anna to Rawlings (99-3409)
- Component 29: North Anna Substation Terminal Equipment Upgrade (99-3409)
- Component 30: Rawlings Substation Terminal Equipment Upgrade (99-3409)
- Component 31: Elmont Substation Transformer Uprate (99-3428)
- Component 32: Line 559 Cut-In to Auburn Farm Substation (99-2944)
- Component 33: Line 569 Cut-In to Auburn Farm Substation (99-2944)
- Component 34: Line 2008 Cut-In to Auburn Farm Substation (99-2944)
- Component 35: Line 2173 Cut-In to Auburn Farm Substation (99-2944)
- Component 36: Auburn Farm – New Substation (99-2944)
- Component 37: Clifton Substation Relay Reset (99-2944)
- Component 38: Elklick Substation Upgrade (99-2944)

- Component 39: Lincoln Park Substation Upgrade (99-2944)
- Component 40: Loudoun Substation Upgrade (99-2944)
- Component 41: Morrisville Substation Upgrade (99-2944)
- Component 42: Mosby Substation Upgrade (99-2944)
- Component 43: Heritage Substation A-Frame Addition (99-3447)
- Component 44: Lexington Substation Transformer Bank #1 & #3 Replacement (99-3082)
- Component 45: Heritage Substation 500 kV Expansion (99-3447)
- Component 46: Line 539 Rebuild – Bristers to Ox
- Component 47: Ox Substation Terminal Equipment Upgrade
- Component 48: Second 500 kV Line – Aspen to Brambleton
- Component 49: Aspen Substation Terminal Equipment Upgrade
- Component 50: Brambleton Substation Terminal Equipment Upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

New 500 kV Line – Lexington to Dooms (99-3177)

Based on the proposal, 40.5 miles of ROW will be needed ranging from 50–90 feet in width. While this is a significant amount of ROW, most of it is in rural areas and should not cause too much of an issue. The area of Fishersville may have some opposition to the ROW acquisition.

New 500 kV Line – North Anna to Rawlings (99-3409)

Based on the proposal, 98.75 miles of ROW will be needed ranging from 40 feet in width to 125 feet in width. Between Midlothian and Trabue Junction, expansion of ROW would include residences. Following section of line also has ROW expansion that may impact businesses and residences.

New North Anna-Ladysmith 500 kV Line (99-3149)

Proposal states that new 500 kV line will be adjacent to the existing and occupy the same 275 feet ROW corridor. We see this as feasible, and no ROW will be required.

New 500 kV Line (North Anna-Spotsylvania) (99-3169)

Based on the proposal, 1.14 miles of 85’ wide ROW will be required for this project. However, it is not clear that the existing ROW is maintained to the width described and additional acquisition may be required. This includes a residential area between structures 10–14 that will likely show great opposition to the project.

Overall, the ROW risk for the transmission line components in this proposal is medium, as moderate mix of greenfield and brownfield construction are required (i.e., uses/overlaps existing ROW but requires expansion or some new greenfield).

Environmental Risk Analysis

New 500 kV Line – Lexington to Dooms (99-3177)

The proposed route has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects 18 conservation easements. Coordination with easement holders – Valley Conservation Council, VA Outdoors Foundation, Headwaters SWCD, Ever Green Team, Virginia Department of Historic Resources, Ward Burton Wildlife Foundation – will be required. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching.

New 500 kV Line – North Anna to Rawlings (99-3409)

The proposed route has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects 32 conservation easements. Coordination with easement holders – American Battlefield Trust, Chesterfield County, VA Dept. of Forestry, VA Outdoors Foundation, Goochland County, Virginia Department of Historic Resources – will be required. Proposed route intersects critical habitat for Atlantic pigtoe and yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Transmission Line Risk Analysis

Most of the work outlined in this proposal, while excessive in volume, is not inherently difficult to design, procure or construct. Most transmission line components are rebuilds or building of new lines adjacent to existing. In several areas, particularly near the substations, many line crossings could be required. It is likely that this will require rebuilding of small segments of adjacent lines to accommodate. There are several lake crossings throughout the various transmission line components, but the span lengths are not particularly troubling. This scope does require some structures to be placed within lakes, which will likely require extensive permitting and will require unique foundations and construction methods. If the existing circuits in these areas cannot allow for extended outages, then new structures will need to be set on

new foundations in the lake, which is an additional challenge. No other noteworthy transmission line risks were identified for these projects.

Substation Risk Analysis

New Auburn Farm Greenfield Substation (99-2944)

Install a new 500 kV greenfield substation set up as a six-breaker ring bus.

Procurement of EHV equipment associated with the greenfield Aubum Farm 500 kV substation could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs.

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.

Overall, this is the largest of all the proposals in this current window. Most of the work outlined in this proposal, while voluminous, is not inherently difficult to design, procure or construct. The major risk to the project is the scale of the work proposed. There is also some risk associated with the amount of work being proposed in a large number of brownfield substations. Availability of outages would need to be examined in detail.

Constructability Summary

Proposal 983 was submitted to provide optional 500 kV solutions to support the major regional joint scenario proposals proposed. Some of these 500 kV components if selected will result in some land acquisition and engineering/construction challenges, for which a medium constructability risk is assessed.

Outage Review

Proposal 983 has some outages that will require coordination, including coordination with a nuclear station. Medium outage risk assessed.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 17**.

Table 17. Proposal 983 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	North Anna-Ladysmith 500 kV Line (99-3149)	69.71	78.09
2	North Anna Substation (99-3149)	9.12	9.12
3	Ladysmith Substation (99-3149)	7.74	7.74
4	New 500 kV Line (North Anna-Spotsylvania) (993169)	131.67	90.98
5	North Anna Equipment Uprate (993169)	5.34	5.34
6	Spotsylvania Equipment Uprate (993169)	8.90	8.90
7	Vint Hill to Meadow Brook Uprate (99-3227)	100.63	100.63
8	Vint Hill Substation Relay Reset (99-3227)	0.02	0.02
9	Line 573 Rebuild – North Anna to Spotsylvania (99-3405)	96.42	73.88
10	North Anna Substation Terminal Equipment Uprate (99-3405)	4.57	4.57
11	Spotsylvania Substation Terminal Equipment Uprate (99-3405)	4.94	4.94
12	Line 594 Rebuild – Spotsylvania to Morrisville (99-3406)	110.36	98.95
13	Morrisville Substation Terminal Equipment Uprate (99-3406)	3.74	3.74
14	Spotsylvania Substation Terminal Equipment Uprate (99-3406)	2.89	2.89
15	Line 576 Rebuild – North Anna to Midlothian (99-3410)	239.90	217.06
16	North Anna Terminal Equipment Uprate (993410)	2.44	2.44
17	Midlothian Substation Terminal Equipment Uprate (99-3410)	6.48	6.48
18	Line 37 Rebuild – Spotsylvania-Wilderness D.P. (99-3420)	10.03	10.03
19	New 500 kV Line – Spotsylvania to Morrisville (99-3420)	90.31	100.77
20	Spotsylvania Substation Terminal Equipment Uprate (99-3420)	8.10	8.10
21	Vint Hill Substation Relay Reset (99-3420)	0.02	0.02
22	New 500 kV Line – Lexington to Dooms (99-3177)	228.56	217.66
23	Dooms Substation Terminal Equipment Upgrade (99-3177)	14.34	14.34
24	Lexington Substation Terminal Equipment Upgrade (99-3177)	14.34	14.34
25	Line 541 Rebuild - Front Royal to Morrisville (99-3226)	346.01	246.46

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
26	Front Royal Substation Terminal Equipment Upgrade (99-3226)	9.12	9.12
27	Morrisville Substation Terminal Equipment Upgrade (99-3226)	3.74	3.74
28	New 500 kV Line – North Anna to Rawlings (99-3409)	783.46	639.55
29	North Anna Substation Terminal Equipment Upgrade (99-3409)	5.34	5.34
30	Rawlings Substation Terminal Equipment Upgrade (99-3409)	5.94	5.94
31	Elmont Substation Transformer Uprate (99-3428)	65.00	65.00
32	Line 559 Cut-In to Auburn Farm Substation (99-2944)	3.85	3.85
33	Line 569 Cut-In to Auburn Farm Substation (99-2944)	3.85	3.85
34	Line 2008 Cut-In to Auburn Farm Substation (99-2944)	2.56	2.56
35	Line 2173 Cut-In to Auburn Farm Substation (99-2944)	2.56	2.56
36	Auburn Farm – New Substation (99-2944)	115.44	148.90
37	Clifton Substation Relay Reset (99-2944)	0.03	0.03
38	Elklick Substation Upgrade (99-2944)	0.19	0.19
39	Lincoln Park Substation Upgrade (99-2944)	0.03	0.03
40	Loudoun Substation Upgrade (99-2944)	0.53	0.53
41	Morrisville Substation Upgrade (99-2944)	0.03	0.03
42	Mosby Substation Upgrade (99-2944)	0.21	0.21
43	Heritage Substation A-Frame Addition (99-3447)	4.04	4.04
44	Lexington Substation Transformer Bank #1 & #3 Replacement (99-3082)	54.15	54.15
45	Heritage Substation 500 kV Expansion (99-3447)	12.72	12.72
46	Line 539 Rebuild – Bristers to Ox	175.00	120.80
47	Ox Substation Terminal Equipment Upgrade	5.00	5.00
48	Second 500 kV Line – Aspen to Brambleton	60.00	42.24
49	Aspen Substation Terminal Equipment Upgrade	5.00	5.00
50	Brambleton Substation Terminal Equipment Upgrade	5.00	5.00
	Total	**2839.36**	**2467.87**

The total proposal cost estimate is 15% greater than the independent cost estimate and is considered low risk.

Schedule Review

The proposed in-service date of June 2029 is reasonable for the proposed scope of the project considering the permitting and land acquisition challenges associated with the proposed

components. The work involved is still of a significant size and scale and the schedule risk is considered medium.

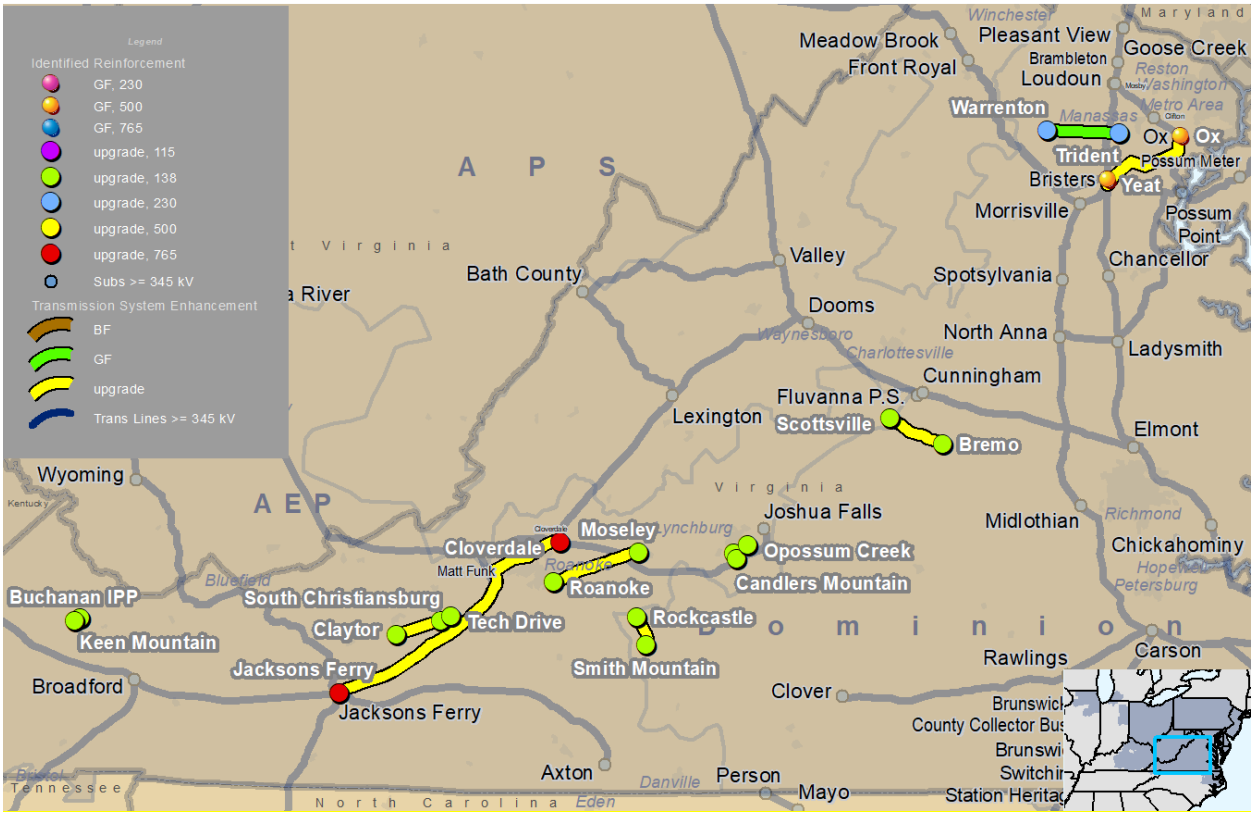
Proposing Entity Experience and Capability Review

Dominion has significant experience with the proposed equipment and the capabilities to construct Proposal 983 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 617 – TRNSRC

TRNSRC Proposal No. 617 (**Error! Not a valid bookmark self-reference.**), described as AEP incumbent upgrades for Portfolio #4, is a required component of the PJM joint proposals No. 279 & 114 (Portfolios 4A & 4B). The project includes six unique transmission components and two unique substation components as part of the wider 11-component proposal, and the construction of one new line, two rebuild/reconductors and three sag studies components. The components will be developed within existing ROWs.

Map 14. Proposal 617



*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

TRNSRC Proposal 617 includes the following components:

- Component 1: Broadford 765 kV Upgrade
- Component 2: Cloverdale 765 Upgrade
- Component 3: Smith Mountain-Rock Castle Sag Study
- Component 4: S Christiansburg-Tech Drive 138 kV Sag Study
- Component 5: Cloverdale-Jackson's Ferry 765 kV Upgrade
- Component 6: Scottsville-Bremo Sag Study

- Component 7: Buchannan-Keen Mountain 138 kV Sag Study
- Component 8: Roanoke-Moseley 138 kV Sag Study
- Component 9: Warrenton-Trident 230 kV
- Component 10: Yeat-OX 500 kV rebuild
- Component 11: Smith Mountain-Redeye-Candler's Mountain-Opossum Creek 138 kV Reconductor

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Warrenton-Trident 230 kV

The Warrenton-Trident 230 kV line will be approximately 12 miles long and connect the existing Warrenton substation to the planned Trident substation. The line from Wheeler to Trident will be rebuilt. The 230 kV line will exit the Warrenton substation from the northeast then travel in a northeast direction until it reaches the Trident substation. The line is entirely located in the state of Virginia and crosses Fauquier and Prince William counties.

Eight miles of new ROW is required. Route is generally rural, but attaining will likely still be difficult. The proposing entity references potential difficulties with land acquisition in this area, including county government opposition and landowner opposition. From a project-duration perspective, it seems unlikely that this ROW will be acquired in time.

All the other components involve pure brownfield upgrades and are generally less risky propositions.

Overall, the ROW risk for components in this proposal is medium due to moderate mix of greenfield and brownfield.

Environmental Risk Analysis

Warrenton-Trident 230 kV

The proposed component has the potential to impact environmental resources including streams, lakes, and/or wetlands subject to USACE Section 404 and/or Section 10 permitting. Proposed route intersects seven FEMA high-risk flood zones (100-year floodplain). Coordination with the floodplain administrator from the following jurisdictions will be required: Fauquier and Prince William counties in Virginia. In addition, the proposed component intersects woodlands with the potential to serve as suitable habitat for federally listed Threatened & Endangered Species and/or birds protected by the Migratory Bird Treaty Act (MBTA). Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have

effects on protected species. Proposed route intersects two conservation easements. Coordination with the following easement holders – Fauquier County, VA and Prince William County, VA – will be required.

Transmission Line Risk Analysis

The main transmission line components are referenced below, including:

- Smith Mountain-Rock Castle sag study: a 7-mile 138 kV “sag study”
- Claytor-S Christiansburg-Tech Drive 138 kV sag study: a 7-mile 138 kV “sag study”
- Scottsville-Bremo sag study: A 7-mile 138 kV “sag study”
- Warrenton-Trident 230 kV: an 8.8-mile 230 kV greenfield single-circuit line
- Yeat-OX 500 kV rebuild: a 22.4-mile 500 kV line that will have mid-span structures installed
- Smith Mountain-Redeye-Candler's Mountain-Opossum Creek 138 kV Reconductor: a 34-mile 138 kV reconductor

Overall, the transmission components do not pose significant design, schedule or cost risk with the main risks assessed for the land acquisition for the Warrenton-Trident 230 kV line route.

Substation Risk Analysis

Overall 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.

Constructability Summary

Proposal 617 is assessed a medium-high constructability risk due to anticipated difficulty with land acquisition and permitting for the Warranton-Trident line component, with known historical opposition to transmission development in the affected counties.

Outage Review

The outages and coordination required for the 500 kV rebuild within this proposal earns it a medium outage risk.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 18**.

Table 18. Proposal 617 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Broadford 765 kV Upgrade	4.50	4.50
2	Cloverdale 765 Upgrade	0.20	0.20
3	Smith Mountain-Rock Castle Sag Study	0.90	0.90
4	Claytor-S Christiansburg-Tech Drive 138 kV Sag Study	1.40	1.40
5	Cloverdale-Jackson's Ferry 765 kV Upgrade	5.00	5.00
6	Scottsville-Bremo Sag Study	1.74	1.74
7	Buchannan-Keen Mountain 138 kV Sag Study	0.33	0.33
8	Roanoke-Moseley 138 kV Sag Study	0.03	0.03
9	Warrenton-Trident 230 kV	32.46	42.50
10	Yeat-OX 500 kV rebuild	80.00	105.55
11	Smith Mountain-Redeye-Candler's Mountain-Opossum Creek 138 kV Reconductor	40.80	18.29
	Total	**167.35**	**180.44**

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

Schedule Review

Proposal 617 is assessed medium-high schedule risk due to the previously noted challenges with land acquisition and permitting assessed.

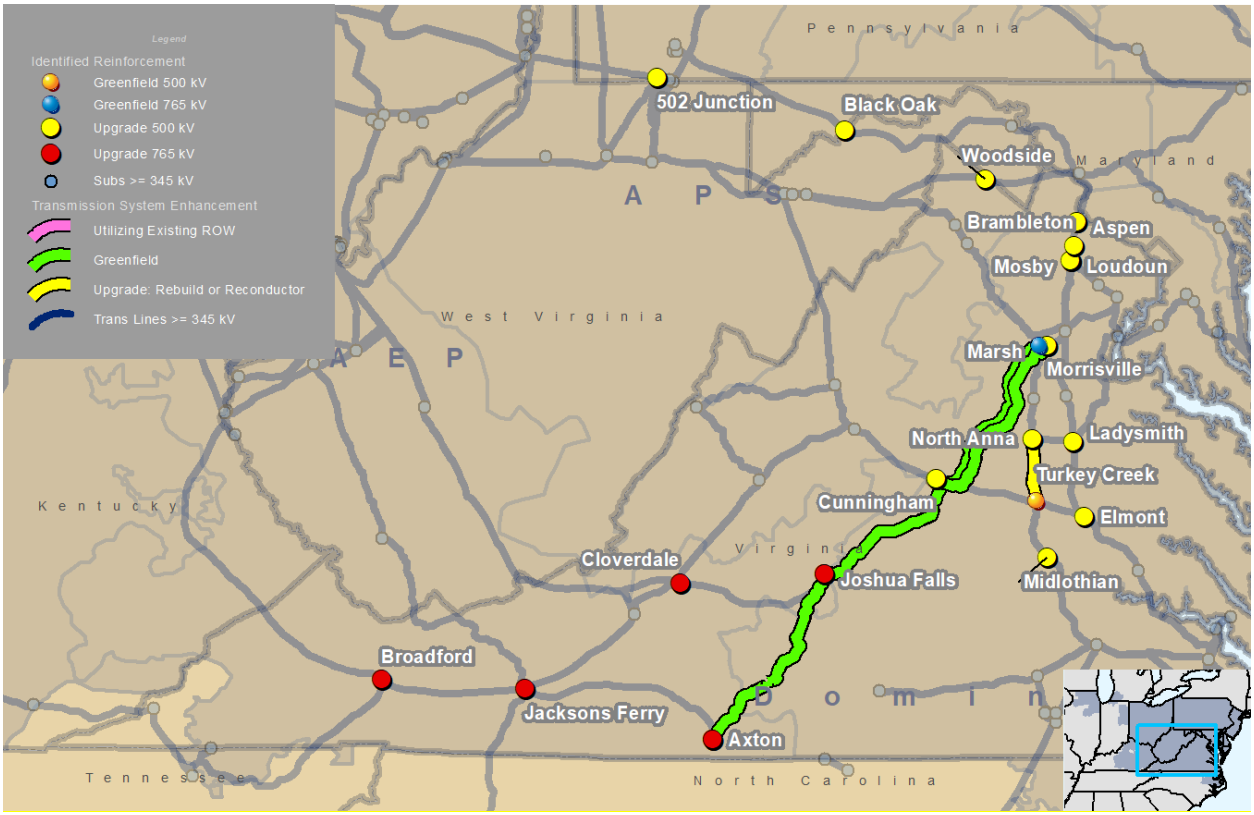
Proposing Entity Experience and Capability Review

Transource has significant experience with the proposed equipment and the capabilities to construct Proposal 617 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 78 – CLTLTM (LS Power)

LS Power Proposal No. 78 (**Map 15**) is described as F5 Solution: 765 kV, 500 kV and 230 kV upgraded substations and greenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 ("Common Components"). Proposal 78 consists of 11 components, which include: one new greenfield 765/500/230 kV substation (Marsh sub), three substation expansions (Cunningham 500 kV sub, Joshua Falls & Axton 765 kV sub) and one series reactor addition at Turkey Creek sub; two new 765 kV greenfield lines (Axton to Joshua Falls and Joshua Falls to Mash), one new 500 kV greenfield line and two 500/230 kV DCKT lines from Marsh to Morrisville and one new greenfield double CKT 230 kV line to Vint Hill.

Map 15. Proposal 78



*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 Proposal 78 components selected for evaluation in group 1 are as follows:

- Component 1: Marsh 765/500/230 kV Substation
- Component 2: Turkey Creek Series Reactor Addition

- Component 3: Cunningham 500 kV Substation Expansion
- Component 4: Axton 765 kV Substation Expansion
- Component 5: Joshua Falls 765 kV Substation Expansions
- Component 6: Axton to Joshua Falls 765 kV Transmission Line
- Component 7: Joshua Falls to Marsh 765 kV Transmission Line
- Component 8: Cunningham to Marsh 500 kV Transmission Line
- Component 9: Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line
- Component 10: Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line
- Component 11: Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Axton-Joshua Falls 765 kV Line

The route heads generally north away from the existing Axton substation and traverses woodlands and some farmland for approximately 74.8 miles before terminating at the existing Joshua substation.

Joshua Falls-Marsh 765 kV Line

The route heads generally north away from the existing Joshua Falls substation and traverses woodlands and some farmland for approximately 122 miles before terminating at the new Marsh substation.

Marsh-Cunningham 500 kV Line

The route heads generally north away from the existing Cunningham substation and traverses woodlands and some farmland for approximately 68.6 miles before terminating at the new Marsh substation.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The routes for both lines head generally east away from the new Marsh substation and traverses woodlands and some farmland for approximately 3 miles before terminating at the existing Morrisville substation.

Marsh-Vint Hill 230 kV DCT lines

The route heads generally north away from the new Marsh substation and traverses woodlands and some farmland for approximately 20.9 miles before terminating at the existing Vint Hill substation.

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

Environmental Risk Analysis

Axton-Joshua Falls 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects one conservation easement. Coordination with easement holder – Ever Green Team – will be required.

Joshua Falls-Marsh 765 kV Line

The proposed route travels through one historical district: Green Springs Historic District, and coordination with the VA SHPO is required. The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 24 conservation easements and/or protected areas. Coordination with easement holders – Virginia Department of Historic Resources; Virginia Outdoors Foundation; Fluvanna County, VA; Culpeper Soil and Water Conservation District; Virginia Department of Forestry; U.S. National Park Service; VA Dept. of Forestry; Ever Green Team – will be required.

Marsh-Cunningham 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and

USFWS. Proposed route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 12 conservation easements. Coordination with easement holders – Fluvanna County, VA DHR, VA Outdoors Foundation, Virginia Dept. of Historic Resources, U.S. National Park Service – will be required.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects two conservation easements. Coordination with easement holder – Fauquier County, VA – will be required.

Marsh-Vint Hill 230 kV DCT Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 19 conservation easements. Coordination with the following easement holders – Fauquier County, Northern Virginia Conservation Trust, Virginia Dept. of Historic Resources – is required.

Overall, the constructability risk is medium-high due to extensive greenfield components and the combination of factors such as permitting and constraint mitigation, land/ROW acquisition and construction complexity.

Transmission Line Risk Analysis

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. Where lines are paralleling existing transmission lines, this may pose a risk in limiting the ability for future expansion considerations. The majority of the terrain is hilly

and forested, which may require alternative construction methods and/or excessive tree clearing.

Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Marsh to Morrisville uses common towers for 500 and 230 kV feeders, leading to some increased risk with a shared tower layout.

EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Axton to Joshua Falls 765 kV transmission line crossing under Joshua Falls to Cloverdale 765 kV transmission line
- Joshua Falls to Marsh 765 kV transmission line crossing over Cunningham to Elmont 500 kV
- Cunningham to Marsh 500 kV transmission line crossing under Cunningham to Elmont 500 kV transmission line
- Marsh to Morrisville #1 double circuit 500 kV/230 kV transmission line crossing under Front Royal to Morrisville 500 kV and Morrisville to North Anna 500 kV transmission lines
- Marsh to Morrisville #2 double circuit 500 kV/230 kV transmission line crossing under Cunningham to Elmont and Front Royal to Morrisville 500 kV transmission lines

The primary transmission line risks are those associated with permitting and land acquisition for the proposed greenfield lines as well as some of the 765 kV or 500 kV crossing.

Substation Risk Analysis

Marsh Substation

The Marsh substation will consist of a three-position double-breaker double-bus 765 kV yard including two 3125 MVA, 765/500 kV transformers; a seven-position breaker-and-a-half 500 kV yard including two 1440 MVA, 500/230 kV transformers; and a six-position four-thirds configuration 230 kV yard. The yard also includes a 765 kV, 300 MVAR line reactor and a 500 kV, 300 MVAR shunt capacitor.

Turkey Creek Series Reactor

This component adds a 500 kV, 200 MVA series reactor with a normally open bypass breaker to the new Turkey Creek substation on the Turkey Creek to Cunningham 500 kV transmission line. The base Turkey Creek substation is included in Proposal ID 2024-W1-200 ("Common Components").

Cunningham Substation

The Cunningham 500 kV substation expansion consists of adding one double-breaker double-bus line position to the existing 500 kV substation, which includes two 500 kV circuit breakers and associated facilities.

Axton Substation

The Axton 765 kV substation expansion consists of adding four 765 kV circuit breakers and associated facilities to create four new 765 kV positions with one 765 kV, 300 MVAR line reactor to the existing 765 kV substation.

Joshua Falls Substation

The Joshua Falls 765 kV substation expansion consists of adding six 765 kV circuit breakers and associated facilities to create three new 765 kV DBDB positions with one 765 kV, 200 MVAR line reactor.

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

Marsh substation utilizes a 500 kV breaker-and-a-third bay consisting of four breakers to extend one 500 kV feeder to Cunningham while simultaneously terminating two 500/230 kV transformers. A more uniform and reliable approach at this voltage would be to create an additional bay consisting of a 500 kV breaker-and-a-half to extend the feeder while allowing the two transformers to terminate in a separate breaker-and-a-half bay, thereby removing the breaker-and-a-third configuration altogether. There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformers proposed at the Marsh Run substation due to their size. The size of these transformers will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication for these transformers may need to be completed in the field, which introduces potential constructability and schedule constraints.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA, 765 kV transformers, as well as the ratings proposed for the 765 kV lines, which would require higher-capability breakers than

what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 19**.

Table 19. Proposal 78 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	Marsh 765/500/230 kV Substation	303.75	606.46
2	Turkey Creek Series Reactor Addition	5.06	7.09
3	Cunningham 500 kV Substation Expansion	7.81	8.71
4	Axton 765 kV Substation Expansion	35.88	60.00
5	Joshua Falls 765 kV Substation Expansions	41.30	120.00
6	Axton to Joshua Falls 765 kV Transmission Line	390.11	423.47
7	Joshua Falls to Marsh 765 kV Transmission Line	664.17	690.68
8	Cunningham to Marsh 500 kV Transmission Line	335.36	368.68
9	Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line	16.60	23.55
10	Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line	16.60	23.55
11	Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line	80.41	115.63
	Total	**1,897.05**	**2,447.82**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

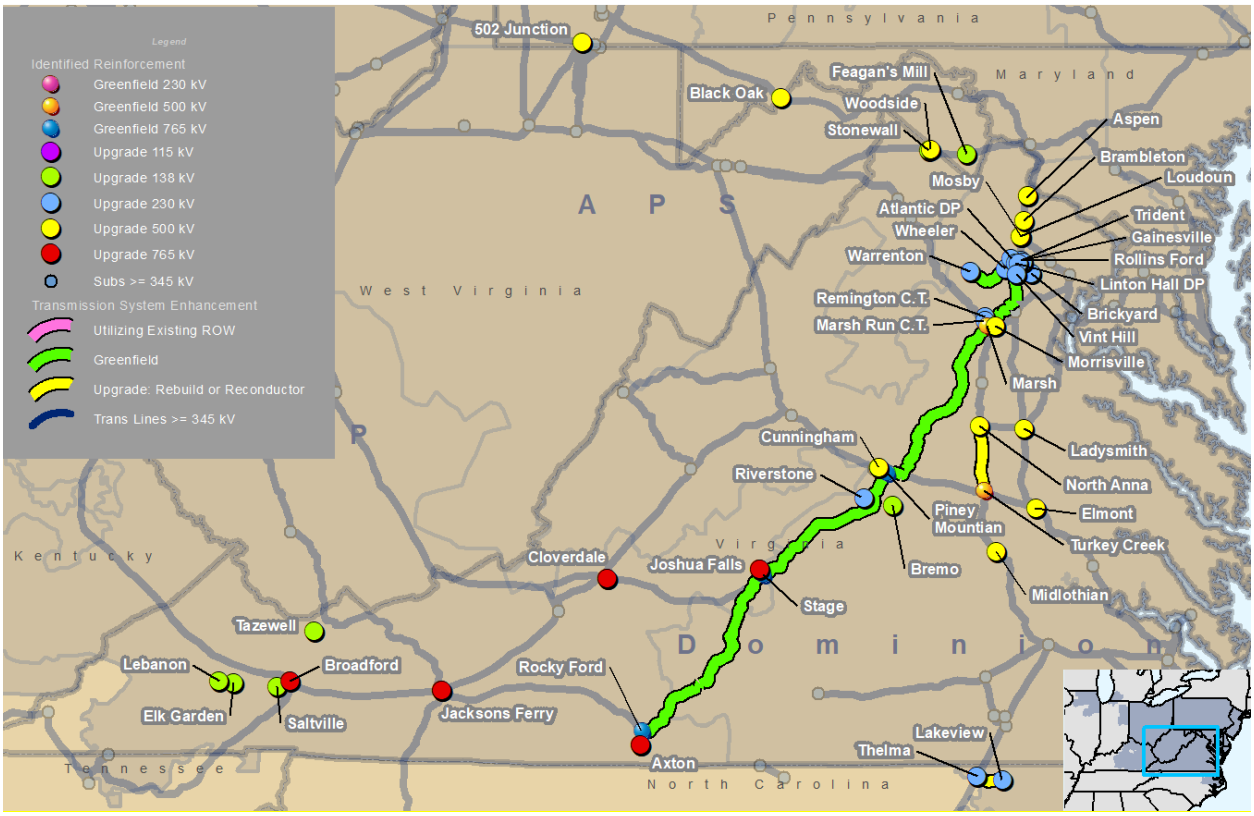
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 124 – CLTLTM (LS Power)

LS Power Proposal No. 124 (**Map 16**) is described as an F4 Solution, which involves 765 kV, 500 kV and 230 kV upgrades/greenfield substations and greenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 (common components). It comprises 15 total components that include five greenfield substations, one existing substation upgrade, and seven total greenfield transmission lines, and two 765 kV line loop-in within the Virginia area.

Map 16. Proposal 124



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 No. 124 includes 15 components, all of which are selected for the detailed evaluations.

- Component 1: Rocky Ford 765 KV Substation
- Component 2: Stage 765 kV Substation
- Component 3: Marsh 765/500/230 kV Substation
- Component 4: Piney Mountain 765/500 kV Substation
- Component 5: Turkey Creek PAR Addition
- Component 6: Cunningham 500 kV Substation Expansion
- Component 7: Rocky Ford to Stage 765 kV Transmission Line
- Component 8: Stage to Piney Mountain 765 kV Transmission Line
- Component 9: Piney Mountain to Cunningham 500 kV Transmission Line
- Component 10: Piney Mountain to Marsh 765 kV Transmission Line
- Component 11: Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line
- Component 12: Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line
- Component 13: Marsh to Vint Hill Double Circuit 230 kV Transmission Line
- Component 14: Axton to Jackson Ferry 765 kV Transmission Line Loop-In
- Component 15: Joshua Falls to Cloverdale 765 kV Loop-In

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Rocky Ford to Stage 765 kV Line

The route heads generally north away from the new Rocky Ford substation and traverses woodlands and some farmland for approximately 71 miles before terminating at the new Stage substation.

Stage to Piney Mountain 765 kV Line

The route heads generally north away from the new Stage substation and traverses woodlands and some farmland for approximately 56.1 miles before terminating at the new Piney Mountain substation.

Piney Mountain-Marsh 765 kV Line

The route heads generally north away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 65.6 miles before terminating at the new Marsh substation.

Piney Mountain to Cunningham 500 kV Line

The route heads generally west away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 3.4 miles before terminating at the existing Cunningham substation.

Piney Mountain to Marsh 765 kV Line

The route heads generally north away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 65.6 miles before terminating at the new Marsh substation.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The routes for both lines head generally east away from the new Marsh substation and traverses woodlands and some farmland for approximately 3 miles before terminating at the existing Morrisville substation.

Marsh to Vint Hill Double Circuit 230 kV Line

The route heads generally north away from the new Marsh substation and traverses woodlands and some farmland for approximately 20.9 miles before terminating at the existing Vint Hill substation.

Axton to Jackson Ferry 765 kV Line

The loop-in will require the construction of approximately 0.5 miles of new 765 kV transmission line.

Joshua Falls to Cloverdale 765 kV Line

The loop-in will require the construction of approximately one mile of new 765 kV transmission line to loop the existing line into the new Stage substation.

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

Environmental Risk Analysis

Rocky Ford to Stage 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – Team Green – will be required.

Stage to Piney Mountain 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. The proposed route intersects with one recorded underground storage tank (UST). A file review of state records to determine the current status and potentially a subsurface investigation is needed to determine if contamination is present and the extent of contamination originating from USTs. Proposed route intersects three conservation easements. Coordination with easement holders – Virginia Department of Forestry and Ever Green Team – will be required.

Piney Mountain-Marsh 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. The proposed route intersects with one recorded underground storage tank (UST). A file review of state records to determine the current status and potentially a subsurface investigation is needed to determine if contamination is present and the extent of contamination originating from USTs. Proposed route intersects three conservation easements. Coordination with easement holders – Virginia Department of Forestry, Ever Green Team – will be required.

Piney Mountain to Cunningham 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate

county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Overall, the constructability risk is medium-high due to extensive greenfield components and the combination of factors such as permitting and constraint mitigation, land/ROW acquisition and construction complexity.

Transmission Line Risk Analysis

There are number of line crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Rocky Ford to Stage 765 kV transmission line crossing under Joshua Falls to Cloverdale 765 kV transmission line
- Piney Mountain to Marsh 765 kV transmission line crossing over Cunningham to Elmont 500 kV transmission line
- Marsh to Morrisville #1 double circuit 500 kV/230 kV transmission line crossing under Front Royal to Morrisville 500 kV and Morrisville to North Anna 500 kV transmission lines
- Marsh to Morrisville #2 double circuit 500 kV/230 kV transmission line crossing under Morrisville to North Anna 500 kV and Front Royal to Morrisville 500 kV transmission lines

The majority of the terrain is hilly and forested, which may require alternative construction methods and excessive tree clearing. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Components that tie into the existing line assume that the existing structures are adequate to the support the changes. Marsh to Morrisville use common towers for 500 and 230 kV feeders, leading to some increased risk with a shared tower layout.

Overall risk is medium-high. Even though all the line components are feasible, but as most greenfield 765 kV lines, they are in a hilly, forested terrain, which adds to the complexity of the EHV project as well as significant challenges to achieve permits in time.

Substation Risk Analysis

Rocky Ford Substation

The Rocky Ford 765 kV substation will consist of a three-position double-breaker double-bus 765 kV yard with a total of seven circuit breakers and a 300 MVAR line reactor.

Stage Substation

The Stage 765 kV substation will consist of a four-position double-breaker double-bus 765 kV yard with a total of nine circuit breakers and a 200 MVAR line reactor.

Marsh Substation

The Marsh 765/500/230 kV substation will consist of a four-position double-breaker double-bus 765 kV yard, including a total of three 765/500 kV transformers, eight 765 kV breakers and a 765 kV, 300 MVAR line reactor; a seven-position breaker-and-a-half 500 kV yard, including a total of two 500/230 kV transformers, 10 500 kV breakers and a 500 kV, 300 MVAR shunt capacitor; and an eight-position four-thirds configuration 230 kV yard with a total of eight 230 kV breakers and associated equipment.

Piney Mountain Substation

The Piney Mountain substation will consist of a three-position double-breaker double-bus 765 kV yard with one 3125 MVA, 765/500 kV transformer.

Turkey Creek PAR

This component adds a 500 kV, 2000 MVA PAR with a normally open bypass breaker to the new Turkey Creek substation on the Turkey Creek to Cunningham 500 kV transmission line. The base Turkey Creek substation is included in Proposal ID 2024-W1-200 ("Common Components").

Cunningham Substation

The Cunningham 500 kV substation is to expand the existing 500 kV yard to the southeast to accommodate one new 500 kV double-breaker double-bus line position to Piney Mountain.

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

Marsh substation utilizes a 500 kV breaker-and-a-third bay consisting of four breakers to extend one 500 kV feeder to Cunningham while simultaneously terminating two 500/230 kV transformers. A more uniform and reliable approach at this voltage would be to create an additional bay consisting of a 500 kV breaker-and-a-half to extend the feeder while allowing the two transformers to terminate in a separate breaker-and-a-half bay, thereby removing the breaker-and-a-third configuration altogether.

There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformer proposed at the Piney Mountain substation due to its size. The size of this transformer will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication may need to be completed in the field, which introduces potential constructability and schedule constraints.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA, 765 kV transformers, as well as the ratings proposed for the 765 kV lines, which would require higher capability breakers than what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 20**.

Table 20. Proposal 124 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Rocky Ford 765 KV Substation	49.07	91.23
2	Stage 765 kV Substation	57.86	109.35
3	Marsh 765/500/230 kV Substation	300.07	606.46
4	Piney Mountain 765/500 kV Substation	104.79	167.72
5	Turkey Creek PAR Addition	124.20	158.96

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
6	Cunningham 500 kV Substation Expansion	7.81	8.71
7	Rocky Ford to Stage 765 kV Transmission Line	370.29	401.95
8	Stage to Piney Mountain 765 kV Transmission Line	305.41	317.60
9	Piney Mountain to Cunningham 500 kV Transmission Line	16.62	18.27
10	Piney Mountain to Marsh 765 kV Transmission Line	357.13	371.38
11	Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line	16.60	23.55
12	Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line	16.60	23.55
13	Marsh to Vint Hill Double Circuit 230 kV Transmission Line	80.41	115.63
14	Axton to Jackson Ferry 765 kV Transmission Line Loop-In	1.99	5.00
15	Joshua Falls to Cloverdale 765 kV Loop-In	1.99	10.00
	Total	**1810.83**	**2429.37**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

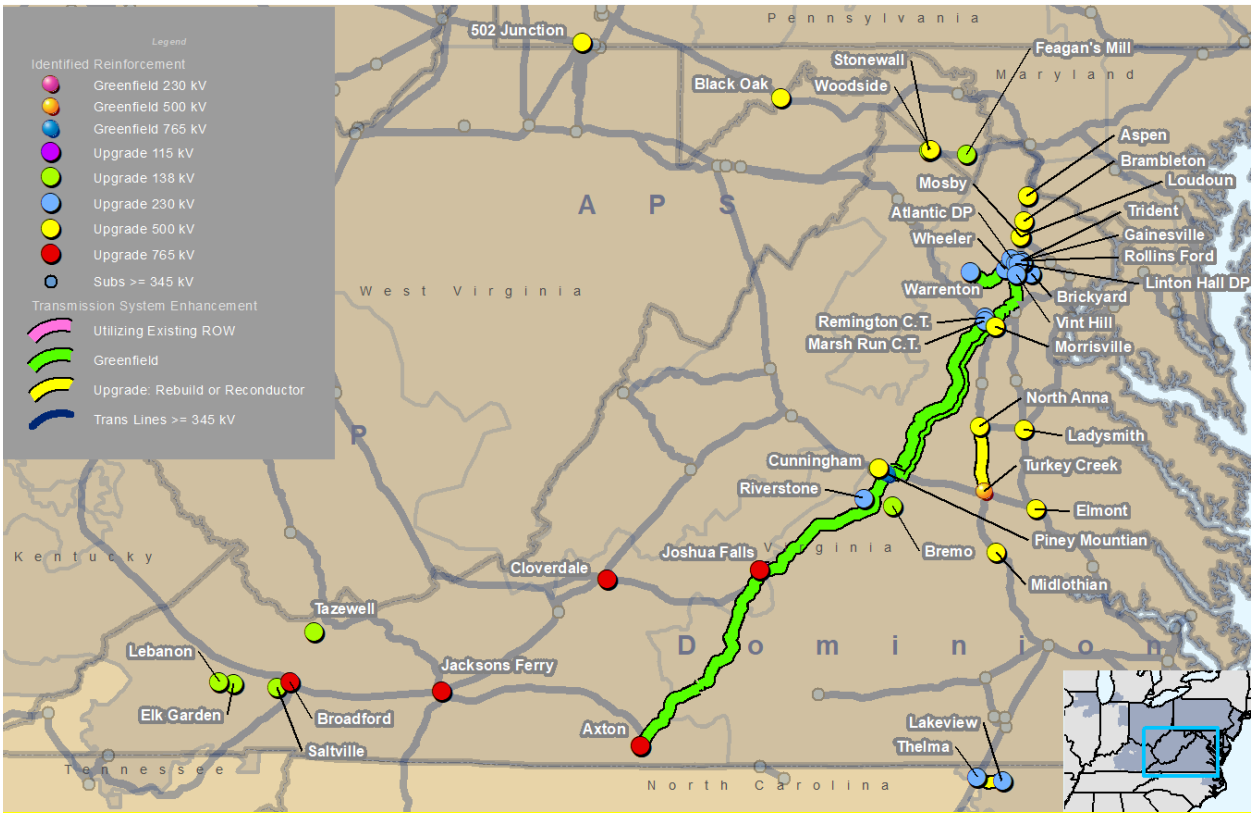
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 317 – CLTLTM (LS Power)

LS Power Proposal No. 317 (**Map 17**), described as F7 Solution, involves 765 kV, 500 kV and 230 kV upgraded and greenfield substations and greenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 ("Common Components"). It comprises a total of eleven components that include one greenfield substation, four existing substation expansion or addition, and six total greenfield transmission lines components within the Virginia area.

Map 17. Proposal 317



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 317 includes the following components:

- Component 1: Piney Mountain 765/500 kV Substation
- Component 2: Turkey Creek PAR Addition
- Component 3: Cunningham 500 kV Substation Expansion
- Component 4: Axton 765 kV Substation Expansion
- Component 5: Joshua Falls 765 kV Substation Expansions
- Component 6: Axton to Joshua Falls 765 kV Transmission Line
- Component 7: Joshua Falls to Piney Mountain 765 kV Transmission Line
- Component 8: Piney Mountain to Cunningham 500 kV Transmission Line
- Component 9: Piney Mountain to Morrisville #1 500 kV Transmission Line
- Component 10: Piney Mountain to Morrisville #2 500 kV Transmission Line
- Component 11: Morrisville to Vint Hill Double Circuit 230/230 kV Transmission Line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Axton to Joshua Falls 765 kV Line

The route heads generally north away from the existing Axton substation and traverses woodlands and some farmland for approximately 74.8 miles before terminating at the existing Joshua substation.

Joshua Falls to Piney Mountain 765 kV Line

The route heads generally north away from the existing Joshua Falls substation and traverses woodlands and some farmland for approximately 56.1 miles before terminating at the new Piney Mountain substation.

Piney Mountain-Cunningham 500 kV Line

The route heads generally west away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 3.4 miles before terminating at the existing Cunningham substation.

Piney Mountain to Morrisville #1 and #2 500 kV Lines

The route for both lines heads generally north away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 72 miles before terminating at the existing Morrisville substation.

Morrisville to Vint Hill Double Circuit 230/230 kV Line

The route heads generally north away from the new Marsh substation and traverses woodlands and some farmland for approximately 21.9 miles before terminating at the existing Vint Hill substation.

Overall, the ROW risk for components in this proposal is high due to the combination factors of the terrain, line crossing and extensive greenfield of the proposed new transmission line routes.

Environmental Risk Analysis

Axton to Joshua Falls 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate

county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects one conservation easement. Coordination with easement holder – Ever Green Team – will be required.

Joshua Falls to Piney Mountain 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects three conservation easements. Coordination with easement holders – VA Dept. of Forestry and Ever Green Team – will be required.

Piney Mountain-Cunningham 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Piney Mountain to Morrisville #1 and #2 500 kV Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 14 conservation easements. Coordination with the following easement holders – Fluvanna County, VA DHR, VA Outdoors Foundation, U.S. National Park Service, Fauquier County, and Virginia Dept. of Historic Resources – will be required.

Morrisville to Vint Hill Double Circuit 230/230 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 18 conservation easements. Coordination with the following easement holders – Northern Virginia Conservation Trust; Virginia Dept. of Historic Resources; Fauquier County, Virginia – is required.

Overall, the ROW risk for components in this proposal is high due to the combination factors of the terrain, line crossing and extensive greenfield of the proposed new transmission line routes.

Transmission Line Risk Analysis

There are significant number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc.

EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Axton to Joshua Falls 765 kV transmission line crossing under Joshua Falls to Cloverdale 765 kV transmission line
- Piney Mountain to Morrisville #1 500 kV transmission line crossing under Cunningham to Elmont 500 kV, under Front Royal to Morrisville 500 kV, and under Morrisville to North Anna 500 kV
- Piney Mountain to Morrisville #2 500 kV transmission line crossing under Cunningham to Elmont 500 kV, under Front Royal to Morrisville 500 kV, and under Morrisville to North Anna 500 kV

Where lines are paralleling existing transmission lines this may pose a risk in limiting the ability for future expansion considerations. The majority of the terrain is hilly and forested, which may require alternative construction methods and/or excessive tree clearing. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Some components may have Federal Aviation Administration impacts.

Overall, even though all the line components are feasible, there would be significant engineering, permitting and constructions risks anticipated as most greenfield 765 kV lines are

in a hilly, forested terrain, which add to the complexity of the EHV project as well as significant challenges to achieve permits in time.

Substation Risk Analysis

Piney Mountain Substation

The Piney Mountain substation will consist of a three-position double-breaker double-bus 765 kV yard including two 3125 MVA, 765/500 kV transformers and a total of six 765 kV breakers, and a five-position breaker-and-a-half 500 kV yard with total eight breakers and associated equipment.

Turkey Creek PAR

This component adds a 500 kV, 2000 MVA PAR with a normally open bypass breaker to the new Turkey Creek substation on the Turkey Creek to Cunningham 500 kV transmission line. The base Turkey Creek substation is included in Proposal ID 2024-W1-200 ("Common Components").

Cunningham Substation

The Cunningham 500 kV substation is to expand the existing 500 kV yard to the southeast to accommodate one new 500 kV double-breaker double-bus line position to Piney Mountain.

Axton Substation

The Axton 765 kV substation expansion consists of adding four 765 kV circuit breakers and associated facilities to create four new 765 kV positions and one 765 kV, 300 MVAR line reactor to the existing 765 kV substation.

Joshua Falls Substation

The Joshua Falls 765 kV substation expansion consists of adding six 765 kV circuit breakers and associated facilities to create three new 765 kV positions and one 765 kV, 200 MVAR line reactor to the existing 765 kV substation.

The substation components of this proposal consist of mixed new greenfield and expansion/upgrade existing substations. Some of the risks include procurement of EHV equipment that could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs. The 500 kV, 2000 MVA PAR at Turkey Creek substation is specialty equipment, and lead time will be on the

order of several years. The large expansion of Joshua Falls will likely require additional considerations for civil/site development and cut/fill due to the existing terrain and land topology.

There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformers proposed at the Piney Mountain substation due to their size. The size of these transformers will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication may need to be completed in the field, which introduces potential constructability and schedule constraints.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA, 765 kV transformers, as well as the ratings proposed for the 765 kV lines, which would require higher capability breakers than what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 21**.

Table 21. Proposal 317 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Piney Mountain 765/500 kV Substation	202.96	284.46
2	Turkey Creek PAR Addition	124.20	158.96
3	Cunningham 500 kV Substation Expansion	7.81	8.71
4	Axton 765 kV Substation Expansion	35.88	60.00
5	Joshua Falls 765 kV Substation Expansions	41.30	120.00
6	Axton to Joshua Falls 765 kV Transmission Line	390.11	423.47
7	Joshua Falls to Piney Mountain 765 kV Transmission Line	305.41	317.60
8	Piney Mountain to Cunningham 500 kV Transmission Line	16.62	18.27
9	Piney Mountain to Morrisville #1 500 kV Transmission Line	344.11	384.81
10	Piney Mountain to Morrisville #2 500 kV Transmission Line	344.11	384.81
11	Morrisville to Vint Hill Double Circuit 230/230 kV Transmission Line	84.26	121.16
	Total	**1,896.76**	**2,282.24**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

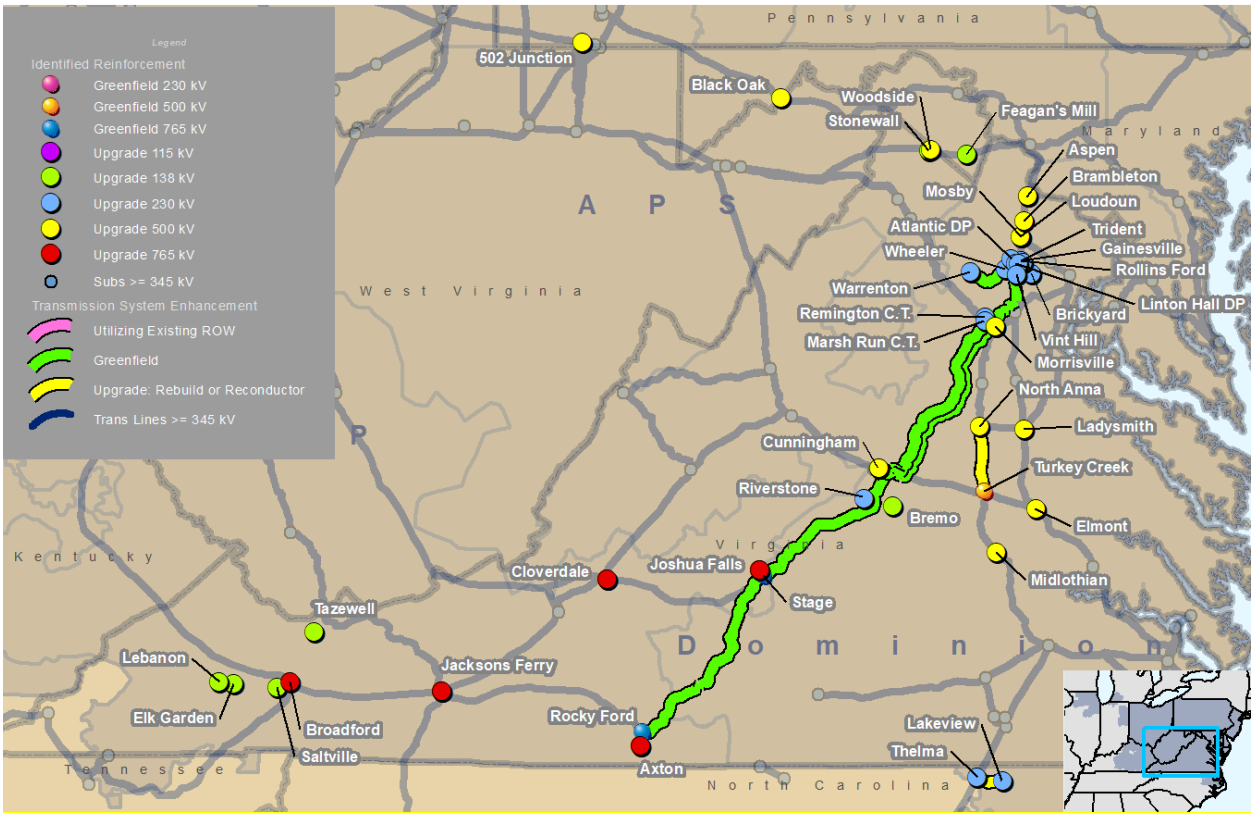
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 506 – CLTLTM (LS Power)

LS Power Proposal No. 506 (**Map 18**), described as F6 solution, involves 765 kV, 500 kV and 230 kV greenfield and upgraded substation and greenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 ("Common Components"). It consists of a total of 10 components, including two greenfield 765/500 kV substations, one existing substation expansion, five new greenfield 500/230 kV lines and two 765 kV transmission line loop-ins.

Map 18. Proposal 506



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

LSPower Proposal 506 includes the following components:

- Component 1: Rocky Ford 765/500 kV Substation
- Component 2: Stage 765/500 kV Substation
- Component 3: Cunningham 500 kV Substation Expansion
- Component 4: Rocky Ford to Stage 500 kV Transmission Line
- Component 5: Stage to Cunningham 500 kV Transmission Line
- Component 6: Cunningham to Morrisville #1 500 kV Transmission Line

- Component 7: Cunningham to Morrisville #2 500 kV Transmission Line
- Component 8: Morrisville to Vint Hill Double Circuit 230/230 kV Transmission Line
- Component 9: Axton to Jackson Ferry 765 kV Transmission Line Loop-In
- Component 10: Joshua Falls to Cloverdale 765 kV Transmission Line Loop-In

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Rocky Ford-Stage 500 kV Line

The route heads generally north away from the new Rocky Ford substation and traverses woodlands and some farmland for approximately 71 miles before terminating at the new Stage substation.

Stage-Cunningham 500 kV Line

The route heads generally north away from the new Stage substation and traverses woodlands and some farmland for approximately 59.5 miles before terminating at the existing Cunningham substation.

Cunningham to Morrisville #1 and #2 500 kV Lines

The route for both lines heads generally north away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 71.6 miles before terminating at the existing Morrisville substation.

Morrisville to Vint Hill Double Circuit 230/230 kV Line

The route heads generally north away from the new Marsh substation and traverses woodlands and some farmland for approximately 21.9 miles before terminating at the existing Vint Hill substation.

Axton to Jackson Ferry 765 kV Line

The loop-in will require the construction of approximately 0.5 miles of new 765 kV transmission line.

Joshua Falls to Cloverdale 765 kV Line

The loop-in will require the construction of approximately one mile of new 765 kV transmission line to loop the existing line into the new Stage substation.

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

Environmental Risk Analysis

Rocky Ford-Stage 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects one conservation easement. Coordination with the following easement holder – Ever Green Team – is required.

Stage-Cunningham 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects seven FEMA high-risk flood zones (100-year floodplain). Coordination with the floodplain administrator from the following jurisdictions will be required: Fluvanna, Louisa, Orange, Culpeper and Fauquier counties, Virginia. Proposed route intersects three conservation easements. Coordination with the following easement holders – VA Dept. of Forestry and Ever Green Team – is required.

Cunningham to Morrisville #1 and #2 500 kV Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects designated critical habitat for the following species: yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 15 conservation easements. Coordination with the following easement holders – Fluvanna County,

Fauquier County, VA Outdoors Foundation, VA DHR, and U.S. National Park Service – is required.

Overall, the constructability risk is medium-high due to extensive greenfield components and the combination of factors such as permitting and constraint mitigation, land/ROW acquisition and construction complexity.

Transmission Line Risk Analysis

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Rocky Ford to Stage 500 kV transmission line crossing under Joshua Falls to Cloverdale 765 kV transmission line
- Cunningham to Morrisville #1 500 kV transmission line crossing under Cunningham to Elmont 500 kV, Front Royal to Morrisville 500 kV, and Morrisville to North Anna 500 kV transmission lines
- Cunningham to Morrisville #2 500 kV transmission line crossing under Cunningham to Elmont 500 kV, Front Royal to Morrisville 500 kV, and Morrisville to North Anna 500 kV transmission lines

There is inherent reliability risk of the two Morrisville to Vint Hill 230 kV lines using a common tower in a double circuit configuration. The majority of the terrain is characterized by hills and ridges, which may require alternative construction methods. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Components that tie into the existing line assume that the existing structures are adequate to the support the changes.

Substation Risk Analysis

Rocky Ford Substation

The Rocky Ford 765 kV substation will consist of a three-position double-breaker double-bus 765 kV yard with total six circuit breakers.

Stage Substation

The Stage 765 kV substation will consist of a three-position double-breaker double-bus 765 kV yard with a total of one 3125 MVA, 765/500 kV transformer and six 765 kV circuit breakers; and one 500 kV four-position ring bus yard with five circuit breakers and one 500 kV, 300 MVAR line reactor.

Cunningham Substation

The Cunningham 500 kV substation will expand the yard by approximately 835.85 ft. x 824.5 ft. to southeast side to add three double-breaker double-bus positions with total six 500 kV breakers and two 500 kV fixed series capacitors to the existing 500 kV substation.

Procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur which will impact costs. Series capacitors at Cunningham substation should be equipped with fast-by-pass switches to remove the capacitors from service should system conditions arise necessitating this.

There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformer proposed at the Stage substation due to its size. The size of this transformer will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication may need to be completed in the field, which introduces potential constructability and schedule constraints.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, and others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA, 765 kV transformer, as well as the ratings proposed for the 765 kV lines, which would require higher capability breakers than what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 22**.

Table 22. Proposal 506 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Rocky Ford 765/500 kV Substation	104.79	167.72
2	Stage 765/500 kV Substation	131.61	245.67
3	Cunningham 500 kV Substation Expansion	99.32	112.98
4	Rocky Ford to Stage 500 kV Transmission Line	332.89	381.58
5	Stage to Cunningham 500 kV Transmission Line	290.88	319.78
6	Cunningham to Morrisville #1 500 kV Transmission Line	342.19	384.81
7	Cunningham to Morrisville #2 500 kV Transmission Line	342.19	384.81
8	Morrisville to Vint Hill Double Circuit 230/230 kV Transmission Line	84.26	121.16
9	Axton to Jackson Ferry 765 kV Transmission Line Loop-In	1.99	5.00
10	Joshua Falls to Cloverdale 765 kV Transmission Line Loop-In	1.99	10.00
	Total	**1,732.11**	**2,133.50**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

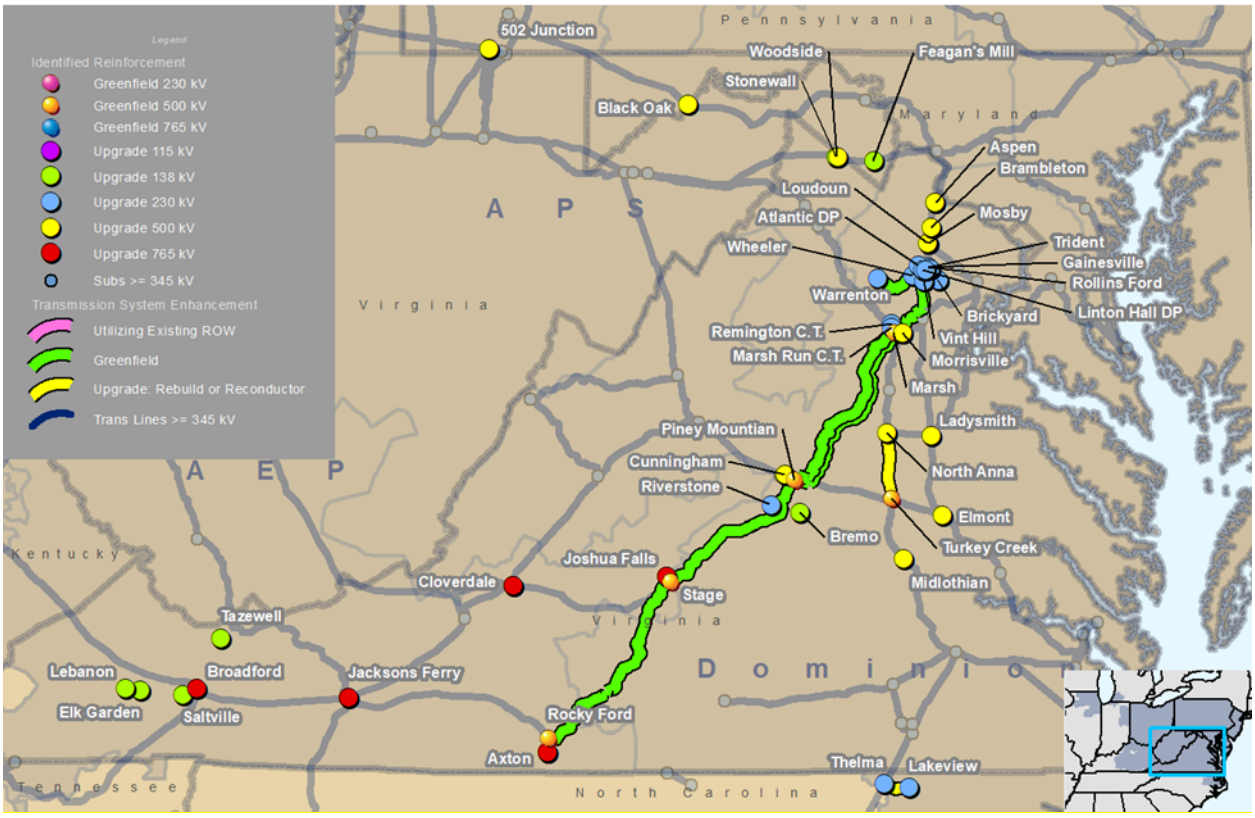
Proposing Entity Experience and Capability Review

LS Power has significant experience with the proposed equipment and the capabilities to construct Proposal 506 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 622 – CLTLTM (LS Power)

LS Power Proposal No. 622 (**Map 19**), described as F2 solution, involves 765 kV, 500 kV and 230 kV greenfield and upgraded substation and greenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 ("Common Components"). It consists of a total of 15 components, including four greenfield substations, one existing 500 kV substation expansion, eight new greenfield 500/230 kV lines and two 765 kV transmission line loop-ins.

Map 19. Proposal 622



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

LSPower Proposal 622 includes the following components:

- Component 1: Rocky Ford 765/500 kV Substation
- Component 2: Stage 765/500 kV Substation
- Component 3: Marsh 500/230 kV Substation
- Component 4: Piney Mountain 500 kV Substation
- Component 5: Cunningham 500 kV Substation Expansion
- Component 6: Rocky Ford to Stage 500 kV Transmission Line

- Component 7: Stage to Piney Mountain 500 kV Transmission Line
- Component 8: Piney Mountain to Cunningham 500 kV Transmission Line
- Component 9: Piney Mountain to Marsh #1 500 kV Transmission Line
- Component 10: Piney Mountain to Marsh #2 500 kV Transmission Line
- Component 11: Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line
- Component 12: Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line
- Component 13: Axton to Jackson Ferry 765 kV Transmission Line Loop-In
- Component 14: Joshua Falls to Cloverdale 765 kV Transmission Line Loop-In
- Component 15: Marsh - Morrisville #2 Double Circuit 500/230 kV Circuit

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Rocky Ford-Stage 500 kV Line

The route heads generally north away from the new Rocky Ford substation and traverses woodlands and some farmland for approximately 71 miles before terminating at the new Stage substation.

Stage-Piney Mountain 500 kV Line

The route heads generally north away from the new Stage substation and traverses woodlands and some farmland for approximately 56.7 miles before terminating at the new Piney Mountain substation.

Piney Mountain Marsh 500 kV #1 and #2 Lines

The route for both lines heads generally north away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 65.6 miles before terminating at the new Marsh substation.

Piney Mountain-Cunningham 500 kV Line

The route heads generally west away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 3.4 miles before terminating at the existing Cunningham substation.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The routes for both lines head generally east away from the new Marsh substation and traverses woodlands and some farmland for approximately 3 miles before terminating at the existing Morrisville substation.

Marsh to Vint Hill Double Circuit 230/230 kV Line

The route heads generally north away from the new Marsh substation and traverses woodlands and some farmland for approximately 20.9 miles before terminating at the existing Vint Hill substation.

Axton to Jackson Ferry 765 kV Line

The loop-in will require the construction of approximately 0.5 miles of new 765 kV transmission line.

Joshua Falls to Cloverdale 765 kV Line

The loop-in will require the construction of approximately one mile of new 765 kV transmission line to loop the existing line into the new Stage substation.

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

Environmental Risk Analysis

Rocky Ford-Stage 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – Ever Green Team – will be required.

Stage-Piney Mountain 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are

federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects three conservation easements. Coordination with easement holders – VA Dept. of Forestry and Ever Green Team – will be required.

Piney Mountain-Marsh 500 kV #1 and #2 Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 13 conservation easements. Coordination with easement holders – Fluvanna, VA DHR, VA Outdoors Foundation, and U.S. National Park Service – will be required.

Piney Mountain-Cunningham 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects two

conservation easements. Coordination with easement holder – Fauquier County, VA – will be required.

Overall, the constructability risk is medium-high due to extensive greenfield components and the combination of factors such as permitting and constraint mitigation, land/ROW acquisition and construction complexity.

Transmission Line Risk Analysis

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. There are some components in the vicinity of airports that may require Federal Aviation Administration permitting. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Rocky Ford to Stage 500 kV transmission line crossing under Joshua Falls to Cloverdale 765 kV transmission line
- Piney Mountain to Marsh #1 500 kV transmission line crossing under Cunningham to Elmont 500 kV transmission line
- Piney Mountain to Marsh #2 500 kV transmission line crossing under Cunningham to Elmont 500 kV transmission line
- Marsh to Morrisville #1 double circuit 500/230 kV transmission lines crossing over Front Royal to Morrisville 500 kV and Morrisville to North Anna 500 kV transmission lines
- Marsh to Morrisville #2 double circuit 500/230 kV transmission lines crossing over Front Royal to Morrisville 500 kV and Morrisville to North Anna 500 kV transmission lines

The majority of the terrain is characterized by hills and ridges, which may require alternative construction methods. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Components that tie into the existing line assume that the existing structures are adequate to the support the changes. Marsh to Morrisville use common towers for 500 and 230 kV feeders, leading to some increased risk with a shared tower layout.

Overall, even though all the proposed line components are feasible, there are significant risks as most greenfield 765 kV lines are in a hilly, forested terrain, which adds to the complexity of the EHV project as well as significant challenges to achieve permits in time.

Substation Risk Analysis

Rocky Ford Substation

The Rocky Ford substation will consist of a three-position double-breaker 765 kV yard with total one 3125 MVA, 765/500 kV transformer and six 765 kV breakers.

Stage Substation

The Stage 765 kV substation will consist of a three-position double-breaker double-bus 765 kV yard with a total of one 3125 MVA, 765/500 kV transformer and six 765 kV circuit breakers; and one 500 kV four-position ring bus yard with four circuit breakers and one 500 kV, 300 MVAR shunt capacitor.

Marsh Substation

The Marsh substation will consist of a six-position breaker-and-a-half 500 kV yard total eleven circuit breakers, two 500/230 kV transformer and a 500 kV, 300 MVAR shunt capacitor; 230 kV four-thirds configuration with six positions yard with total eight breakers.

Piney Mountain Substation

The Piney Mountain substation will consist of a four-position breaker-and-a-half 500 kV with total six circuit breakers and a two 500 kV fixed series capacitors.

Cunningham Substation

The Cunningham 500 kV substation will expand the yard by approximately 835.85 ft. x 824.5 ft. to southeast side to add three double-breaker double-bus positions with total six 500 kV breakers and two 500 kV fixed series capacitors to the existing 500 kV substation.

Procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs. Marsh substation utilizes a 500 kV breaker-and-a-third bay consisting of four breakers to extend one 500 kV feeder to Cunningham while simultaneously terminating two 500/230 kV transformers. A more uniform and reliable approach at this voltage would be to create an additional bay consisting of a 500 kV breaker-and-a-half to extend the feeder while allowing the two transformers to terminate in a separate breaker-and-a-half bay, thereby removing the breaker-and-a-third configuration altogether. Series capacitors at Piney Mountain substation should be equipped with fast-by-pass switches to remove the capacitors from service should system conditions arise necessitating this.

There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformers proposed at the Rocky Ford and Stage substations due to their size. The size of these transformers will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication may need to be completed in the field, which introduces potential constructability and schedule constraints.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA, 765 kV transformers, as well as the ratings proposed for the 765 kV lines, which would require higher capability breakers than what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 23**.

Table 23. Proposal 622 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Rocky Ford 765/500 kV Substation	104.79	167.72
2	Stage 765/500 kV Substation	131.61	245.67
3	Marsh 500/230 kV Substation	122.44	190.20
4	Piney Mountain 500 kV Substation	99.40	109.68
5	Cunningham 500 kV Substation Expansion	7.81	8.70
6	Rocky Ford to Stage 500 kV Transmission Line	332.89	381.58
7	Stage to Piney Mountain 500 kV Transmission Line	274.25	304.73
8	Piney Mountain to Cunningham 500 kV Transmission Line	16.62	18.27
9	Piney Mountain to Marsh #1 500 kV Transmission Line	320.70	352.56
10	Piney Mountain to Marsh #2 500 kV Transmission Line	320.70	352.56
11	Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line	16.27	23.55
12	Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line	80.41	115.63
13	Axton to Jackson Ferry 765 kV Transmission Line Loop-In	1.99	5.00
14	Joshua Falls to Cloverdale 765 kV Transmission Line Loop-In	1.99	10.00
15	Marsh - Morrisville #2 Double Circuit 500/230 kV Circuit	16.27	23.55
	Total	**1,848.14**	**2,309.38**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

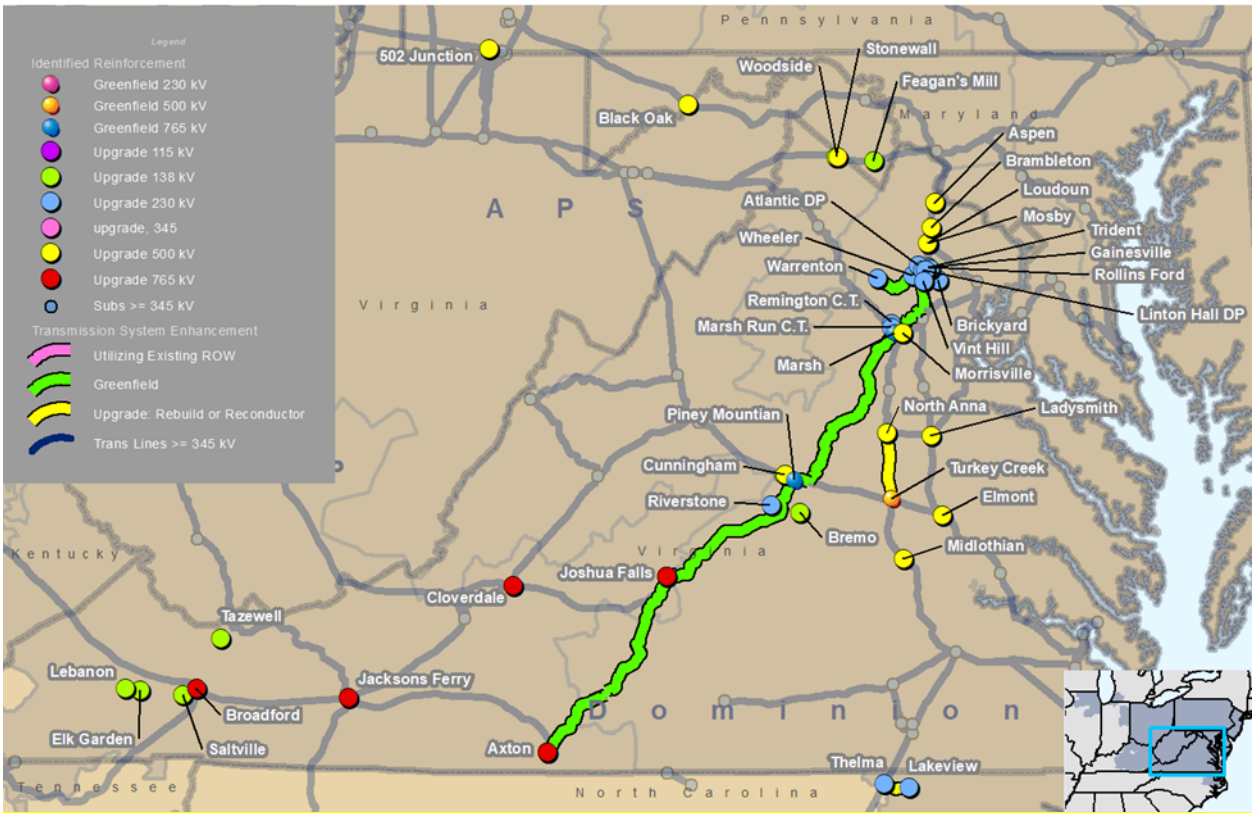
Proposing Entity Experience and Capability Review

LS Power has significant experience with the proposed equipment and the capabilities to construct Proposal 622 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 839 – CLTLTM (LS Power)

LS Power Proposal No. 839 (**Map 20**), described as F8 Solution, involves 765 kV, 500 kV and 230 kV upgraded and geenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 (common components). It comprises a total of thirteen components, including two greenfield substations, four existing substation upgrades and seven total greenfield transmission lines within the Virginia area.

Map 20. Proposal 839



*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 No. 839 includes 13 components, all of which are selected for the detailed evaluations.

- Component 1: Piney Mountain 765/500 kV Substation
- Component 2: Marsh 765/500/230 kV Substation
- Component 3: Turkey Creek PAR Addition
- Component 4: Cunningham 500 kV Substation Expansion
- Component 5: Axton 765 kV Substation Expansion

- Component 6: Joshua Falls 765 kV Substation Expansion
- Component 7: Axton to Joshua Falls 765 kV Transmission Line
- Component 8: Joshua Falls to Piney Mountain 765 kV Transmission Line
- Component 9: Piney Mountain to Marsh 765 kV Transmission Line
- Component 10: Piney Mountain to Cunningham 500 kV Transmission Line
- Component 11: Marsh to Morrisville #1 DoubleCircuit 500/230 kV Transmission Line
- Component 12: Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line
- Component 13: Marsh to Vint Hill Double Circuit 230 kV Transmission Line

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Axton-Joshua Falls 765 kV Line

The route heads generally north away from the existing Axton substation and traverses woodlands and some farmland for approximately 74.8 miles before terminating at the existing Joshua substation.

Joshua Falls-Piney Mountain 765 kV Line

The route heads generally north away from the existing Joshua Falls substation and traverses woodlands and some farmland for approximately 56.1 miles before terminating at the new Piney Mountain substation.

Piney Mountain-Marsh 765 kV Line

The route heads generally north away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 65.6 miles before terminating at the new Marsh substation.

Piney Mountain-Cunningham 500 kV Line

The route heads generally west away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 3.4 miles before terminating at the existing Cunningham substation.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The routes for both lines head generally east away from the new Marsh substation and traverses woodlands and some farmland for approximately 3 miles before terminating at the existing Morrisville substation.

Marsh to Vint Hill Double Circuit 230/230 kV Line

The route heads generally north away from the new Marsh substation and traverses woodlands and some farmland for approximately 20.9 miles before terminating at the existing Vint Hill substation.

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

Environmental Risk Analysis

Axton-Joshua Falls 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects one conservation easement. Coordination with easement holders – Ever Green Team – will be required.

Joshua Falls-Piney Mountain 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects three conservation easements. Coordination with easement holders – VA Dept. of Forestry and Ever Green Team – will be required.

Piney Mountain-Marsh 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed Route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 13 conservation easements. Coordination with

easement holders – Fluvanna, VA DHR, VA Outdoors Foundation, and U.S. National Park Service – will be required.

Piney Mountain-Cunningham 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed Route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 13 conservation easements. Coordination with easement holders – Fluvanna, VA DHR, VA Outdoors Foundation, and U.S. National Park Service – will be required.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects two conservation easements. Coordination with easement holder – Fauquier County, Virginia – will be required.

Marsh to Vint Hill Double Circuit 230/230 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 19 conservation easements. Coordination with the following easement holders – Fauquier County, Northern Virginia Conservation Trust, Virginia Dept. of Historic Resources – is required.

Overall, the constructability risk is medium-high due to extensive greenfield components and the combination of factors such as permitting and constraint mitigation, land/ROW acquisition and construction complexity.

Transmission Line Risk Analysis

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. There are some components in the vicinity of airports that may require Federal Aviation Administration permitting. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Axton to Joshua Falls 765 kV transmission line crossing under Joshua Falls to Cloverdale 765 kV transmission line
- Piney Mountain to Marsh 765 kV transmission line crossing over Cunningham to Elmont 500 kV transmission line
- Marsh to Morrisville #1 double circuit 500 kV/230 kV transmission line crossing under Front Royal to Morrisville 500 kV and Morrisville to North Anna 500 kV transmission lines
- Marsh to Morrisville #2 double circuit 500 kV/230 kV transmission line crossing over Front Royal to Morrisville 500 kV and over Morrisville to North Anna 500 kV transmission lines

The majority of the terrain is characterized by hills and ridges, which may require alternative construction methods. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Components that tie into the existing line assume that the existing structures are adequate to the support the changes. Marsh to Morrisville use common towers for 500 and 230 kV feeders, leading to some increased risk with a shared tower layout.

Overall, even though all the proposed line components are feasible, there are significant risks as most Greenfield 765 kV lines are in a hilly, forested terrain, which add to the complexity of the EHV project as well as significant challenges to achieve permits in time.

Substation Risk Analysis

Piney Mountain Substation

The Piney Mountain substation will consist of a three-position double-breaker double-bus 765 kV yard with one 3125 MVA, 765/500 kV transformer and six circuit breakers.

Marsh Substation

The Marsh 765/500/230 kV substation will consist of a four-position double-breaker double-bus 765 kV yard, including total three 765/500 kV transformers, eight 765 kV breakers and a 765 kV,

300 MVAR line reactor; a seven-position breaker-and-a-half 500 kV yard, including total two 500/230 kV transformers, ten 500 kV breakers and a 500 kV, 300 MVAR shunt capacitor; and an eight-position four-thirds configuration 230 kV yard with total eight 230 kV breakers and associated equipment.

Turkey Creek PAR

This component adds a 500 kV, 2000 MVA PAR with a normally open bypass breaker to the new Turkey Creek substation on the Turkey Creek to Cunningham 500 kV transmission line. The base Turkey Creek substation is included in Proposal ID 2024-W1-200 ("Common Components").

Cunningham Substation

The Cunningham 500 kV substation is to expand the existing 500 kV yard to the southeast to accommodate one new 500 kV double-breaker double-bus line position to Piney Mountain.

Axton Substation

The Axton 765 kV substation expansion consists of adding four 765 kV circuit breakers and associated facilities to create four new 765 kV positions with one 765 kV, 300 MVAR line reactor to the existing 765 kV substation.

Joshua Falls Substation

The Joshua Falls 765 kV substation expansion consists of adding six 765 kV circuit breakers and associated facilities to create three new 765 kV DBDB positions with one 765 kV, 200 MVAR line reactor.

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.

Overall, the substation components are feasible. However, procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs. Marsh substation utilizes a 500 kV breaker-and-a-third bay consisting of four breakers to terminate one 765/500 kV transformer and to terminate two 500/230 kV transformers. A more uniform and reliable approach at this voltage would be to create an additional bay consisting of a 500 kV breaker-and-a-half to terminate the three transformers, thereby removing the breaker-and-a-third configuration altogether. Joshua Falls station expansion is large and consideration should be given for civil site development and cut/fill requirements.

There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformer proposed at the Piney Mountain substation due to its size. The size of this transformer will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication may need to be completed in the field, which introduces potential constructability and schedule constraints.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA, 765 kV transformer, as well as the ratings proposed for the 765 kV lines, which would require higher capability breakers than what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 24**.

Table 24. Proposal 839 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Piney Mountain 765/500 kV Substation	104.79	167.72
2	Marsh 765/500/230 kV Substation	300.07	606.46
3	Turkey Creek PAR Addition	124.20	158.96
4	Cunningham 500 kV Substation Expansion	7.81	8.71
5	Axton 765 kV Substation Expansion	35.88	60.00

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
6	Joshua Falls 765 kV Substation Expansion	41.30	120.00
7	Axton to Joshua Falls 765 kV Transmission Line	390.11	423.47
8	Joshua Falls to Piney Mountain 765 kV Transmission Line	305.41	317.60
9	Piney Mountain to Marsh 765 kV Transmission Line	356.58	371.38
10	Piney Mountain to Cunningham 500 kV Transmission Line	16.62	18.27
11	Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line	22.45	23.55
12	Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line	22.45	23.55
13	Marsh to Vint Hill Double Circuit 230/230 kV Transmission Line	80.41	115.63
	Total	**1,808.09**	**2,415.30**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

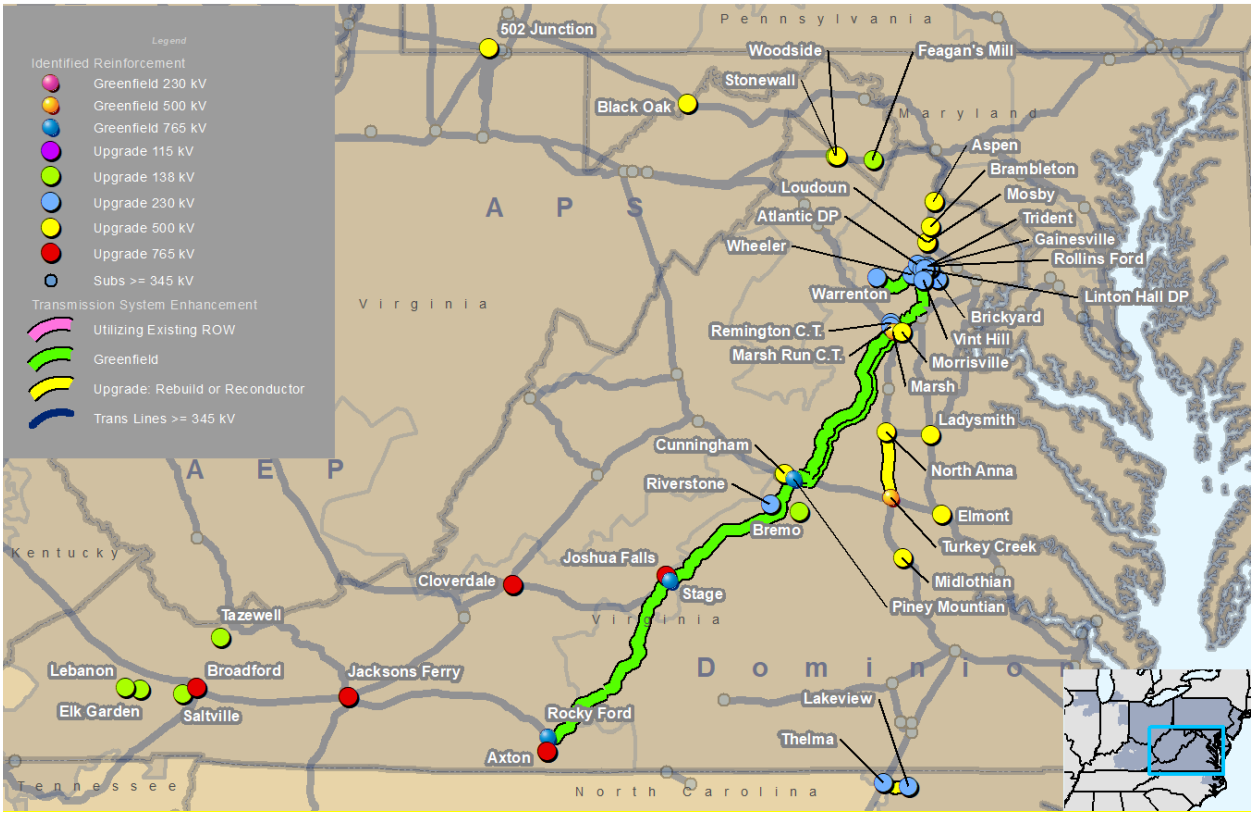
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 898 – CLTLTM (LS Power)

LS Power Proposal No. 898 (**Map 21**), described as F3 Solution, involves 765 kV, 500 kV and 230 kV upgraded and greenfield substations and greenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 ("Common Components"). It comprises a total of sixteen components that include four greenfield substations, two existing substation expansion/additions, eight total greenfield transmission lines, and two new substation loop-in lines within the Virginia area.

Map 21. Proposal 898



*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 898 includes the following components:

- Component 1: Rocky Ford 765 KV Substation
- Component 2: Stage 765 kV Substation
- Component 3: Marsh 500/230 kV Substation
- Component 4: Piney Mountain 765/500 kV Substation
- Component 5: Turkey Creek PAR Addition
- Component 6: Cunningham 500 kV Substation Expansion

- Component 7: Rocky Ford to Stage 765 kV Transmission Line
- Component 8: Stage to Piney Mountain 765 kV Transmission Line
- Component 9: Piney Mountain to Cunningham 500 kV Transmission Line
- Component 10: Piney Mountain to Marsh #1 500 kV Transmission Line
- Component 11: Piney Mountain to Marsh #2 500 kV Transmission Line
- Component 12: Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line
- Component 13: Marsh to Vint Hill Double Circuit 230 kV Transmission Line
- Component 14: Axton to Jackson Ferry 765 kV Transmission Line Loop-In
- Component 15: Joshua Falls to Cloverdale 765 kV Loop-In
- Component 16: Marsh - Morrisville #2 Double Circuit 500/230 kV Circuit

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Rocky Ford-Stage 765 kV Line

The route heads generally north away from the new Rocky Ford substation and traverses woodlands and some farmland for approximately 71 miles before terminating at the new Stage substation.

Stage-Piney Mountain 765 kV Line

The route heads generally north away from the new Stage substation and traverses woodlands and some farmland for approximately 56.1 miles before terminating at the new Piney Mountain substation.

Piney Mountain-Cunningham 500 kV Line

The route heads generally west away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately3.4 miles before terminating at the existing Cunningham substation.

Piney Mountain-Marsh 500 kV #1 and #2 Lines

The route for both lines heads generally north away from the new Piney Mountain substation and traverses woodlands and some farmland for approximately 65.6 miles before terminating at the new Marsh substation.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The routes for both lines head generally east away from the new Marsh substation and traverses woodlands and some farmland for approximately 3 miles before terminating at the existing Morrisville substation.

Overall, the ROW risk for components in this proposal is high due to the combination factors of the terrain, line crossing and extensive greenfield of the proposed new transmission line routes.

Environmental Risk Analysis

Rocky Ford-Stage 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – Ever Green Team – will be required.

Stage-Piney Mountain 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. The proposed route intersects with one recorded underground storage tank (UST). A file review of state records to determine the current status and potentially a subsurface investigation is needed to determine if contamination is present and the extent of contamination originating from USTs. Proposed route intersects three conservation easements. Coordination with easement holders – Virginia Department of Forestry and Ever Green Team – will be required.

Piney Mountain-Cunningham 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route

corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Piney Mountain-Marsh 500 kV #1 and #2 Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects designated critical habitat for the following species: yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 12 conservation easements. Coordination with the following easement holders – Fluvanna County, Virginia Dept. of Historic Resources, VA Outdoors Foundation, and U.S. National Park Service – is required.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects two conservation easements. Coordination with easement holder – Fauquier County, Virginia – will be required.

Transmission Line Risk Analysis

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. There are some components in the vicinity of airports that may require Federal Aviation Administration permitting. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Rocky Ford to Stage 765 kV transmission line crosses under Joshua Falls to Cloverdale 765 kV transmission line
- Piney Mountain to Marsh #1 50 0 kV transmission line crosses under Cunningham to Elmont 500 kV transmission line

- Piney Mountain to Marsh #2 500 kV transmission line crosses under Cunningham to Elmont 500 kV transmission line
- Marsh to Morrisville #1 double circuit 500 kV/230 kV transmission line crossing under Front Royal to Morrisville 500 kV and Morrisville to North Anna 500 kV transmission lines
- Marsh to Morrisville #2 double circuit 500 kV/230 kV transmission line crossing over Front Royal to Morrisville 500 kV and over Morrisville to North Anna 500 kV

The majority of the terrain is characterized by hills and ridges, which may require alternative construction methods. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Components that tie into the existing line assume that the existing structures are adequate to the support the changes. Marsh to Morrisville use common towers for 500 and 230 kV feeders, leading to some increased risk with a shared tower layout.

Overall, even though all the proposed line components are feasible, there are significant risks as most greenfield 765 kV lines are in a hilly, forested terrain, which add to the complexity of the EHV project as well as significant challenges to achieve permits in time.

Substation Risk Analysis

Rocky Ford Substation

The Rocky Ford 765 kV substation will consist of a three-position double-breaker double-bus 765 kV yard with total seven circuit breakers and a 300 MVAR line reactor.

Stage Substation

The Stage 765 kV substation will consist of a four-position double-breaker double-bus 765 kV yard with total nine circuit breakers and a 200 MVAR line reactor.

Marsh Substation

The Marsh substation will consist of a seven-position breaker-and-a-half 500 kV yard with total eleven circuit breakers, two 500/230 kV transformer and a 500 kV, 300 MVAR shunt capacitor, and a six-position four-thirds configuration 230 kV yard with total eight breakers.

Piney Mountain Substation

The Piney Mountain substation will consist of a three-position double-breaker double-bus 765 kV yard including two 3125 MVA, 765/500 kV transformers and total six 765 kV breakers, and a five-position breaker-and-a-half 500 kV yard with total eight 500 kV breakers.

Turkey Creek PAR

This component adds a 500 kV, 2000 MVA PAR with a normally open bypass breaker to the new Turkey Creek substation on the Turkey Creek to Cunningham 500 kV transmission line. The base Turkey Creek substation is included in Proposal ID 2024-W1-200 ("Common Components").

Cunningham Substation

The Cunningham 500 kV substation is to expand the existing 500 kV yard to the southeast to accommodate one new 500 kV double-breaker double-bus line position to Piney Mountain.

Procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs. Marsh substation utilizes a 500 kV breaker-and-a-third bay consisting of four breakers to terminate two 500/230 kV transformers. A more uniform and approach would be to convert this to a breaker-and-a-half bay to terminate the two transformers. Turkey Creek 500 kV, 2000 MVA PAR is a specialty piece of equipment with an extended lead time and balance of plant considerations, which should be accounted for during design and execution.

There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformers proposed at the Piney Mountain substation due to their size. The size of these transformers will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication may need to be completed in the field, which introduces potential constructability and schedule constraints.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA, 765 kV transformers, as well as the ratings proposed for the 765 kV lines, which would require higher capability breakers than what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 25**.

Table 25. Proposal 898 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Rocky Ford 765 KV Substation	49.07	91.23
2	Stage 765 kV Substation	57.86	109.35
3	Marsh 500/230 kV Substation	122.44	190.20
4	Piney Mountain 765/500 kV Substation	202.96	284.46
5	Turkey Creek PAR Addition	124.20	158.96
6	Cunningham 500 kV Substation Expansion	7.81	8.71
7	Rocky Ford to Stage 765 kV Transmission Line	370.29	401.95
8	Stage to Piney Mountain 765 kV Transmission Line	305.41	317.60
9	Piney Mountain to Cunningham 500 kV Transmission Line	16.62	18.27
10	Piney Mountain to Marsh #1 500 kV Transmission Line	320.70	352.56
11	Piney Mountain to Marsh #2 500 kV Transmission Line	320.70	352.56
12	Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line	16.60	23.55
13	Marsh to Vint Hill Double Circuit 230 kV Transmission Line	80.41	115.63
14	Axton to Jackson Ferry 765 kV Transmission Line Loop-In	1.99	5.00
15	Joshua Falls to Cloverdale 765 kV Loop-In	1.99	10.00
16	Marsh - Morrisville #2 Double Circuit 500/230 kV Circuit	16.60	23.55
	Total	**2,015.63**	**2,463.58**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

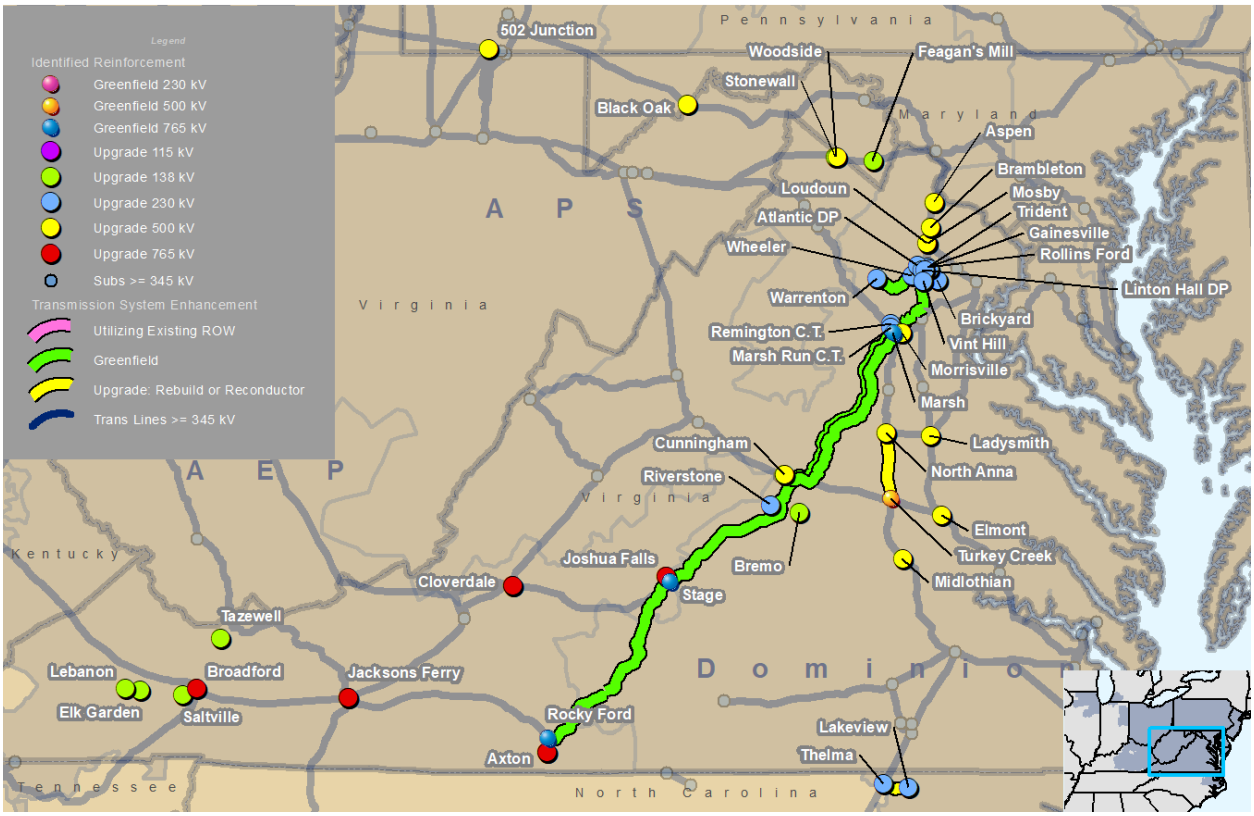
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 904 – CLTLTM (LS Power)

LS Power Proposal No. 904 (**Map 22**), described as F1 Solution, involves 765 kV, 500 kV and 230 kV upgraded substations and greenfield transmission line solutions to be paired with PJM Proposal ID 2024-W1-200 ("Common Components"). Proposal 904 consist of a total of 13 components, which include: three new greenfield 765/500/230 kV substations, two substation expansion/additions, six new greenfield lines and two 765 kV substation loop-ins.

Map 22. Proposal 904



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

Project Overview

LS Proposal 904 components selected for evaluation are as follows:

- Component 1: Rocky Ford 765 KV Substation
- Component 2: Stage 765 KV Substation
- Component 3: Marsh 765/500/230 kV Substation
- Component 4: Turkey Creek Series Reactor
- Component 5: Cunningham 500 kV Substation Expansion
- Component 6: Rocky Ford to Stage 765 kV Transmission Line

- Component 7: Stage to Marsh 765 kV Transmission Line
- Component 8: Marsh to Morrisville #1 Double Circuit 500/230 kV Transmission Line
- Component 9: Marsh to Morrisville #2 Double Circuit 500/230 kV Transmission Line
- Component 10: Cunningham to Marsh 500 kV Transmission Line
- Component 11: Marsh to Vint Hill Double Circuit 230 kV Transmission Line
- Component 12: Axton to Jackson Ferry 765 kV Transmission Line Loop-In
- Component 13: Joshua Falls to Cloverdale 765 kV Transmission Line Loop-In

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Rocky Ford-Stage 765 kV Line

The route heads generally north away from the new Rocky Ford substation and traverses woodlands and some farmland for approximately 71 miles before terminating at the new Stage substation.

Stage-Marsh 765 kV Line

The route heads generally north away from the new Stage substation and traverses woodlands and some farmland for approximately 121.6 miles before terminating at the new Marsh substation.

Stage to Marsh 765 kV Line

The route heads generally north away from the new Stage substation and traverses woodlands and some farmland for approximately 121.6 miles before terminating at the new Marsh substation.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The routes for both lines head generally east away from the new Marsh substation and traverses woodlands and some farmland for approximately 3 miles before terminating at the existing Morrisville substation.

Cunningham to Marsh 500 kV Line

The route heads generally north away from the existing Cunningham substation and traverses woodlands and some farmland for approximately 68.6 miles before terminating at the new Marsh substation.

Marsh to Vint Hill Double Circuit 230 kV Line

The route heads generally north away from the new Marsh substation and traverses woodlands and some farmland for approximately 20.9 miles before terminating at the existing Vint Hill substation.

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

Environmental Risk Analysis

Rocky Ford-Stage 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – Ever Green Team – will be required.

Stage to Marsh 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. The proposed route intersects with one historical district: Green Springs Historical District (200-ft. buffer). Coordination with the VA SHPO is required. Proposed Route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 24 conservation easements. Coordination with easement holders – Fluvanna County, Culpeper SWCD, VA Outdoors Foundation, U.S. National Park Service, VA DHR, VA Dept. of Forestry and Evergreen Team – will be required.

Marsh-Morrisville #1 & #2 500/230 kV DCT Lines

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are

federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects two conservation easements. Coordination with easement holder – Fauquier County, VA – will be required.

Cunningham to Marsh 500 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects critical habitat for yellow lance. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 12 conservation easements. Coordination with the following easement holders – Fluvanna County, VA DHR, VA Outdoors Foundation, Virginia Dept. of Historic Resources, and U.S. National Park Service – will be required.

Marsh to Vint Hill Double Circuit 230 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects 19 conservation easements. Coordination with the following easement holders – Fauquier County, Northern Virginia Conservation Trust, Virginia Dept. of Historic Resources – is required.

Overall, the constructability risk is medium-high due to extensive greenfield components and the combination of factors such as permitting and constraint mitigation, land/ROW acquisition and construction complexity.

Transmission Line Risk Analysis

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. There are some components in the vicinity of airports that may require Federal Aviation Administration permitting. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- Rocky Ford to Stage 765 kV transmission line crossing under Joshua Falls to Cloverdale 765 kV
  transmission line
- Stage to Marsh 765 kV transmission line crossing over Cunningham to Elmont 500 kV
- Marsh to Morrisville #1 double circuit 500 kV/230 kV transmission line crossing under Front Royal to Morrisville 500 kV transmission line and Morrisville to North Anna 500 kV transmission line
- Marsh to Morrisville #2 double circuit 500 kV/230 kV transmission line crossing over Front Royal to Morrisville 500 kV and Morrisville to North Anna 500 kV Cunningham transmission lines
- Cunningham to Marsh 500 kV transmission line crossing under Cuningham to Elmont 500 kV transmission line

The majority of the terrain is characterized by hills and ridges that may require alternative construction methods. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Components that tie into the existing line assume that the existing structures are adequate to the support the changes. Marsh to Morrisville uses common towers for 500 and 230 kV feeders, leading to some increased risk with a shared tower layout.

Overall, even though all the proposed line components are feasible, there are significant risks as most Greenfield 765 kV lines are in a hilly, forested terrain, which add to the complexity of the EHV project as well as significant challenges to achieve permits in time.

Substation Risk Analysis

Rocky Ford Substation

The Rocky Ford 765 kV substation will consist of a three-position double-breaker double-bus 765 kV yard with a total of seven circuit breakers and a 300 MVAR line reactor.

Stage Substation

The Stage 765 kV substation will consist of a four-position double-breaker double-bus 765 kV yard with a total of nine circuit breakers and a 200 MVAR shunt reactor.

Marsh Substation

The Marsh substation will consist of a three-position double-breaker double-bus 765 kV yard including two 3125 MVA, 765/500 kV transformers; a seven-position breaker-and-a-half 500 kV yard including two 1440 MVA, 500/230 kV transformers; and a six-position four-thirds

configuration 230 kV yard. The yard also includes a 765 kV, 300 MVAR line reactor and a 500 kV, 300 MVAR shunt capacitor.

Turkey Creek Series Reactor

This component adds a 500 kV, 200 MVA series reactor with a normally open bypass breaker to the new Turkey Creek substation on the Turkey Creek to Cunningham 500 kV transmission line. The base Turkey Creek substation is included in Proposal ID 2024-W1-200 ("Common Components").

There were some concerns about the ability to install the 3125 MVA, 765/500 kV transformers proposed at the Marsh Run substation due to their size. The size of these transformers will likely require a two-piece tank design due to shipping constraints; therefore, completion of the fabrication for these transformers may need to be completed in the field, which introduces potential constructability and schedule constraints.

Cunningham Substation

The Cunningham 500 kV substation expansion consists of adding one double-breaker double-bus line position to the existing 500 kV substation, with adding total two 500 kV circuit breakers and associated facilities.

The substation components of this proposal is feasible. However, procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs. Marsh substation utilizes a 500 kV breaker-and-a-third bay consisting of four breakers to terminate one 500 kV feeder to Cunningham and to terminate two 500/230 kV transformers. A more uniform and reliable approach at this voltage would be to create an additional bay consisting of a 500 kV breaker-and-a-half, thereby removing the breaker-and-a-third configuration altogether.

Constructability Summary

At a high level, all eight LS Power's main proposals have similarities in routes and the areas they connect. Some use more new greenfield substations near existing substations, others use more existing substations. The greenfield EHV lines in each proposal contain majority of the risks assessed. All eight use long lines, between 200 and 300 total 765+500 mileage, and there were notable environmental and permitting constraints identified on those routes. PJM identified some constructability concerns with the proposed 3125 MVA 765 kV transformers, as well as the ratings proposed for the 765 kV lines, which would require higher capability breakers than what is widely in circulation at this time. These factors, and more, contributed into a medium-high constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 26**.

Table 26. Proposal 904 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	Rocky Ford 765 kV Substation	49.07	91.23
2	Stage 765 kV Substation	57.86	109.35
3	Marsh 765/500/230 kV Substation	303.75	606.46
4	Turkey Creek Series Reactor	5.06	7.09
5	Cunningham 500 kV Substation Expansion	7.81	8.71
6	Rocky Ford to Stage 765 kV Transmission Line	370.29	401.95
7	Stage to Marsh 765 kV Transmission Line	661.99	688.42
8	Marsh to Morrisville #1 Double-Circuit 500/230 kV Transmission Line	16.60	23.55
9	Marsh to Morrisville #2 Double-Circuit 500/230 kV Transmission Line	16.60	23.55
10	Cunningham to Marsh 500 kV Transmission Line	291.21	368.68
11	Marsh to Vint Hill Double Circuit 230 kV Transmission Line	80.41	115.63
12	Axton to Jackson Ferry 765 kV Transmission Line Loop-In	1.99	5.00
13	Joshua Falls to Cloverdale 765 kV Transmission Line Loop-In	1.99	10.00
	Total	**1,864.62**	**2,459.62**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered as medium risk.

Schedule Review

Taking into account the constructability and land acquisition risks for lines of the proposed voltage levels and lengths, PJM considered the June 1, 2029, in-service date aggressive and assessed medium-high risk.

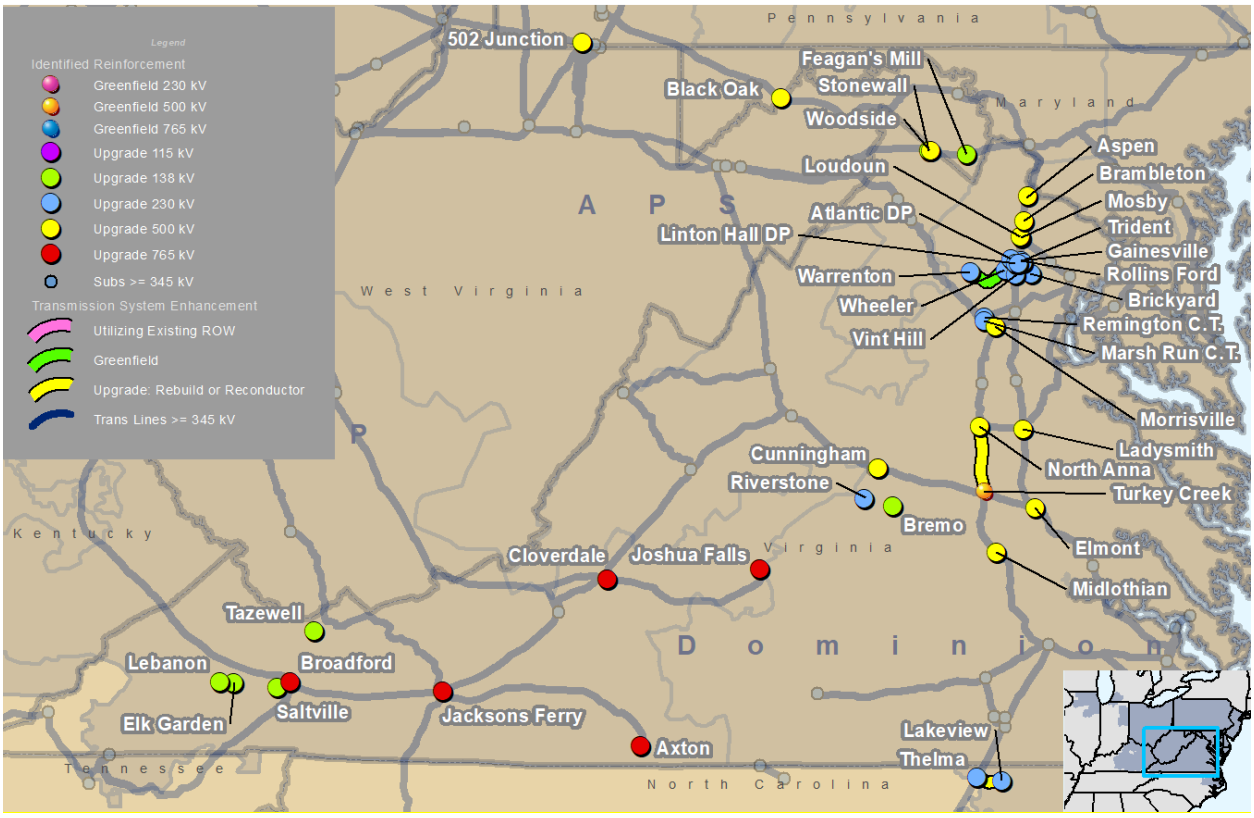
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 200 – CLTLTM (LS Power)

LS Power Proposal No. 200 (**Map 23**), described as Common Components, includes new substations, new transmission lines, substation upgrades, and transmission line upgrades that are common components of proposals W1-904/622/898/124/78/506/317/839 submitted in response to PJM's 2024 RTEP Window #1. Proposal No. 200 is located within Allegany County, Maryland; Halifax County, North Carolina; and Fauquier, Hanover, Louisa and Prince William counties, which include nine unique transmission components and 23 unique substation components as part of the wider 32-component proposal, including work in in Northern Virginia. The proposed components will traverse approximately 60 miles in total, with some components being developed within existing ROWs and others requiring the purchase and development of additional real estate.

Map 23. Proposal 200



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 No. 200 includes the following components:

- Component 1: Morrisville Substation Expansion
- Component 2: Vint Hill Substation Expansion
- Component 3: Warrenton Substation Expansion
- Component 4: Wheeler Substation Expansion
- Component 5: Brickyard Substation Expansion
- Component 6: Vint Hill to Rollins Ford Series Reactor
- Component 7: Bremo to Riverstone Series Reactor
- Component 8: Black Oak Substation Expansion
- Component 9: Ladysmith Breaker Replacement
- Component 10: Switch in Broadford to Smyth 138 kV Series Reactor
- Component 11: Cloverdale & Joshua Falls 765 kV Terminal Equipment Upgrade

- Component 12: Broadford & Jacksons Ferry 765 kV Terminal Equipment Upgrade
- Component 13: Jacksons Ferry & Cloverdale 765 kV Terminal Equipment Upgrade
- Component 14: Axton & Jacksons Ferry 765 kV Terminal Equipment Upgrade
- Component 15: Linton Tap & Atlantic 230 kV Terminal Equipment Upgrade
- Component 16: Atlantic & Trident 230 kV Terminal Equipment Upgrade
- Component 17: Trident & Gainesville 230 kV Terminal Equipment Upgrade
- Component 18: Lebanon & Elk Garden 138 kV Terminal Equipment Upgrade
- Component 19: Saltville & Tazewell 138 kV Terminal Equipment Upgrade
- Component 20: Feagan Mill & Stonewall 138 kV Terminal Equipment Upgrade
- Component 21: Loudoun & Mosby 500 kV Terminal Equipment Upgrade
- Component 22: Aspen & Brambleton 500 kV Terminal Equipment Upgrade
- Component 23: Turkey Creek 500 kV Substation
- Component 24: Warrenton to Wheeler 230 kV Overhead and Underground Transmission Line
- Component 25: Vint Hill to Brickyard 230 kV Underground Transmission Line
- Component 26: North Anna to Turkey Creek 500 kV Reconductor
- Component 27: Wheeler to Linton Tap 230 kV Reconductor
- Component 28: Marsh Run to Remington CT 230 kV Reconductor
- Component 29: Thelma to Lakeview 230 kV Reconductor
- Component 30: Elmont to Cunningham 500 kV Loop-In
- Component 31: Midlothian to North Anna 500 kV Loop-In
- Component 32: 502 Junction to Woodside 500 kV Loop-In

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Warrenton to Wheeler 230 kV Line

This component consists of a 4-mile 230 kV overhead greenfield and 4-mile 230 kV underground greenfield transmission line.

The line is entirely located in the state of Virginia and crosses Fauquier and Prince William counties. Route is generally rural, but attaining will likely still be difficult. Difficulties are anticipated for land acquisition due to historical county government opposition and landowner opposition.

This component would cross approximately two transmission lines with Virginia Electric & Power Co. and an unknown owner and approximately two roads crossings in Fauquier County. A part of the line is underground, which reduces the number of anticipated constraints. It is anticipated that the proposal requires permits, consultations, clearances and authorizations from two counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits are required.

Vint Hill to Brickyard 230 kV Line

This component consists of a 5.2-mile underground 230 kV greenfield transmission line. The line is entirely located in the state of Virginia and crosses Manassas and Prince William counties.

This component is underground and aligns with three state highways' ROWs. It would cross approximately three overhead transmission lines with Virginia Electric & Power Co (low permitting risk) and approximately three pipelines with Transcontinental Gas PL, Colonial Pipeline Co and Dominion Transmission Co. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from one county and one city in Virginia. State PSC Approval, CPCN and DOT utility permits, and driveway/local road permits are required.

Turkey Creek 500 kV Substation

This project will be sited on a new land parcel to be acquired by the proposing entity.

North Anna to Turkey Creek 500 kV Line

This component consists of a 20.4-mile 230 kV reconductor project

Wheeler to Linton Tap 230 kV Line

This component consists of a 4.12-mile 230 kV reconductor project

Marsh Run to Remington CT 230 kV Line

This component consists of a 1.71-mile 230 kV reconductor project

Thelma to Lakeview 230 kV Line

This component consists of a 8.67-mile 230 kV reconductor project

Elmont to Cunningham 500 kV Line

This component consists of a cut-in of a 500 kV circuit to a new greenfield substation

Midlothian to North Anna 500 kV Line

This component consists of a cut-in of a 500 kV circuit to a new greenfield substation

502 Junction to Woodside 500 kV Line

This component consists of a cut-in of a 500 kV circuit to a new greenfield substation

Overall, the ROW risk for components in this proposal is medium due to the moderate mix of greenfield and brownfield development proposed. Most of the components of this proposal are brownfield projects that do not require additional ROW.

Environmental Risk Analysis

Warrenton to Wheeler 230 kV Line

The proposed route intersects with the following recorded historical sites/structures/districts: Auburn Battlefield Historic District. Coordination with the VA SHPO is required. The proposed component has the potential to impact environmental resources including streams, lakes, and/or wetlands subject to USACE Section 404 and/or Section 10 permitting. Proposed route intersects two FEMA high-risk flood zones (100-year floodplain). Coordination with the floodplain administrator from the following jurisdictions will be required: VA_Prince William and VA_Fauquier. In addition, the proposed component intersects woodlands with the potential to serve as suitable habitat for federally listed Threatened & Endangered Species and/or birds protected by the Migratory Bird Treaty Act (MBTA). Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. Proposed route intersects one conservation easement. Coordination with the following easement holder – Fauquier Open Space Easement – is required.

Vint Hill to Brickyard 230 kV Line

This component consists of a 5.2-mile underground 230 kV greenfield transmission line. The line is entirely located in the state of Virginia and crosses Manassas and Prince William counties.

Substation Risk Analysis

New Turkey Creek 500 kV Greenfield Substation

The Turkey Creek substation will be a 500 kV greenfield consisting of four-position breaker-and-a-half (BAAH) yard.

Vint Hill and Brickyard Substation Expansions

The Vint Hill substation expansion consists of adding three breaker-and-a-half positions to the existing 230 kV substation.

The Brickyard substation expansion consists of adding one double-breaker double-bus position to the existing 230 kV substation and a series reactor on the new Vint Hill to Brickyard 230 kV transmission line.

Constructability concerns have been identified for the Vint Hill and Brickyard substation expansions, as the incumbent transmission owner (Dominion) has informed that there is insufficient space at Vint Hill and Brickyard to accommodate the proposed scope.

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.

Constructability Summary

Proposal 200 is assessed a high constructability risk due to anticipated difficulty with land acquisition and permitting for the Warrenton-Wheeler line component, with known historical opposition to transmission development in the affected counties, as well as the feasibility concerns with the proposed expansions for the Vint Hill and Brickyard substations.

Outage Review

The 500 kV work, including the outages required to accommodate the 230 kV facility upgrades, is the primary driver for Proposal 200's medium outage risks.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **0**.

Table 27. Proposal 200 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Morrisville Substation Expansion	23.43	28.00
2	Vint Hill Substation Expansion	10.04	16.17
3	Warrenton Substation Expansion	3.91	15.00
4	Wheeler Substation Expansion	2.23	4.30
5	Brickyard Substation Expansion	3.91	9.90
6	Vint Hill to Rollins Ford Series Reactor	3.68	3.00
7	Bremo to Riverstone Series Reactor	3.09	2.50
8	Black Oak Substation Expansion	13.39	18.69
9	Ladysmith Breaker Replacement	15.62	8.30
10	Switch in Broadford to Smyth 138 kV Series Reactor	0.00	0.00
11	Cloverdale & Joshua Falls 765 kV Terminal Equipment Upgrade	1.25	7.50
12	Broadford & Jacksons Ferry 765 kV Terminal Equipment Upgrade	1.25	10.00
13	Jacksons Ferry & Cloverdale 765 kV Terminal Equipment Upgrade	1.25	10.00
14	Axton & Jacksons Ferry 765 kV Terminal Equipment Upgrade	1.25	5.00
15	Linton Tap & Atlantic 230 kV Terminal Equipment Upgrade	0.66	4.40
16	Atlantic & Trident 230 kV Terminal Equipment Upgrade	0.66	4.40
17	Trident & Gainesville 230 kV Terminal Equipment Upgrade	0.66	4.40
18	Lebanon & Elk Garden 138 kV Terminal Equipment Upgrade	0.46	1.00
19	Saltville & Tazewell 138 kV Terminal Equipment Upgrade	0.46	1.00
20	Feagan Mill & Stonewall 138 kV Terminal Equipment Upgrade	0.46	4.71
21	Loudoun & Mosby 500 kV Terminal Equipment Upgrade	1.06	10.00
22	Aspen & Brambleton 500 kV Terminal Equipment Upgrade	1.06	10.00
23	Turkey Creek 500 kV Substation	35.67	47.28
24	Warrenton to Wheeler 230 kV Overhead and Underground Transmission Line	125.18	135.05
25	Vint Hill to Brickyard 230 kV Underground Transmission Line	143.75	122.66
26	North Anna to Turkey Creek 500 kV Reconductor	27.81	125.21
27	Wheeler to Linton Tap 230 kV Reconductor	2.71	21.82
28	Marsh Run to Remington CT 230 kV Reconductor	1.07	9.22

29	Thelma to Lakeview 230 kV Reconductor	8.79	44.69
30	Elmont to Cunningham 500 kV Loop-In	1.66	4.30
31	Midlothian to North Anna 500 kV Loop-In	1.66	4.30
32	502 Junction to Woodside 500 kV Loop-In	1.66	9.43
	Total	**439.75**	**702.23**

The total proposal cost estimate is within 31–40% of the independent cost estimate and is considered medium-high risk.

Schedule Review

The included in-service date of June 2029 is considered a medium-high risk for the proposed scope of the project, considering the significant permitting, engineering, and construction and land acquisition risks associated with the line routes.

Proposing Entity Experience and Capability Review

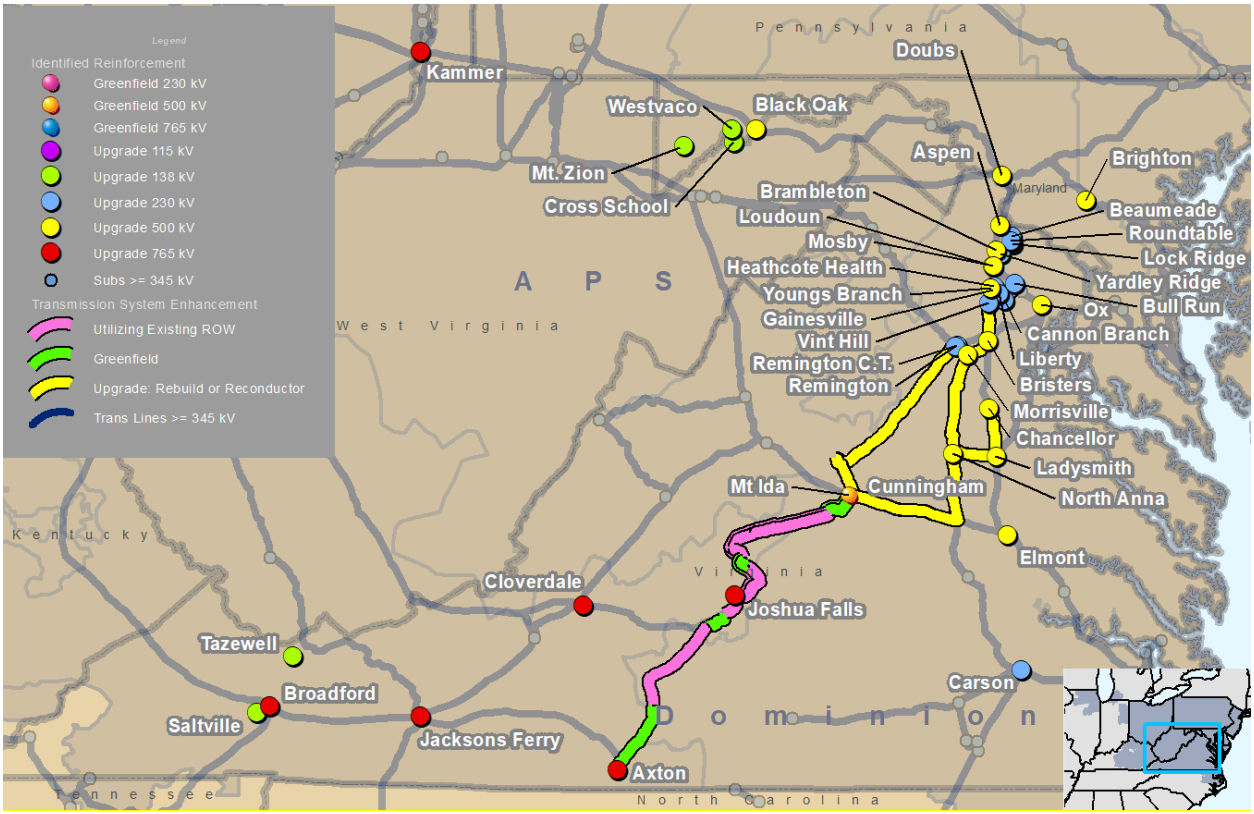
LS Power has significant experience with the proposed equipment and the capabilities to construct Proposal 200 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 146 – NEETMH (NextEra)

NextEra Proposal No. 146 (**Map 24**), described as Axton-Joshua Falls 765 kV line and Joshua Falls-Mt. Ida 500 kV line, expands the Joshua Falls substation with 765/500 kV transformation. It constructs a new double circuit 500 kV transmission line from Joshua Falls substation to the newly proposed Mt. Ida substation in the Dominion zone.

There are a total of 52 components in NextEra Proposal No. 146, which includes one greenfield substation component, 39 substation upgrade components, five greenfield transmission line components, and seven transmission line upgrade components. This proposals contains 307 miles of total EHV (500 kV and 765 kV).

Map 24. Proposal 146



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 146 includes the following components:

- Component 1: Axton to Joshua Falls 765 kV
- Component 2: Joshua Falls to Mt. Ida double circuit 500 kV
- Component 3: Mt. Ida 500 kV substation
- Component 4: Mt. Ida to Morrisville #1 (greenfield portion)
- Component 5: 502 Junction-Woodside tap to Black Oak
- Component 6: 502 Junction-Woodside tap to Black
- Component 7: Cloverdale Upgrades
- Component 8: Jacksons Ferry upgrades
- Component 9: Doubs expansion
- Component 10: Saltville terminal equipment upgrades
- Component 11: Tazewell terminal equipment upgrades
- Component 12: Aspen terminal equipment upgrades
- Component 13: Brambleton terminal equipment upgrades
- Component 14: Brighton terminal equipment upgrade

- Component 15: Heathcote terminal equipment upgrades
- Component 16: Bristers cap bank
- Component 17: Bull Run expansion
- Component 18: Cannon Branch expansion
- Component 19: Youngs Branch expansion
- Component 20: Chancellor expansion
- Component 21: Morrisville expansion
- Component 22: Axton expansion
- Component 23: North Anna expansion
- Component 24: Mt. Zion terminal equipment upgrades
- Component 25: Gainesville expansion
- Component 26: Ladysmith terminal equipment upgrades
- Component 27: Elmont expansion and upgrades
- Component 28: Kammer terminal equipment upgrades
- Component 29: Black Oak expansion
- Component 30: Broadford upgrades
- Component 31: Loudoun breaker upgrades
- Component 32: Carson breaker upgrades
- Component 33: Lockridge breaker upgrades
- Component 34: Beaumeade breaker upgrades
- Component 35: Liberty breaker upgrades
- Component 36: Mosby breaker upgrades
- Component 37:Yardley breaker upgrades
- Component 38: Vint Hill breaker upgrades
- Component 39: Roundtable breaker upgrades
- Component 40: Remington CT breaker upgrades
- Component 41: Remington breaker upgrades
- Component 42: Ox breaker upgrades
- Component 43: Joshua Falls 765/500 kV expansion
- Component 44: West Vaco terminal equipment upgrades
- Component 45: Cross School terminal equipment upgrades
- Component 46: Bull Run-Cannon Branch 230 kV
- Component 47: Morrisville-Loudoun 500 kV tap to Youngs Branch
- Component 48: Mt. Ida-Morrisville 500 kV #1
- Component 49: Mt. Ida to Morrisville 500 kV #2
- Component 50: Dooms-Cunningham loop into Mt. Ida
- Component 51: North Anna-Chancellor 500 kV
- Component 52: Morrisville-Gainesville 230 kV

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Axton-Joshua Falls 765 kV Line

The 76-mile route connects the existing Axton substation to the existing Joshua Falls substation, colocating with existing 138 kV and 765 kV corridors to the maximum extent practical. The majority of the route, approximately 99%, will have a ROW width of 200 ft. Approximately 1% of the route will have a ROW width of 175 ft. in more congested areas. The proposed ROW will be an expansion of an existing transmission line corridor for approximately 53% of the route length; the remainder will be greenfield ROW. This component would cross approximately four railroads with Norfolk Southern Railroad, approximately five transmission lines with two entities (AEP and VEPCO), and approximately 75 roads/highways in Campbell County, Bedford County, Pittsylvania County and Henry County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. Cost estimate is significantly lower than proposing entity's estimate. Proposing entity also included a land acquisition plan detailing strategy and compensation principles. Siting is primarily backcountry, and cover-type compositions appear consistent with proposal summary from visual inspection. Route parallels existing route for significant segments, helping to reduce lands risks.

Joshua Falls-Mt. Ida Double Circuit 500 kV Line

The 69-mile route generally follows existing transmission corridors north from Joshua Falls to the new Mt. Ida substation, with deviations to minimize impacts to communities, protected lands, and historically and culturally sensitive sites. The majority of the route, approximately 98%, will have a ROW width of 200 ft. Approximately 2% of the route will have a ROW width of 150 ft. in more congested areas. The proposed ROW will be an expansion of existing transmission line corridors for approximately 72% of the route length; the remainder will be greenfield ROW. This component would cross approximately three railroads with CSXT; approximately nine transmission lines with AEP and unknown owners; approximately two pipelines with Colonial Pipeline Co and Transcontinental Gas PL; and approximately 61 roads/highways in Fluvanna County, Nelson County, Alemarle County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from five counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. The proposing entity's land budget is significantly more than the cost estimate. The route is primarily backcountry, with no major impacts based on developed lands adjacent to the route identified. This line is located in the following Virginia counties: Campbell, Appomattox, Amherst, Nelson, Albemarle and Fluvanna.

Mt. Ida-Morrisville #1 (Greenfield Portion) 500 kV Line

Install a new 1.5-mile 500 kV line from the Mt. Ida substation to the existing Mt. Eagle-Bremo corridor. The route will have a ROW width of 200 ft. throughout its length. The ROW will be entirely greenfield. Mt. Ida-Morrisville 500 kV #1 will proceed to Morrisville via a brownfield component. This component would cross approximately three transmission lines with VIRGINIA ELECTRIC & POWER CO and approximately one road in Fluvanna County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from one county in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits are required. The terrain is composed of hills, irregular plains, and isolated ridges and mountains with no habitable structures. The project area is mostly forested, interspersed with agricultural and developed land.

502 Junction-Woodside Tap to Black Oak 500 kV Line

Install a new 0.3-mile 500 kV transmission line to connect the 502 Junction-Woodside line to the existing Black Oak substation. The route will have a ROW width of 100 ft. throughout its length. The ROW will be entirely greenfield. This line portion is located in Allegany County, Maryland.

502 Junction-Woodside Tap to Black Oak 500 kV Line

Install a new 0.3-mile 500 kV transmission line to connect the 502 Junction-Woodside line to the existing Black Oak substation. The route will have a ROW width of 200 ft. throughout its length. The ROW will be entirely greenfield. This line portion is located in Allegany County, Maryland.

Mt. Ida Substation

The land for the new station is currently unutilized. Proposer has made notable progress toward site control. It is anticipated that the proposal requires permits, consultations, clearances and authorizations from Fluvanna County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. Based on the comparable sales analysis, the cost estimate is significantly less than what the proposing entity has budgeted. Based on visual inspection, there are limited siting concerns. Substation footprint is in undeveloped forested/timber land.

Overall, the ROW risk for components in this proposal is medium-high due to the nature of mostly greenfield with some brownfield of the proposed new transmission line routes.

Environmental Risk Analysis

Axton-Joshua Falls 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 &

Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder: Blue Ridge Land Conservancy will be required.

Joshua Falls-Mt. Ida Double Circuit 500 kV Line

The proposed route intersects one historical district: Southern Albemarle Rural Historic District. Coordination with the VA SHPO is required to confirm the existence and significance of this feature. The proposed route has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects eight conservation easements. Coordination with easement holders – VA Outdoors Foundation and VA Dept. of Forestry – will be required. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. Proposed route intersects critical habitat for green floater. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Mt. Ida Substation

The proposed component has the potential to impact environmental resources including streams, lakes, and/or wetlands subject to USACE Section 404 and/or Section 10 permitting. In addition, the proposed component intersects woodlands with the potential to serve as suitable habitat for federally listed Threatened & Endangered Species and/or birds protected by the Migratory Bird Treaty Act (MBTA). Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Transmission Line Risk Analysis

Axton-Joshua Falls 765 kV Line

This component would cross approximately four railroads with Norfolk Southern Railroad, approximately five transmission lines with two entities (Appalachian Power Co and Virginia Electric & Power Co), and approximately 75 roads/highways in Campbell County, Bedford County, Pittsylvania County and Henry County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Joshua Falls-Mt. Ida Double Circuit 500 kV Line

This component would cross approximately three railroads with CSXT; approximately nine transmission lines with Appalachia Electric & Power Co and unknown owners; approximately two pipelines with Colonial Pipeline Co and Transcontinental Gas PL; and approximately 61 roads/highways in Fluvanna County, Nelson County, Alemarle County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from five counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

There are a number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, solar fields and wetlands. Some transmission lines will intersect floodplains, which impact the design of the structures in these areas. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

Mt. Ida to Morrisville #1 500 kV Line Crossing Under Mt. Ida to Morrisville #2 500 kV Transmission Line

Where lines are paralleling existing transmission lines, this may pose a risk in limiting the ability for future expansion considerations. There are components that are near the Lynchburg Airport within the FAA Notification Zone. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Some components do have reduced ROW due to congested areas, and this may pose risk to EMF or clearances to the edge of ROW. Components that tie into the existing line assume that the existing structures are adequate to the support the changes.

Substation Risk Analysis

Mt. Ida Substation

It is anticipated that the proposal requires permits, consultations, clearances and authorizations from Fluvanna County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

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

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.

Overall, the substation components are feasible. However, procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for overseas equipment are likely to occur, which will impact costs. The large expansion of Joshua Falls will likely require additional considerations for civil/site development and cut/fill due to the existing terrain and land topology.

Constructability Summary

Proposal 146 utilizes Axton-Joshua Falls 765 kV line with a build that is about 50% parallel and 50% greenfield. 146 uses double circuit 500 kV format to run from Joshua Falls to Mount Ida. The ROW exceeds two-thirds paralleling and one-third greenfield. The last major portion is between Mount Ida and Morrisville. This runs about 160 miles. The significantly long EHV facilities and their associated ROW and permitting risks lead to a medium-high risk assessment for overall constructability.

Outage Review

Proposal 146 wrecks and rebuilds existing significant Dominion 500 kV transmission lines as a major part of their proposed scope. This is the primary driver for the medium-high outage risk assessment.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 28.**

Table 28. Proposal 146 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Axton to Joshua Falls 765 kV	383.25	430.26
2	Joshua Falls to Mt Ida double circuit 500 kV	481.13	450.31
3	Mt Ida 500 kV substation	119.30	148.48
4	Mt Ida to Morrisville #1 (greenfield portion)	9.66	8.06
5	502 Junction – Woodside tap to Black Oak	3.82	1.61

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
6	502 Junction – Woodside tap to Black Oak	3.88	1.61
7	Cloverdale Upgrades	16.00	16.50
8	Jacksons Ferry upgrades	5.00	12.50
9	Doubs expansion	25.00	49.68
10	Saltville terminal equipment upgrades	1.00	1.00
11	Tazewell terminal equipment upgrades	1.00	1.00
12	Aspen terminal equipment upgrades	2.00	0.02
13	Brambleton terminal equipment upgrades	2.00	13.00
14	Brighton terminal equipment upgrade	2.00	5.23
15	Heathcote terminal equipment upgrades	1.50	2.20
16	Bristers cap bank	3.00	4.00
17	Bull Run expansion	9.00	8.72
18	Cannon Branch expansion	1.50	1.80
19	Youngs Branch expansion	50.00	146.80
20	Chancellor expansion	7.50	8.30
21	Morrisville expansion	100.00	70.00
22	Axton expansion	12.00	57.50
23	North Anna expansion	3.00	3.50
24	Mt Zion terminal equipment upgrades	1.50	0.44
25	Gainesville expansion	2.00	1.80
26	Ladysmith terminal equipment upgrades	2.00	3.60
27	Elmont expansion and upgrades	2.00	5.00
28	Kammer terminal equipment upgrades	2.00	0.00
29	Black Oak expansion	8.00	18.69
30	Broadford upgrades	2.00	15.00
31	Loudoun breaker upgrades	10.00	12.75
32	Carson breaker upgrades	2.00	1.50
33	Lockridge breaker upgrades	2.00	1.50
34	Beaumeade breaker upgrades	1.50	0.75
35	Liberty breaker upgrades	1.50	0.75
36	Mosby breaker upgrades	11.00	16.50
37	Yardley breaker upgrades	4.00	3.00
38	Vint Hill breaker upgrades	3.00	0.00
39	Roundtable breaker upgrades	6.00	4.50
40	Remington CT breaker upgrades	1.50	0.75
41	Remington breaker upgrades	4.00	3.00
42	Ox breaker upgrades	5.00	5.25
43	Joshua Falls 765/500 kV expansion	150.00	200.00

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
44	West Vaco terminal equipment upgrades	1.50	0.00
45	Cross School terminal equipment upgrades	1.50	0.00
46	Bull Run-Cannon Branch 230 kV	15.00	26.58
47	Morrisville-Loudoun 500 kV tap to Youngs Branch	1.50	4.30
48	Mt Ida-Morrisville 500 kV #1	284.00	376.28
49	Mt Ida to Morrisville 500 kV #2	365.52	468.11
50	Dooms-Cunningham loop into Mt Ida	0.30	1.32
51	North Anna-Chancellor 500 kV	118.90	154.63
52	Morrisville-Gainesville 230 kV	12.00	54.62
	Total	**2,263.76**	**2,822.69**

The total proposal cost estimate is within 11–20% of the independent cost estimate and is considered low-medium risk.

Schedule Review

For schedule risks, considering the previously discussed factors and the coordination required between the proposer, the incumbents and system conditions, the June 1, 2030, in-service date was assessed as aggressive, and Proposal 146 is assessed medium-high risk.

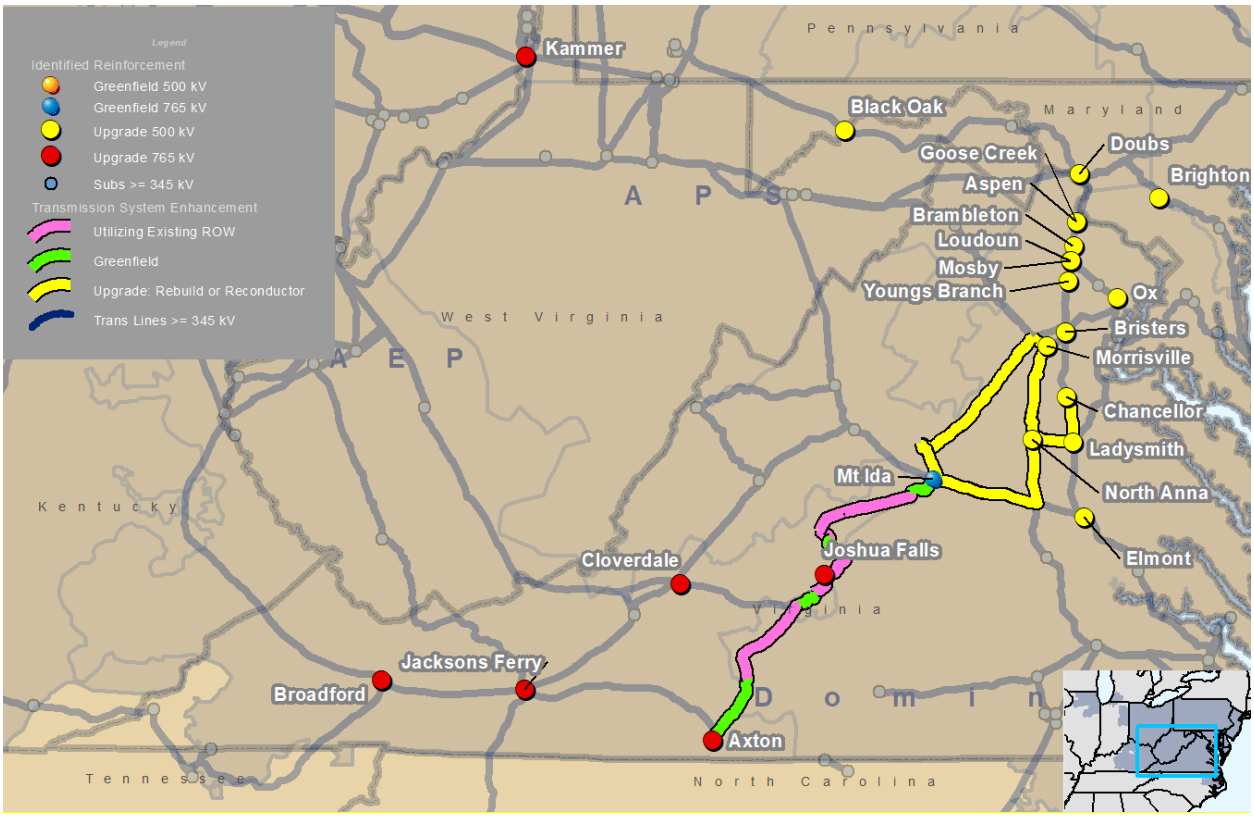
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 768 – NEETMH (NextEra)

NextEra Proposal No. 768 (**Map 25**), described as Axton-Joshua Falls-Mt. Ida 765 kV, aims to connect AEP to the Dominion system with an additional 765 kV pathway. This proposal consists of one greenfield substation component, 42 substation upgrade components, five greenfield transmission line components and seven transmission line upgrade components. This proposals contains 307 miles of total EHV (500 kV and 765 kV).

Map 25. Proposal 768



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 768 includes the following components:

- Component 1: Axton to Joshua Falls 765 kV
- Component 2: Mt. Ida 765/500 kV substation
- Component 3: Joshua Falls to Mt. Ida 765 kV
- Component 4: 502 Junction-Black Oak tap
- Component 5: Black Oak to Woodside tap
- Component 6: Mt. Ida to Morrisville 500 kV #1 (greenfield portion)
- Component 7: Cloverdale upgrades
- Component 8: Jacksons Ferry upgrades
- Component 9: Doubs expansion
- Component 10: Saltville terminal equipment upgrades
- Component 11: Tazewell terminal equipment upgrades
- Component 12: Aspen terminal equipment upgrades
- Component 13: Brambleton terminal equipment upgrades

- Component 14: Brighton terminal equipment upgrade
- Component 15: Heathcote terminal equipment upgrades
- Component 16: Bristers cap bank
- Component 17: Bull Run expansion
- Component 18: Cannon Branch expansion
- Component 19: Youngs Branch expansion
- Component 20: Chancellor expansion
- Component 21: Morrisville expansion
- Component 22: Axton expansion
- Component 23: North Anna expansion
- Component 24: Mt. Zion terminal equipment upgrades
- Component 25: Gainesville expansion
- Component 26: Ladysmith terminal equipment upgrades
- Component 27: Elmont expansion and upgrades
- Component 28: Kammer terminal equipment upgrades
- Component 29: Black Oak expansion
- Component 30: Broadford upgrades
- Component 31: Loudoun breaker upgrades
- Component 32: Carson breaker upgrades
- Component 33: Lockridge breaker upgrades
- Component 34: Beaumeade breaker upgrades
- Component 35: Liberty breaker upgrades
- Component 36: Braddock breaker upgrades
- Component 37: Buttermilk breaker upgrades
- Component 38: Goose Creek breaker upgrades
- Component 39: Mosby breaker upgrades
- Component 40: Yardley breaker upgrades
- Component 41: Vint Hill breaker upgrades
- Component 42: Roundtable breaker upgrades
- Component 43: Remington CT breaker upgrades
- Component 44: Remington breaker upgrades
- Component 45: Ox breaker upgrades
- Component 46: Joshua Falls 765/500 kV expansion
- Component 47: West Vaco terminal equipment upgrades
- Component 48: Cross School terminal equipment upgrades
- Component 49: Bull Run-Cannon Branch 230 kV
- Component 50: Morrisville-Loudoun 500 kV tap to Youngs Branch
- Component 51: Mt. Ida-Morrisville 500 kV #1
- Component 52: Mt. Ida to Morrisville 500 kV #2
- Component 53: Dooms-Cunningham loop into Mt. Ida

- Component 54: North Anna-Chancellor 500 kV
- Component 55: Morrisville-Gainesville 230 kV

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Axton-Joshua Falls 765 kV Line

The 76-mile route connects the existing Axton substation to the existing Joshua Falls substation, colocating with existing 138 kV and 765 kV corridors to the maximum extent practical. The majority of the route, approximately 99%, will have a ROW width of 200 ft. Approximately 1% of the route will have a ROW width of 175 ft. in more congested areas. The proposed ROW will be an expansion of an existing transmission line corridor for approximately 53% of the route length; the remainder will be greenfield ROW. This component would cross approximately four railroads with Norfolk Southern Railroad; approximately five transmission lines with two entities (APPALACHIAN POWER CO and VIRGINIA ELECTRIC & POWER CO); and approximately 75 roads/highways in Campbell County, Bedford County, Pittsylvania County and Henry County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. Cost estimate is significantly lower than proposing entity's estimate. Proposing entity also included a land acquisition plan detailing strategy and compensation principles. Siting is primarily backcountry, and cover-type compositions appear consistent with proposal summary from visual inspection. Route parallels existing route for significant segments, helping to reduce lands risks.

Joshua Falls-Mt. Ida 765 kV Line

New 69-mile 765 kV line route follows existing transmission ROWs and infrastructure north from Joshua Falls to the new Mt. Ida substation, with deviations to minimize impacts to communities, protected lands, and historically and culturally sensitive sites. The majority of the route, approximately 98%, will have a ROW width of 200 ft. Approximately 2% of the route will have a ROW width of 175 ft. in more congested areas. The proposed ROW will be an expansion of existing transmission line corridors for approximately 72% of the route length; the remainder will be greenfield ROW. This component would cross approximately three railroads with CSXT; approximately nine transmission lines with APPALACHIA ELECTRIC & POWER CO and unknown owners; approximately two pipelines with COLONIAL PIPELINE CO and Transcontinental Gas PL; and approximately 61 roads/highways in Fluvanna County, Nelson County, Alemarle County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from six counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. The proposing entity's land budget is significantly more than the cost estimate. The route is

primarily backcountry, with no major impacts based on developed lands adjacent to the route identified. This line is located in the following Virginia counties: Campbell, Appomattox, Amherst, Nelson, Albemarle and Fluvanna.

502 Junction-Black Oak Tap 500 kV Line

Install a new 0.3-mile 500 kV transmission line to connect the 502 Junction-Woodside line to the existing Black Oak substation. The route will have a ROW width of 100 ft. throughout its length. The ROW will be entirely greenfield. This line portion is located in Allegany County, Maryland.

Black Oak-Woodside Tap 500 kV Line

Install a new 0.3-mile 500 kV transmission line to connect the 502 Junction-Woodside line to the existing Black Oak substation. The route will have a ROW width of 200 ft. throughout its length. The ROW will be entirely greenfield. This line portion is located in Allegany County, Maryland.

Mt. Ida-Morrisville #1 (Greenfield Portion) 500 kV Line

Install a new 1.5-mile 500 kV line from the Mt. Ida substation to the existing Mt. Eagle-Bremo corridor. The route will have a ROW width of 200 ft. throughout its length. The ROW will be entirely greenfield. Mt. Ida-Morrisville 500 kV #1 will proceed to Morrisville via a brownfield component. This component would cross approximately three transmission lines with VIRGINIA ELECTRIC & POWER CO and approximately one road in Fluvanna County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from one county in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits are required. The terrain is composed of hills, irregular plains, and isolated ridges and mountains with no habitable structures. The project area is mostly forested, interspersed with agricultural and developed land.

Mt. Ida Substation

The land for the new station is currently unutilized. Proposer has made notable progress toward site control. It is anticipated that the proposal requires permits, consultations, clearances and authorizations from Fluvanna County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. Based on the comparable sales analysis, the cost estimate is significantly less than what the proposing entity has budgeted. Based on visual inspection, there are limited siting concerns. Substation footprint is in undeveloped forested/timber land.

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

Environmental Risk Analysis

Axton-Joshua Falls 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – Blue Ridge Land Conservancy – will be required.

Joshua Falls-Mt. Ida 765 kV Line

The proposed route intersects one historical district: Southern Albemarle Rural Historic District. Coordination with the VA SHPO is required to confirm the existence and significance of this feature. The proposed route has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects eight conservation easements. Coordination with easement holders – VA Outdoors Foundation and VA Dept. of Forestry – will be required. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. Proposed route intersects critical habitat for green floater. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Mt. Ida Substation

The proposed component has the potential to impact environmental resources including streams and 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 & Endangered Species. Impacts to these resources will require coordination with state wildlife agencies, USACE and USFWS. Proposed substation footprint does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the area. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Transmission Line Risk Analysis

Axton-Joshua Falls 765 kV Line

This component would cross approximately four railroads with Norfolk Southern Railroad; approximately five transmission lines with two entities (APPALACHIAN POWER CO and VIRGINIA ELECTRIC & POWER CO); and approximately 75 roads/highways in Campbell County, Bedford County, Pittsylvania County and Henry County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Joshua Falls-Mt. Ida 765 kV Line

This component would cross approximately three railroads with CSXT; approximately nine transmission lines with APPALACHIA ELECTRIC & POWER CO and unknown owners; approximately two pipelines with COLONIAL PIPELINE CO and Transcontinental Gas PL; and approximately 61 roads/highways in Fluvanna County, Nelson County, Alemarle County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from five counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights:

- 1B-6) Mt. Ida to Morrisville #1 500 kV line crossing under Mt. Ida to Morrisville #2 500 kV transmission line

Where lines are paralleling existing transmission lines, this may pose a risk in limiting the ability for future expansion considerations. The majority of the terrain is hilly and forested, which may require alternative construction methods and/or excessive tree clearing. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. Some components do have reduced ROW due to congested areas, and this may pose risk to EMF or clearances to the edge of ROW. Components that tie into the existing line assume that the existing structures are adequate to the support the changes.

Overall, even though all the proposed line components are feasible, there are significant risks as above analysis.

Substation Risk Analysis

Mt. Ida Substation

It is anticipated that the proposal requires permits, consultations, clearances and authorizations from Fluvanna County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits are required.

Mt. Ida is a large greenfield station development featuring a unique 500 kV +/- 500 MVAR STATCOM. Balance of plant and extended lead times must be considered with this solution. Much of the station pad is hilly and forested, which will require significant tree clearing.

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.

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

Constructability Summary

Proposal 768 utilizes Axton-Joshua Falls 765 kV line with a build that is about 50% parallel and 50% greenfield. 768 uses a 765 kV format to run from Joshua Falls to Mount Ida. The ROW exceeds two-thirds paralleling and one-third greenfield. The last major portion is between Mount Ida and Morrisville. This runs about 160 miles. The significantly long EHV facilities and their associated ROW and permitting risks lead to a medium-high risk assessment for overall constructability.

Outage Review

Proposal 768 wrecks and rebuilds Dominion 500 kV ROW as a part of their work. This is the primary driver for the medium-high outage risk assessment.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **0**.

Table 29. Proposal 768 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Axton to Joshua Falls 765 kV	382.44	430.26
2	Mt Ida 765/500 kV Substation	295.33	395.33
3	Joshua Falls to Mt Ida 765 kV	361.17	390.63
4	502 Junction-Black Oak tap	3.82	1.61
5	Black Oak to Woodside tap	3.88	1.61
6	Mt Ida to Morrisville 500 kV #1 (greenfield portion)	9.65	8.06
7	Cloverdale Upgrades	16.00	16.50
8	Jacksons Ferry upgrades	5.00	12.50
9	Doubs expansion	25.00	21.07
10	Saltville terminal equipment upgrades	1.00	1.00
11	Tazewell terminal equipment upgrades	1.00	1.00
12	Aspen terminal equipment upgrades	2.00	0.02
13	Brambleton terminal equipment upgrades	2.00	13.00
14	Brighton terminal equipment upgrade	2.00	5.23
15	Heathcote terminal equipment upgrades	1.50	2.20
16	Bristers cap bank	3.00	4.00
17	Bull Run expansion	9.00	8.72
18	Cannon Branch expansion	1.50	1.80
19	Youngs Branch expansion	50.00	146.80
20	Joshua Falls expansion	12.00	100.00
21	Chancellor expansion	7.50	8.30
22	Morrisville expansion	100.00	70.00
23	Axton expansion	12.00	57.50
24	North Anna expansion	3.00	3.50
25	Mt Zion terminal equipment upgrades	1.50	0.44
26	Gainesville expansion	2.00	1.80
27	Ladysmith terminal equipment upgrades	2.00	3.60
28	Elmont expansion and upgrades	2.00	5.00
29	Kammer terminal equipment upgrades	2.00	3.21
30	Black Oak expansion	8.00	18.69
31	Broadford upgrades	2.00	5.00
32	Loudoun breaker upgrades	10.00	12.75
33	Carson breaker upgrades	2.00	1.50
34	Lockridge breaker upgrades	2.00	1.50
35	Beaumeade breaker upgrades	1.50	0.75
36	Liberty breaker upgrades	1.50	0.75

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
37	Braddock breaker upgrades	3.00	3.00
38	Buttermilk breaker upgrades	5.00	0.75
39	Goose Creek breaker upgrades	2.00	1.50
40	Mosby breaker upgrades	11.00	16.50
41	Yardley breaker upgrades	4.00	3.00
42	Vint Hill breaker upgrades	3.00	0.00
43	Roundtable breaker upgrades	6.00	4.50
44	Remington CT breaker upgrades	1.50	0.75
45	Remington breaker upgrades	4.00	3.00
46	Ox breaker upgrades	5.00	5.25
47	West Vaco terminal equipment upgrades	1.50	0.00
48	Cross School terminal equipment upgrades	1.50	0.00
49	Bull Run-Cannon Branch 230 kV	15.00	26.58
50	Morrisville-Loudoun 500 kV tap to Youngs Branch	1.50	4.30
51	Mt Ida-Morrisville 500 kV #1	284.00	376.28
52	Mt Ida to Morrisville 500 kV #2	365.52	468.11
53	Dooms - Cunningham loop into Mt Ida	0.30	1.32
54	North Anna - Chancellor 500 kV	118.90	154.63
55	Morrisville - Gainesville 230 kV	12.00	54.62
	Total	**2,191.01**	**2,879.72**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

For schedule risks, considering the previously discussed factors and the coordination required between the proposer, the incumbents and system conditions, the June 1, 2030, in-service date was assessed as aggressive, and Proposal 768 is assessed medium-high risk.

The proposer, to date, has not built and operated 765 kV facilities but did provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity experience and capability risk is considered medium-high.

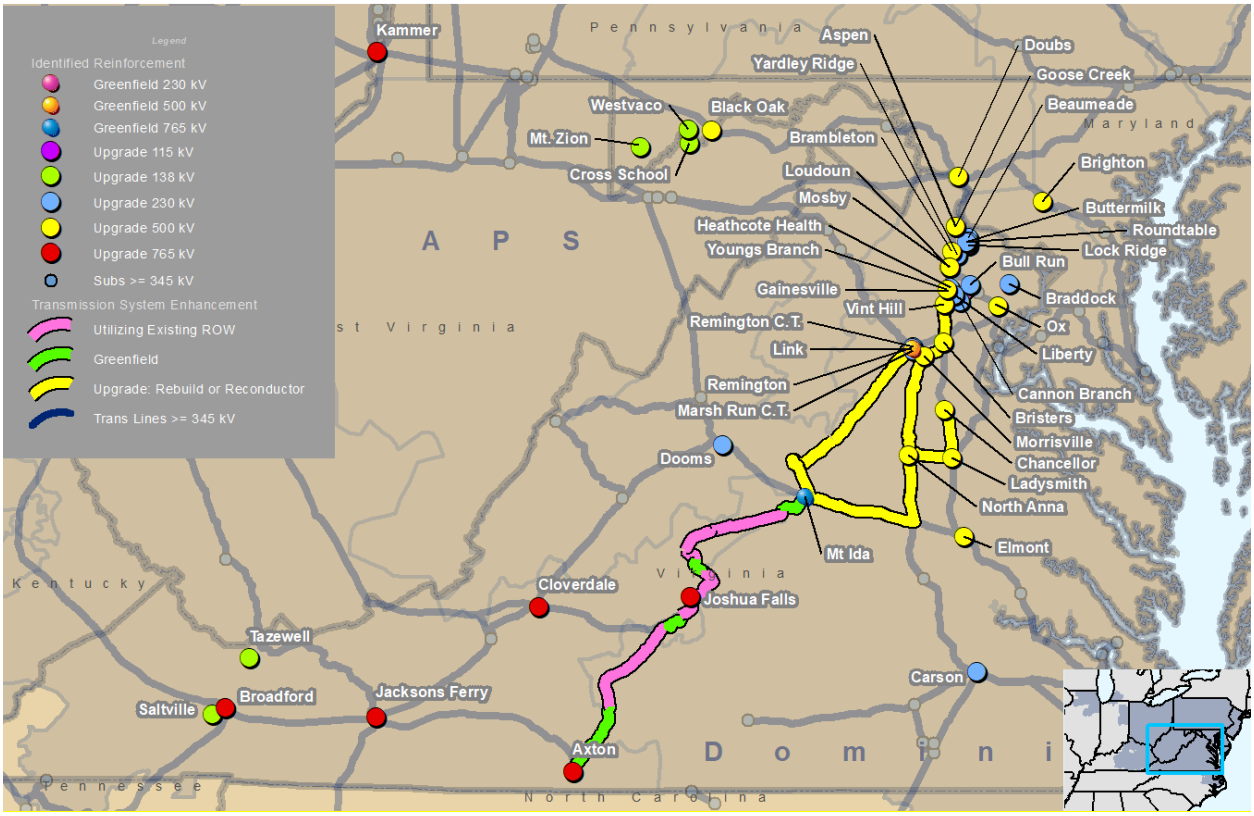
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 992 – NEETMH (NextEra)

NextEra Proposal No. 992 (**Map 26**) constructs a new 765 kV transmission line from AEP's Axton substation to AEP's Joshua Falls substation and from Joshua Falls to a new 765/500 kV substation Mt. Ida. It also constructs a new 500/230 kV Link substation. Proposal 992 comprises a total of 66 components, including five greenfield transmission line components, two greenfield substation components, 12 transmission line upgrade components and 47 substation upgrade components. This proposals contains 302 miles of total EHV (500 kV and 765 kV).

Map 26. Proposal 992



*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 992 includes the following components:

- Component 1: Axton-Joshua Falls 765 kV
- Component 2: Joshua Falls-Mt. Ida 765 kV
- Component 3: Mt. Ida 765/500 kV substation
- Component 4: Mt. Ida-Link (greenfield portion)
- Component 5: Link 500/230 kV substation
- Component 6: 502 Junction-Woodside tap to Black Oak

- Component 7: 502 Junction-Woodside tap to Black Oak
- Component 8: Cloverdale upgrades
- Component 9: Jacksons Ferry upgrades
- Component 10: Doubs expansion
- Component 11: Saltville terminal equipment upgrades
- Component 12: Tazewell terminal equipment upgrades
- Component 13: Aspen terminal equipment upgrades
- Component 14: Brambleton terminal equipment upgrades
- Component 15: Brighton terminal equipment upgrade
- Component 16: Heathcote terminal equipment upgrades
- Component 17: Bristers cap bank
- Component 18: Bull Run expansion
- Component 19: Cannon Branch expansion
- Component 20: Youngs Branch expansion
- Component 21: Joshua Falls expansion
- Component 22: Axton expansion
- Component 23: North Anna expansion
- Component 24: Chancellor expansion
- Component 25: Mt. Zion terminal equipment upgrades
- Component 26: Gainesville expansion
- Component 27: Ladysmith terminal equipment upgrades
- Component 28: Elmont expansion and upgrades
- Component 29: Kammer terminal equipment upgrades
- Component 30: Black Oak expansion
- Component 31: Broadford upgrades
- Component 32: Loudoun breaker upgrades
- Component 33: Carson breaker upgrades
- Component 34: Lockridge breaker upgrades
- Component 35: Beaumeade breaker upgrades
- Component 36: Liberty breaker upgrades
- Component 37: Braddock breaker upgrades
- Component 38: Buttermilk breaker upgrades
- Component 39: Goose Creek breaker upgrades
- Component 40: Mosby breaker upgrades
- Component 41: Yardley breaker upgrades
- Component 42: Vint Hill breaker upgrades
- Component 43: Roundtable breaker upgrades
- Component 44: Remington CT breaker upgrades
- Component 45: Remington breaker upgrades
- Component 46: Ox breaker upgrades
- Component 47: Vint Hill terminal equipment upgrades
- Component 48: Marsh Run CT terminal equipment upgrades
- Component 49: Remington CT terminal equipment upgrades
- Component 50: Remington terminal equipment upgrades

- Component 51: Morrisville expansion
- Component 52: Dooms breaker upgrades
- Component 53: West Vaco terminal equipment upgrades
- Component 54: Cross School terminal equipment upgrades
- Component 55: Bull Run-Cannon Branch 230 kV
- Component 56: Morrisville-Loudoun 500 kV tap to Youngs Branch
- Component 57: Mt. Ida to Morrisville 500 kV #2
- Component 58: Dooms-Cunningham loop into Mt. Ida
- Component 59: North Anna-Chancellor 500 kV
- Component 60: Morrisville-Gainesville 230 kV
- Component 61: Remington CT-Marsh Run 230 kV reconductor
- Component 62: Remington-Link and Remington CT-Link tap
- Component 63: Link-Marsh Run CT 230 kV tap
- Component 64: Tap for Meadowbrook - Vint Hill + Mt. Ida-Link into Link substation
- Component 65: Vint Hill-Link 500 kV tap
- Component 66: New Mt. Ida-Link 500 kV (brownfield portion)

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Axton-Joshua Falls 765 kV Line

The 76-mile route connects the existing Axton substation to the existing Joshua Falls substation, colocating with existing 138 kV and 765 kV corridors to the maximum extent practical. The majority of the route, approximately 99%, will have a ROW width of 200 ft. Approximately 1% of the route will have a ROW width of 175 ft. in more congested areas. The proposed ROW will be an expansion of an existing transmission line corridor for approximately 53% of the route length; the remainder will be greenfield ROW. This component would cross approximately four railroads with Norfolk Southern Railroad; approximately five transmission lines with two entities (APPALACHIAN POWER CO and VIRGINIA ELECTRIC & POWER CO); and approximately 75 roads/highways in Campbell County, Bedford County, Pittsylvania County and Henry County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. Cost estimate is significantly lower than proposing entity's estimate. Proposing entity also included a land acquisition plan detailing strategy and compensation principles. Siting is primarily backcountry, and cover-type compositions appear consistent with proposal summary from visual inspection. Route parallels existing route for significant segments, helping to reduce lands risks.

Joshua Falls-Mt. Ida 765 kV Line

New 69-mile 765 kV line route follows existing transmission ROWs and infrastructure north from Joshua Falls to the new Mt. Ida substation, with deviations to minimize impacts to communities, protected lands, and historically and culturally sensitive sites. The majority of the route, approximately 98%, will have a ROW width of 200 ft. Approximately 2% of the route will have a ROW width of 175 ft. in more congested areas. The proposed ROW will be an expansion of existing transmission line corridors for approximately 72% of the route length; the remainder will be greenfield ROW. This component would cross approximately three railroads with CSXT; approximately nine transmission lines with APPALACHIA ELECTRIC & POWER CO and unknown owners; approximately two pipelines with COLONIAL PIPELINE CO and Transcontinental Gas PL; and approximately 61 roads/highways in Fluvanna County, Nelson County, Alemarle County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from six counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. The proposing entity's land budget is significantly more than the cost estimate. The route is primarily backcountry, with no major impacts based on developed lands adjacent to the route identified. This line is located in the following Virginia counties: Campbell, Appomattox, Amherst, Nelson, Albemarle and Fluvanna.

502 Junction-Black Oak Tap 500 kV Line

Install a new 0.3-mile 500 kV transmission line to connect the 502 Junction-Woodside line to the existing Black Oak substation. The route will have a ROW width of 100 ft. throughout its length. The ROW will be entirely greenfield. This line portion is located in Allegany County, Maryland.

Black Oak-Woodside Tap 500 kV Line

Install a new 0.3-mile 500 kV transmission line to connect the 502 Junction-Woodside line to the existing Black Oak substation. The route will have a ROW width of 200 ft. throughout its length. The ROW will be entirely greenfield. This line portion is located in Allegany County, Maryland.

Mt. Ida-Link (Greenfield Portion) 500 kV Line

Install a new 1.5-mile 500 kV line from the Mt. Ida substation to the existing Mt. Eagle-Bremo corridor. The route will have a ROW width of 200 ft. throughout its length. The ROW will be entirely greenfield. Mt. Ida-Link will proceed to Link via a brownfield component. This component would cross approximately three transmission lines with VIRGINIA ELECTRIC & POWER CO and approximately one road in Fluvanna County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from one county in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits are required. The terrain is composed of hills, irregular plains, and isolated ridges and mountains with no habitable structures. The project area is mostly forested, interspersed with agricultural and developed land.

Mt. Ida Substation

The land for the new station is currently unutilized. Proposer has made notable progress toward site control. It is anticipated that the proposal requires permits, consultations, clearances and authorizations from Fluvanna County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. Based on the comparable sales analysis, the cost estimate is significantly less than what the proposing entity has budgeted. Based on visual inspection, there are limited siting concerns. Substation footprint is in undeveloped forested/timber land.

Link Substation

It is anticipated that the proposal requires site plan review, consultations, clearances and authorizations from Fauquier County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required. Based on the comparable sales analysis, the proposing entity has budgeted significantly more than the cost estimate. Based on visual inspection, there are no siting concerns. Substation footprint is in undeveloped forested/timber land.

Overall, the ROW risk for components in this proposal is medium-high due the mix of greenfield and brownfield components of the proposed new transmission line routes.

Environmental Risk Analysis

Axton-Joshua Falls 765 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Coordination with conservation easement holder – Blue Ridge Land Conservancy – will be required.

Joshua Falls-Mt. Ida 765 kV Line

The proposed route intersects one historical district: Southern Albemarle Rural Historic District. Coordination with the VA SHPO is required to confirm the existence and significance of this feature. The proposed route has the potential to impact environmental resources including FEMA floodplains, streams, and 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route intersects eight conservation easements. Coordination

with easement holders – VA Outdoors Foundation and VA Dept. of Forestry – will be required. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. Proposed route intersects critical habitat for green floater. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Mt. Ida Substation

The proposed component has the potential to impact environmental resources including streams, and 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 & Endangered Species. Impacts to these resources will require coordination with state wildlife agencies, USACE and USFWS. Proposed substation footprint does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the area. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Link Substation

The proposed component has the potential to impact environmental resources including 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 & Endangered Species. Impacts to these resources will require coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species.

Transmission Line Risk Analysis

Axton-Joshua Falls 765 kV Line

This component would cross approximately four railroads with Norfolk Southern Railroad, approximately five transmission lines with two entities (Appalachian Power Co and Virginia Electric & Power Co), and approximately 75 roads/highways in Campbell County, Bedford County, Pittsylvania County and Henry County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

Joshua Falls-Mt. Ida 765 kV Line

This component would cross approximately three railroads with CSXT, approximately nine transmission lines with Appalachia Electric & Power Co and unknown owners, approximately two pipelines with Colonial Pipeline Co and Transcontinental Gas PL, and approximately 61

roads/highways in Fluvanna County, Nelson County, Alemarle County and Appomattox County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from five counties in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

There are number of lines crossings that may necessitate the need for redesign or route changes in the future. The crossings include other transmission lines, bodies of water, roadways, railroads, etc. EHV lines crossing under or over other EHV lines may necessitate excessive structure heights or redesign to raise structure heights.

Mt. Ida to Morrisville #1 500 kV Line Crossing Under Mt. Ida to Morrisville #2 500 kV Transmission Line

Where lines are paralleling existing transmission lines, this may pose a risk in limiting the ability for future expansion considerations. The majority of the terrain is hilly and forested, which may require alternative construction methods and/or excessive tree clearing. Procurement lead times regarding the structures, particularly lattices towers, may pose risk to the proposed in-service dates. There are components that are near the Lynchburg Airport within the FAA Notification Zone. Components that tie into the existing line assume that the existing structures are adequate to the support the changes.

Overall, even though all the proposed line components are feasible, there are significant risks as above analysis

Substation Risk Analysis

Mt. Ida Substation

It is anticipated that the proposal requires permits, consultations, clearances and authorizations from Fluvanna County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits are required.

Link Substation

It is anticipated that the proposal requires site plan review, consultations, clearances and authorizations from Fauquier County in Virginia. State PSC approval, CPCN and DOT utility permits, and driveway/local road permits may be required.

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.

Overall, the substation components are feasible. However, procurement of EHV equipment could lead to unexpected schedule delays due to extended lead times and additional cost. With EHV equipment being relatively uncommon in the U.S., unexpected delays in procurement, engineering and construction may occur. Additionally, regulation and currency fluctuations for

overseas equipment are likely to occur, which will impact costs. The 500 kV STATCOM featured in Link substation will require consideration for an extended lead time and balance of plant integration. Joshua Falls station expansion is large, and consideration should be given for civil site development and cut/fill requirements.

Constructability Summary

Proposal 992 utilizes Axton-Joshua Falls 765 kV line with a build that is about 50% parallel and 50% greenfield. 992 uses a 765 kV format to run from Joshua Falls to Mount Ida. The ROW exceeds two-thirds paralleling and one-third greenfield. The last major portion is between Mount Ida and Morrisville. This runs about 160 miles. The significantly long EHV facilities and their associated ROW and permitting risks lead to a medium-high risk assessment for overall constructability.

Outage Review

Proposal 992 wrecks and rebuilds Dominion 500 kV ROW as a part of their work. This is the primary driver for the medium-high outage risk assessment.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 30**.

Table 30. Proposal 992 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Axton-Joshua Falls 765 kV	380.71	430.26
2	Joshua Falls-Mt Ida 765 kV	359.56	390.63
3	Mt Ida 765/500 kV substation	293.80	395.33
4	Mt Ida-Link (greenfield portion)	9.60	8.06
5	Link 500/230 kV substation	161.67	252.96
6	502 Junction-Woodside tap to Black Oak	3.80	3.80
7	502 Junction-Woodside tap to Black Oak	3.86	3.86
8	Cloverdale Upgrades	16.00	16.50

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
9	Jacksons Ferry upgrades	5.00	12.50
10	Doubs expansion	25.00	49.68
11	Saltville terminal equipment upgrades	1.00	1.00
12	Tazewell terminal equipment upgrades	1.00	1.00
13	Aspen terminal equipment upgrades	2.00	0.02
14	Brambleton terminal equipment upgrades	2.00	13.00
15	Brighton terminal equipment upgrade	2.00	5.23
16	Heathcote terminal equipment upgrades	1.50	2.20
17	Bristers cap bank	3.00	4.00
18	Bull Run expansion	9.00	8.72
19	Cannon Branch expansion	1.50	1.80
20	Youngs Branch expansion	50.00	146.80
21	Joshua Falls expansion	12.00	100.00
22	Axton expansion	12.00	57.50
23	North Anna expansion	3.00	3.50
24	Chancellor expansion	7.50	8.30
25	Mt Zion terminal equipment upgrades	1.50	0.44
26	Gainesville expansion	2.00	1.80
27	Ladysmith terminal equipment upgrades	2.00	3.60
28	Elmont expansion and upgrades	2.00	5.00
29	Kammer terminal equipment upgrades	2.00	3.21
30	Black Oak expansion	8.00	18.69
31	Broadford upgrades	2.00	5.00
32	Loudoun breaker upgrades	10.00	12.75
33	Carson breaker upgrades	2.00	1.50
34	Lockridge breaker upgrades	2.00	1.50
35	Beaumeade breaker upgrades	1.50	0.75
36	Liberty breaker upgrades	1.50	0.75
37	Braddock breaker upgrades	3.00	3.00
38	Buttermilk breaker upgrades	5.00	3.75
39	Goose Creek breaker upgrades	2.00	1.50
40	Mosby breaker upgrades	11.00	16.50
41	Yardley breaker upgrades	4.00	3.00
42	Vint Hill breaker upgrades	3.00	0.00
43	Roundtable breaker upgrades	6.00	4.50
44	Remington CT breaker upgrades	1.50	0.75
45	Remington breaker upgrades	4.00	3.00
46	Ox breaker upgrades	5.00	5.25

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
47	Vint Hill terminal equipment upgrades	2.00	0.02
48	Marsh Run CT terminal equipment upgrades	1.00	9.00
49	Remington CT terminal equipment upgrades	1.00	2.20
50	Remington terminal equipment upgrades	1.00	2.20
51	Morrisville expansion	10.00	70.00
52	Dooms breaker upgrades	4.00	3.00
53	West Vaco terminal equipment upgrades	1.50	0.00
54	Cross School terminal equipment upgrades	1.50	0.00
55	Bull Run-Cannon Branch 230 kV	15.00	26.58
56	Morrisville-Loudoun 500 kV tap to Youngs Branch	1.50	4.30
57	Mt Ida to Morrisville 500 kV #2	365.52	468.11
58	Dooms-Cunningham loop into Mt Ida	0.30	2.58
59	North Anna-Chancellor 500 kV	118.90	154.63
60	Morrisville-Gainesville 230 kV	12.00	54.62
61	Remington CT-Marsh Run 230 kV reconductor	0.25	1.95
62	Remington-Link and Remington CT – Link tap	1.00	3.00
63	Link-Marsh Run CT 230 kV tap	1.00	3.00
64	Tap for Meadowbrook-Vint Hill + Mt Ida – Link into Link substation	0.50	8.39
65	Vint Hill-Link 500 kV tap	0.75	5.49
66	New Mt Ida-Link 500 kV (brownfield portion)	270.00	358.63
	Total	**2,256.23**	**3,190.60**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

For schedule risks, considering the previously discussed factors and the coordination required between the proposer, the incumbents and system conditions, the June 1, 2030, in-service date was assessed as aggressive, and Proposal 992 is assessed medium-high risk.

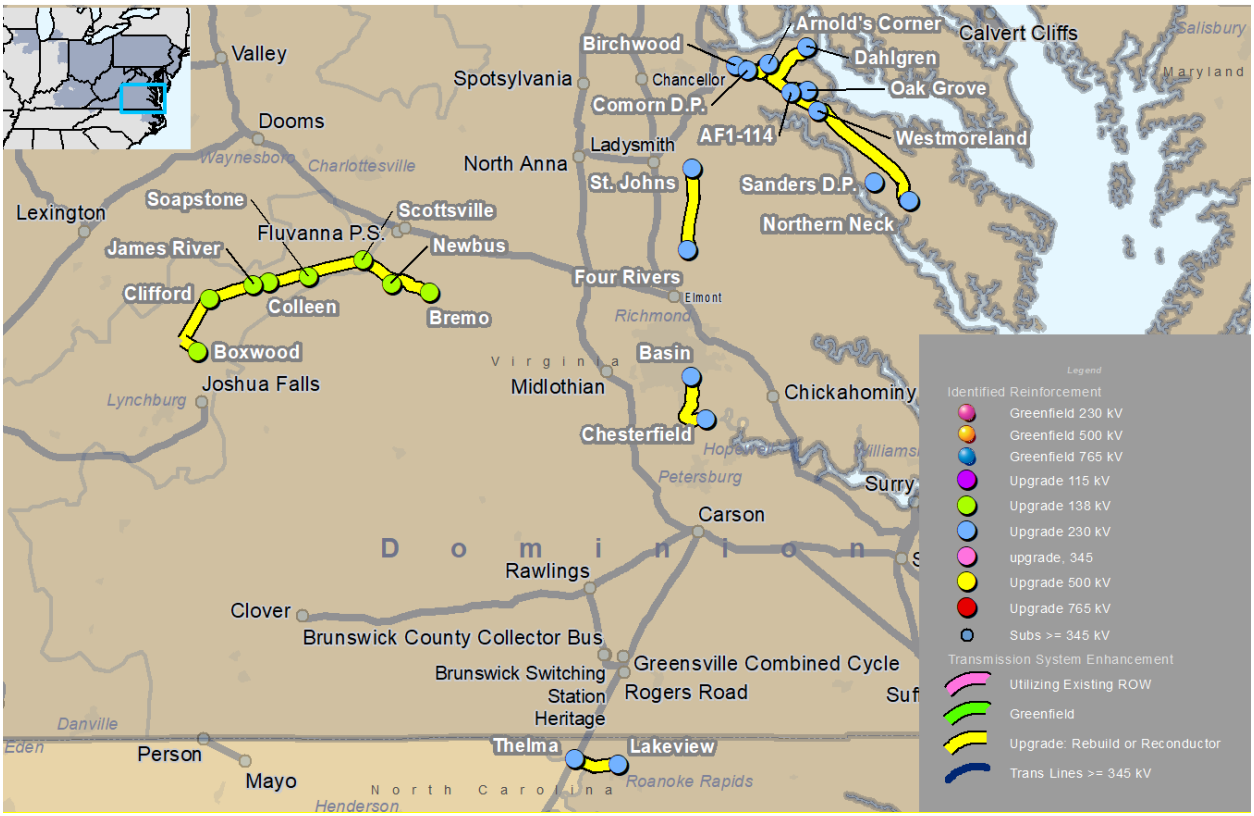
Proposing Entity Experience and Capability Review

To date, the proposing entity has not built or operated 765 kV facilities, but they have provided a detailed plan for fabricating, testing, constructing and operating their proposed 765 kV facilities. The proposing entity's experience and capability risk is considered medium-high.

Proposal 944 – NEETMH (NextEra)

NextEra Proposal No. 944 (**Map 27**) contains upgrades to AEP's 138 kV and Dominion's 230 kV transmission lines, which include eighteen transmission line upgrade components. NextEra Proposal No. 944 is made up of upgrade components to existing facilities owned by incumbent transmission owners, whereas their other core proposals contain more work by the proposer. This proposal contains no EHV (500 kV and 765 kV) miles or substation components.

Map 27. Proposal 944



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 944 includes the following components:

- Component 1: Bremo-Newbus 6-wire 138 kV
- Component 2: Newbus-Scottsville 6-wire 138 kV
- Component 3: Scottsville-Soapstone 6-wire 138 kV
- Component 4: Soapstone-James River 6-wire 138 kV
- Component 5: James River-Colleen 6-wire 138 kV
- Component 6: Colleen-Clifford 6-wire 138 kV
- Component 7: Clifford-Boxwood 6-wire 138 kV
- Component 8: Four Rivers-St John uprate 230 kV
- Component 9: Chesterfield-Basin uprate 230 kV
- Component 10: Oakgrove-AF1-114 uprate 230 kV
- Component 11: Comorn-Birchwood uprate 230 kV
- Component 12: Northern Neck-Sanders uprate 230 kV
- Component 13: Sanders-Westmoreland uprate 230 kV
- Component 14: Westmoreland-Oak Grove uprate 230 kV
- Component 15: AF1-114-Dahlgren uprate 230 kV
- Component 16: Dahlgren-Arnolds Corner 230 kV
- Component 17: Arnolds Corner-Comorn 230 kV
- Component 18: Thelma-Lakeview #1 and #2 230 kV

Constructability Review

Right-of-Way/Land Usage Risk Analysis

All components take place within existing ROW through mostly forested land and some regions of agricultural land and do not require expansion. ROW/land usage risk is low.

Environmental Risk Analysis

Since all components take place within existing ROW/land through mostly forested land and some regions of agricultural land, and do not require expansion, there are relatively few environmental concerns with this proposal.

Transmission Line Risk Analysis

There are no greenfield EHV transmission lines as a part of this proposal. Most of the individual transmission components do not pose significant design, schedule or cost risk, and much of the risk associated with these projects hinges on the ability of the existing structures to accept the proposed changes. Assuming that they do, these projects are all individual low risk. That being

said, some specific issues are identified. Some components are all a bit open-ended in their scope descriptions. They could be a reconductor or a full wreck/rebuild, which would result in scope creep and risks to project success. Additionally, some components have a scope to string the "open position" of the double circuit tower. However, these components have at least some portions of the line in which both positions of the tower occupied. The volume of work being proposed in the schedule provided is a little challenge.

Substation Risk Analysis

There no substation components in this proposal.

Constructability Summary

The work NextEra proposes as a part of their common components is on lower kV facilities and involves primarily brownfield construction. It carries an overall constructability risk of low-medium.

Outage Review

Even though majority of the transmission outages required are for lower-voltage facilities, these facilities have some operational significance. While these facilities are being upgraded, it is likely that those longer-duration outages may cause some issues, and as a result, medium outage risk is assessed.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 31**.

Table 31. Proposal 944 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Bremo-Newbus 6-wire 138 kV	2.88	7.92
2	Newbus-Scottsville 6-wire 138 kV	2.88	7.92
3	Scottsville-Soapstone 6-wire 138 kV	3.32	9.13
4	Soapstone-James River 6-wire 138 kV	3.32	9.13
5	James River-Colleen 6-wire 138 kV	0.58	1.58
6	Colleen-Clifford 6-wire 138 kV	1.51	4.15
7	Clifford-Boxwood 6-wire 138 kV	3.58	9.85
8	Four Rivers-St John uprate 230 kV	9.00	54.95
9	Chesterfield-Basin uprate 230 kV	6.20	46.88
10	Oakgrove-AF1-114 uprate 230 kV	3.05	22.57
11	Comorn-Birchwood uprate 230 kV	3.14	23.20
12	Northern Neck-Sanders uprate 230 kV	2.32	17.21
13	Sanders-Westmoreland uprate 230 kV	3.72	27.49
14	Westmoreland-Oak Grove uprate 230 kV	5.64	41.70
15	AF1-114-Dahlgren uprate 230 kV	6.95	51.43
16	Dahlgren-Arnolds Corner 230 kV	5.99	44.40
17	Arnolds Corner – Comorn 230 kV	0.78	5.74
18	Thelma-Lakeview #1 and #2 230 kV	4.32	31.93
	Total	**69.14**	**417.16**

The total proposal cost estimate is less than 41% of the independent cost estimate and is considered high risk.

Schedule Review

The proposed in-service date of June 2029 is achievable for the proposed scope of the project, and the schedule risk is considered low.

Proposing Entity Experience and Capability Review

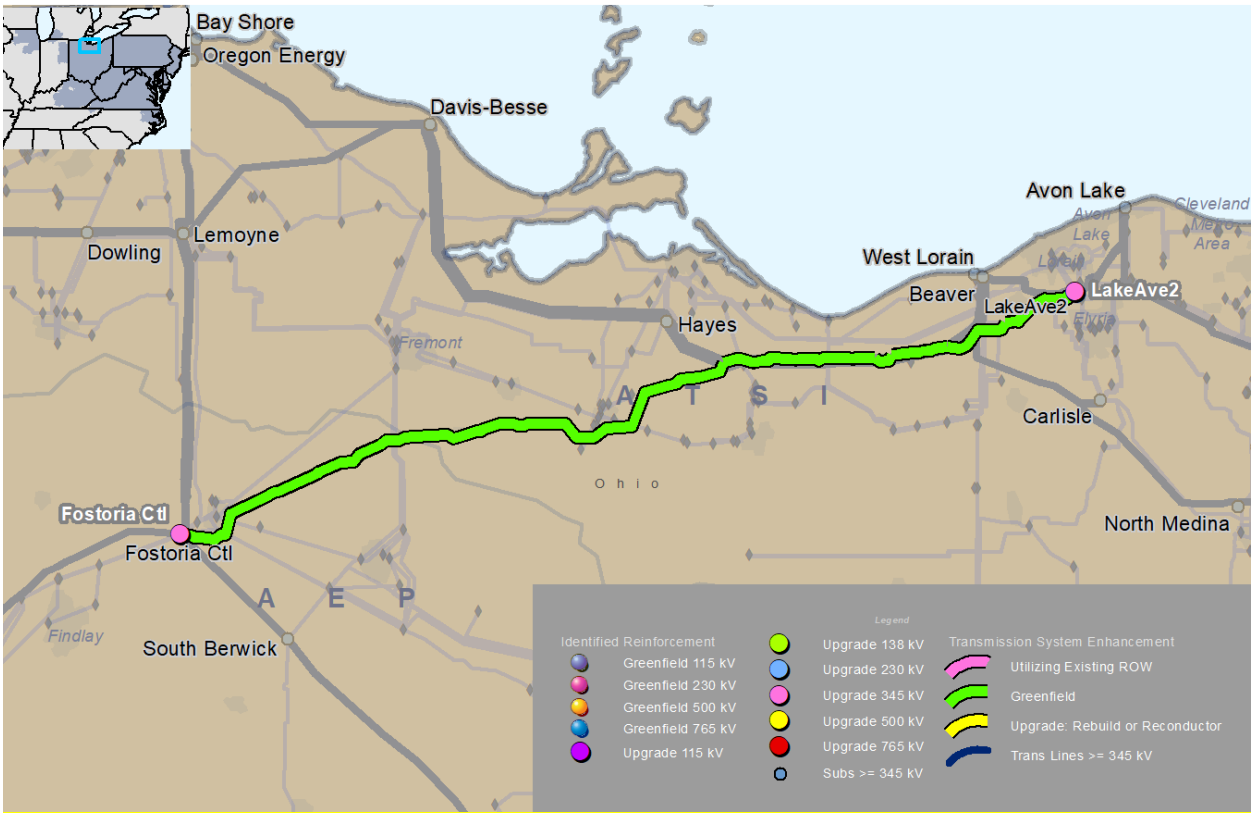
NextEra has significant experience with the proposed equipment and the capabilities to construct Proposal 944 as submitted. The proposing entity experience and capability risk is considered low.

Ohio Cluster Proposals

Proposal 694 – TRNSRC

TRNSRC Proposal No. 694 (**Map 28**), described as Fostoria Central-Lake Ave. 345 kV double circuit, comprises three components, which include two 345 kV expansions at existing Fostoria Central station and Lake Avenue station in Northern Ohio and a new greenfield 79-mile 345 kV double circuit line in between the two stations.

Map 28. Proposal 694



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

TRNSRC Proposal 694 components selected for evaluation are as follows:

- Component 1: Fostoria Central-Lake Ave
- Component 2: Fostoria Central Station Upgrade
- Component 3: Lake Avenue Station Upgrade

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Fostoria Central-Lake Ave. 345 kV Line

The route extends approximately 79-miles of greenfield line effecting six counties (Seneca, Sandusky, Huron, Erie, Hancock and Lorain) in Ohio. The 345 kV line exits the existing Fostoria Central substation from the south, turns east, and then travels in a predominantly northeast direction until it reaches the existing Lake Ave. substation from the east. The greenfield Fostoria

Central-Lake Ave. 345 kV route ROW will be 150 feet in width and will parallel/cross existing rights-of-way to include interstates, roads, railroads, existing transmission lines/utilities, and existing pipelines and best minimizes potential impacts to the natural and human environments. This component would cross approximately 36 railroads with Northern Ohio & Western Railway LTD, Norfolk Southern Railway Company, Wheeling & Lake Erie Railway Company, and CSXT; approximately 13 transmission lines with AMERICAN TRANSMISSION SYSTEMS, INC., OHIO POWER CO, of which eight crossings owners are not available; approximately 28 pipelines with BUCKEYE PARTNERS, North Coast Gas Transmission Co, SUNOCO, Rover Pipeline, Columbia Gas Trans Co, KINDER MORGAN, East Ohio Gas Co, and NEXUS Gas Transmission; and approximately 107 roads/highways in Lorain County, Erie County, Sandusky County, Huron County, Seneca County and Hancock County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from six counties in Ohio. State PUCO approval, DOT utility permits and driveway/local road permits are required. The proposing entity's land acquisition budget is significantly higher than the cost estimate. Siting is predominantly across open agricultural areas and parallels roads, but does run through built up/residential locations as well.

Overall, the ROW risk for this proposal is high due to the nature and significant amount of the greenfield ROW.

Environmental Risk Analysis

Fostoria Central-Lake Ave. 345 kV Line

The proposed component has the potential to impact environmental resources including streams, lakes and/or wetlands subject to USACE Section 404 and/or Section 10 permitting. Proposed route intersects 31 FEMA high-risk flood zones (100-year floodplain). Coordination with the floodplain administrator from the following Ohio jurisdictions will be required: Seneca, Sandusky, Huron, Erie, Lorain and Hancock. In addition, the proposed component intersects woodlands with the potential to serve as suitable habitat for federally listed Threatened & Endangered Species and/or birds protected by the Migratory Bird Treaty Act (MBTA). Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. The proposed route intersects Natural Areas/Reserves/Wildlife Refuge(s): Ottawa National Wildlife Refuge and Sportsman Gun & Reel Club. Coordination with the following agencies – Ohio Department of Natural Resources and Sportsman Gun & Reel Club – is required.

Transmission Line Risk Analysis

Overall, the component of this project does not pose any significant risks to successfully implementing the proposed work. As a double circuit 345 kV line that intends to use BOLD-style

framing on lattice towers, the structures are likely to have large footprints that may face opposition from landowners. While this style been executed successfully, we understand it to cause future maintenance issues, and it may also limit the number of contractors that can support the design/construction of the line due to the limited use across the country – particularly with the use of lattice towers over the use of monopoles.

Substation Risk Analysis

Fostoria Central Station Upgrade

Expand the station fenced area by 50 ft. x 469 ft. to accommodate one new 345 kV breaker-and-a-half string for two new 345 kV line positions to Lake Ave. station (double circuit line) by adding three 345 kV, 5000A 63 kA circuit breakers; two 345 kV phase-over-phase take-off towers and associated equipment, such as line CCVTs, line switches, ground switches, bus work and steel str; adding one new 345 kV breaker with associated switches to complete the existing string for East Lima and Lemonyne lines; and adding three new 345 kV BusVTs at bus #1.

Lake Avenue Station Upgrade

Expand the station fenced area by approximately 238.5 ft. x 339 ft. to accommodate two new 345 kV line positions to Lake Avenue station (double circuit line) by adding one 345 kV breaker-and-a-half with folding arrangement, two 345 kV phase-over-phase take-off towers, three 345 kV circuit breakers and other associated items.

Substation components of this proposal focus primarily on expansion of the existing substations to accommodate the new 345 kV double circuit line positions. This component is feasible typically at low risk if all necessary outages will be available. The existing AC, DC, and telecom. systems will accommodate the new equipment, the existing control enclosure has space for the new relay equipment, ground grid resistivity test data are available, ground grid upgrades will not be needed, the existing cable trench has space for the new control cables, soil boring logs and geotechnical report are available, wetland mitigation will not be needed, all necessary permits will be available, and land will be available to install the equipment outlined in this description.

Constructability Summary

This ~80-mile long, double circuit tower constructed facility may run into some issues in the areas of ROW/land acquisition and permitting for certain stretches. Overall constructability risk assessed at medium.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 32**.

Table 32. Proposal 694 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Fostoria Central - Lake Ave	280.27	400.19
2	Fostoria Central Station Upgrade	10.33	10.33
3	Lake Avenue Station Upgrade	37.77	37.77
	Total	**328.37**	**448.29**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

The proposed in-service date of December 2029 appears to be reasonable for the proposed scope of the project. A schedule risk of medium is assessed due to the expected timing in the areas of ROW/land acquisition and permitting for the project.

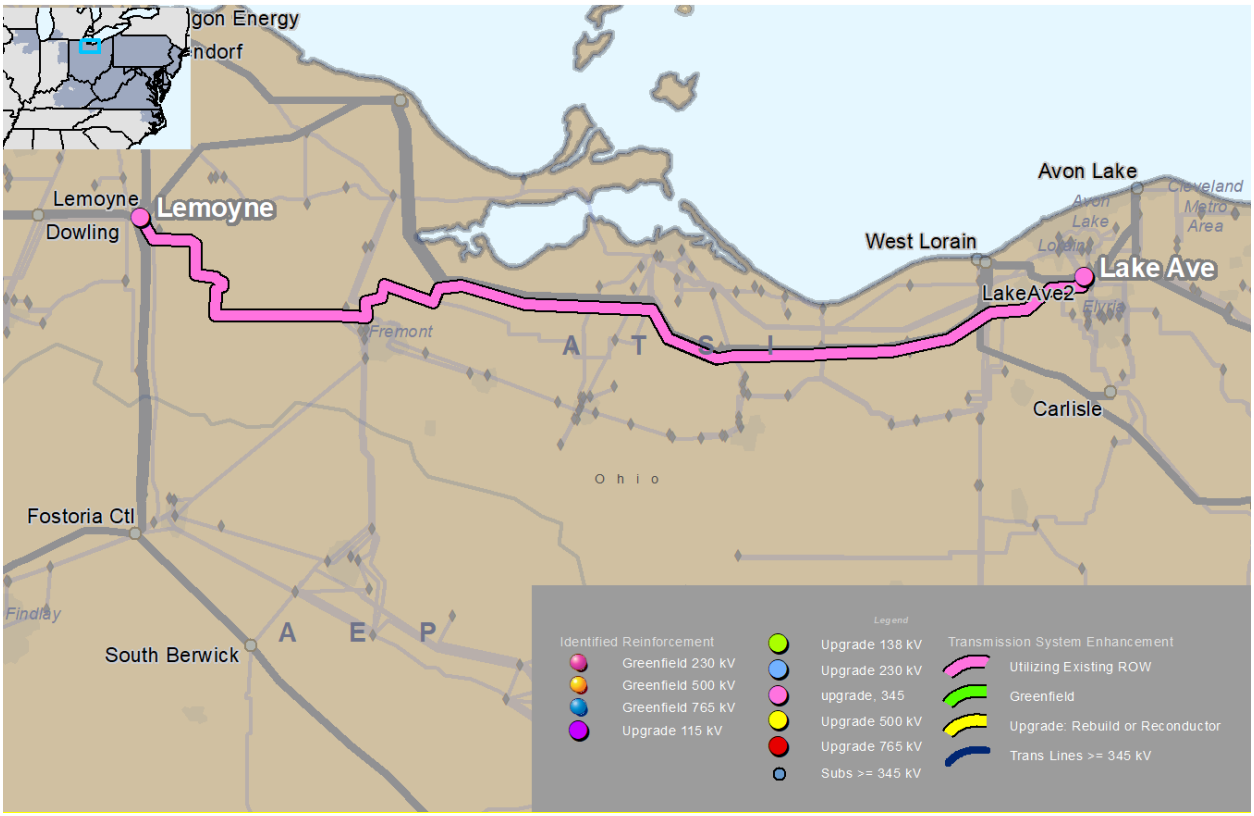
Proposing Entity Experience and Capability Review

Transource has significant experience with the proposed equipment and the capabilities to construct Proposal 694 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 843 – ATSI (FirstEnergy)

First Energy Proposal No. 843 (**Map 29**) is described as the 88-mile Lemoyne-Lake Ave. 345 kV line. The components include a transmission line and substation upgrades; the 345 kV line will be developed within a mix of existing and new ROWs by leveraging existing 138 kV corridors. There are total three components in FirstEnergy Proposal No. 843, including one transmission line upgrade component and two substation upgrade components.

Map 29. Proposal 843



*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

First Energy Proposal No. 843 includes the following components for the Ohio solution:

- Component 1: Lemoyne-Lake Avenue 345 kV Line
- Component 2: Lemoyne Substation
- Component 3: Lake Avenue Substation

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Lemoyne-Lake Avenue 345 kV Line

Approximately 45 miles (50%) of the new 345 kV line will leverage existing 138 kV transmission rights-of-way by rebuilding the following single circuit 138 kV lines with double circuit towers where the 345 kV and 138 kV lines will be on the same structure: 19 miles of the West Fremont-Woodville No 2 138 kV line, six miles of the Avery-Hayes 138 kV line, 7.5 miles of the Avery-Shinrock 138 kV line, 12.5 miles of the Carlisle-Shinrock 138 kV line. Approximately 43.3 miles of the new Lemoyne-Lake Ave. 345 kV line will be constructed on single circuit 345 kV structures, leveraging existing rights-of-way by widening existing 138 kV transmission corridors. The proposed route and approach to this design carries significant risks to successfully implement the proposed work. Portions of the greenfield route follow smaller roadways with residences. The line route crosses over, or in close proximity to, these residences, and a 345 kV easement on these properties will face significant opposition. The brownfield portions of the component, which is a significant length of the line, proposes to overtake and underbuild existing 138 kV circuits. The proposal highlights that it will utilize the existing 138 kV ROW in these areas. However, 345 kV ROW requirements will likely require expansion of existing ROW, which will be difficult based on the location of the 138 kV lines. This line is located within Erie, Lorain, Sandusky and Wood counties in Ohio.

Overall, the ROW risk is medium due to the complex utilization of existing ROW while widening the existing 138 kV corridors for the entire alignment of the proposed new line and rebuild projects.

Environmental Risk Analysis

Lemoyne-Lake Avenue 345 kV Line

A review of several environmental factors indicates that the construction of the project is feasible but may be a lengthy process due to necessary permits and potential access issues. Floodways and 100- and 500-year floodplains are present within the study area, which may impact the ease of access due to a need for permitting at the county and municipal level. Additionally, several navigable waters were mapped within the study area, which will require further review by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE). USACE permitting may take an extended period of up to 270 days. Wetlands will require further studies to determine location and necessary permitting. Individual 401 Water Quality Certifications (WQCs) may be required, as well as additional stormwater best management practices.

Multiple sensitive species were identified; the largest potential issues would come from the possible need for extensive bat and bald eagle surveys. The National Environmental Policy Act

of 1969 (NEPA) may be triggered with construction taking place on federal lands, as well as Federal Section 10 permitting if any rivers are affected by the project. The Ohio Certificate of Environmental Compatibility and Public Need will likely be required as well, which can take up to a year to process. However, no major issues are expected in getting permit approvals. A more detailed review for environmental hazards within the study area will determine if construction setbacks will be required. Avoidance or setbacks from structures such as interstates, major highways, railroads, petroleum pipelines, transmission lines and one aviation facility may be necessary. The proximity of the project to an aviation facility may trigger Form 7460-1 as well.

Transmission Line Risk Analysis

The brownfield portions of the component, which is a significant length of the line, proposes to overtake and underbuild existing 138 kV circuits. This will result in very large poles, and if a skip-span approach is not utilized, a significant number of poles. Overall, the complexity of the design and construction is far greater than comparable proposals in this area. Outage restraints could cause efforts to increase significantly or result in building adjacent to lines. It is also possible that the existing 138 kV configurations will not be able to be transferred to the new structures and will need to be rebuilt entirely.

For the rebuild line routes, there are some risks associated with existing ROW expansion and new ROW and land acquisition needed; the project is feasible with mixed challenges.

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.

Substation Risk Analysis

Proposal 843 includes two unique substation components as part of a larger three-component proposal, including work in in Northern Ohio. Summaries for the individual substation components are provided below:

Lemoyne Substation Expansion

Expand Lemoyne substation to accommodate the interconnection of the Lemoyne-Lake Avenue 345 kV line.

Lake Ave. Substation Expansion

Construct a new 345 kV breaker-and-a-half yard at or near Lake Avenue substation to accommodate the connection of the new Lemoyne-Lake Avenue 345 kV line.

The substation components of this proposal focus primarily on upgrading substations and substation equipment to achieve higher ratings. These types of upgrades are generally low risk. The primary substation component risk for this project is in the requirements for land acquisition at or near Lake Ave. 345 kV substation.

Constructability Summary

Similar to the assessment of other proposals in this cluster, long 345 kV lines that need additional ROW, even if its adjacent to existing ROW, can prove challenging. Medium overall constructability risk assessed.

Outage Review

There are approximately 90 miles connecting these two substations via 345 kV. About half of that stretch will be rebuilds of 138 kV facilities to incorporate multi-line towers, and the other half will parallel and expand existing FirstEnergy ROWs. The 138 kV outages, some of which on important paths, lead to a medium outage risk.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 33**.

Table 33. Proposal 843 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	Lemoyne-Lake Avenue 345 kV Line	455.04	428.28
2	Lemoyne Substation	0.00	17.04
3	Lake Avenue Substation	0.00	22.80
	Total	**455.04**	**468.12**

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 2029 is achievable for the proposed scope of the project, considering the permitting, engineering and construction and land acquisition risks associated with the greenfield portions. Overall, a medium schedule risk is assessed.

Proposing Entity Experience and Capability Review

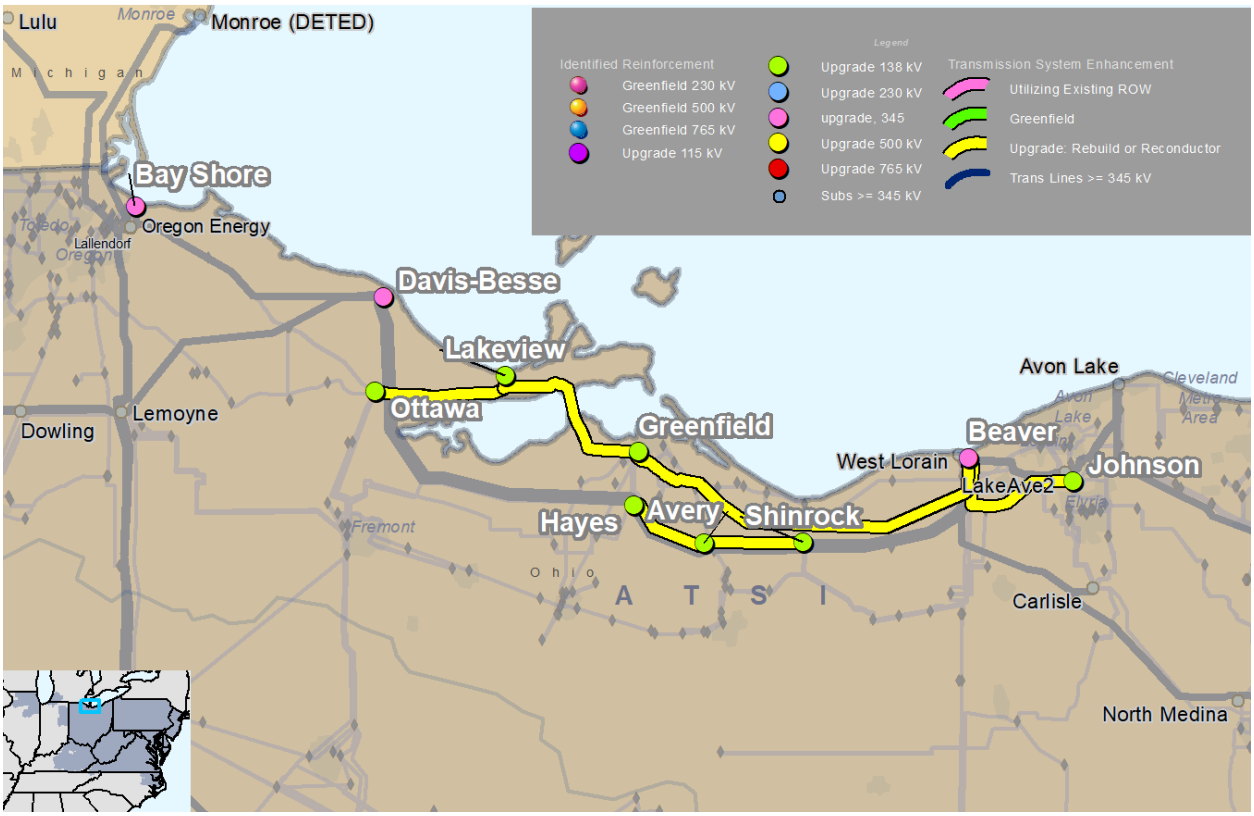
FirstEnergy has significant experience with the proposed equipment and the capabilities to construct Proposal 843 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 605 – ATSI (FirstEnergy)

First energy Proposal No. 605 (**Map 30**), described as ATSI 138 kV rebuild + substation terminal upgrades, involves a rebuild/reconductor of 10 138 kV lines in the ATSI transmission zone to resolve thermal overloads; and upgrade terminal equipment on the Beaver-Davis Besse 345 kV line at Bayshore substation, Davis Besse substation and Beaver substation. Reconfigure the 345 kV line terminals at Beaver substation.

First energy Proposal No. 605 has a total of nine components, including six transmission line upgrade components and three substation upgrades components. This project adds no new greenfield miles of EHV to the system.

Map 30. Proposal 605



*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

First Energy Proposal 605 includes the following components:

- Component 1: Beaver-Johnson 138 kV Line
- Component 2: Ottawa-Lakeview 138 kV Line
- Component 3: Greenfield-Lakeview 138 kV Line
- Component 4: Avery-Shinrock 138 kV Line
- Component 5: Avery-Hayes 138 kV Line
- Component 6: Greenfield-Beaver 138 kV Corridor
- Component 7: Beaver Substation 345 kV Terminal Re-Arrangement
- Component 8: Beaver-Davis Besse 345 kV Line Terminal Upgrades
- Component 9: Davis Besse-Bayshore 345 kV Line Terminal Upgrades

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Rebuild existing transmission line infrastructure approximately 81 miles.

Overall, the ROW risk for the transmission line components in this proposal is low, as all the line components are pure brownfield and within existing ROW, there no additional ROWs required.

Environmental Risk Analysis

No impact on environmental for this pure brownfield work, so the risk is low.

Transmission Line Risk Analysis

The risk is low due to the pure brownfield components.

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.

Constructability Summary

Rebuilding 138 kV facilities in their own ROWs carries low risk, and that's precisely how Proposal 605's overall constructability risk was assessed: low.

Outage Review

Rebuilding facilities requires them to be unavailable for significant periods of time. Medium outage risk assessed, accordingly.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 34**.

Table 34. Proposal 605 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates($M)
1	Beaver - Johnson 138 kV Line	28.80	38.04
2	Ottawa - Lakeview 138 kV Line	1.41	0.40
3	Greenfield - Lakeview 138 kV Line	59.69	40.35
4	Avery - Shinrock 138 kV Line	15.20	22.38
5	Avery - Hayes 138 kV Line	11.02	19.50
6	Greenfield - Beaver 138 kV Corridor	131.43	128.00
7	Beaver Substation 345 kV Terminal Re-Arrangement	10.39	10.39
8	Beaver - Davis Besse 345 kV Line Terminal Upgrades	4.74	4.74
9	Davis Besse - Bayshore 345 kV Line Terminal Upgrades	2.48	2.48
	Total	**265.16**	**266.27**

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 2029 is reasonable for the proposed scope of the project considering the permitting and land acquisition benefits associated with the proposed components. Overall, the schedule risk is considered low.

Proposing Entity Experience and Capability Review

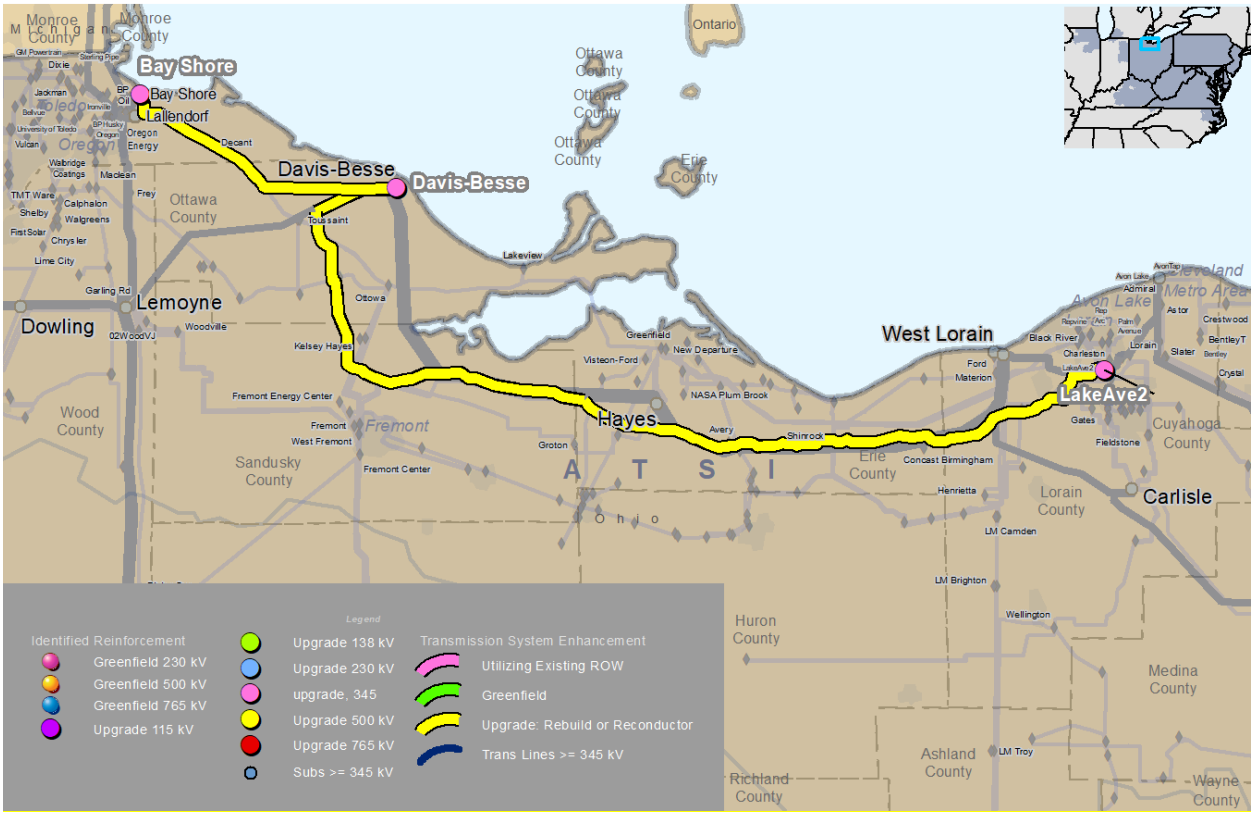
FirstEnergy has significant experience with the proposed equipment and the capabilities to construct Proposal 605 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 294 – NEETMH (NextEra)

NextEra Proposal No. 294 (**Map 31**), described as Bay Shore-Davis-Besse-Lake Ave, proposes to construct a new single circuit 345 kV line from Davis-Besse to Lake Ave. via a combination of brownfield and greenfield construction. Greenfield portion will be double circuit-capable towers, and brownfield portion is to install second circuit on open tower position along the existing Bayshore-Davis-Besse line. Existing Bayshore, Lake Ave. and Davis Besse substations are expanded to terminate new lines.

NextEra Proposal No. 294 has a total of six components, including three substation expansions, two transmission line upgrade components and one 76-mile 345 kV greenfield transmission line component.

Map 31. Proposal 294



*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 294 includes the following components:

- Component 1: Lake Ave. substation expansion
- Component 2: Bay Shore-Davis-Besse 345 kV line

- Component 3: Davis-Besse substation expansion
- Component 4: Bay Shore substation expansion
- Component 5: Davis-Besse to Lake Ave. (Brownfield portion)
- Component 6: Davis-Besse to Lake Ave. 345 kV (Greenfield portion)

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Davis-Besse to Lake Ave. 345 kV Line

Route departs from the existing Davis-Besse-Lemoyne 345 kV corridor north of the Toussaint substation. The route proceeds south until reaching the Ohio Turnpike, at which point it continues east toward Lake Ave. The route is a total of approximately 76.1 miles, and 38% of the route length is an expansion of the existing transmission line corridor and the remainder is greenfield ROW. This component would cross approximately eight railroads with Norfolk Southern Railroad and CSXT; approximately 24 transmission lines with AMERICAN TRANSMISSION SYSTEMS, INC., OHIO EDISON CO, of which 16 crossings owners are not available; approximately 17 pipelines with BUCKEYE PARTNERS, Columbia Gas Trans Co, East Ohio Gas Co, and NEXUS Gas Transmission; and approximately 98 roads/highways in Lorain County, Erie County, Sandusky County and Ottawa County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Ohio. State PUCO approval, DOT utility permits and driveway/local road permits are required. Proposing entity's land acquisition budget is significantly higher than cost estimate. Siting is backcountry (wooded and agricultural). The route does come in close proximity with some residential areas where there may be landowner opposition due to visual impacts.

Overall, the ROW risk is medium-high due to the mix of greenfield and brownfield; the majority of the risk is the greenfield portion if the Davis-Besse-Lake Ave. 345 kV line; specifically, it may be more complex as it nears the Lake Ave. sub as it's far more populated. ROW and land acquisition could prove difficult.

Environmental Risk Analysis

Davis-Besse to Lake Ave. 345 kV Line

The proposed component has the potential to impact environmental resources including FEMA floodplains, streams, and/or 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 & Endangered Species. Impacts to these resources will require coordination with the appropriate county floodplain administrator and coordination with state wildlife agencies, USACE and USFWS. Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the

route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. The proposed route intersects with one recorded underground storage tank (UST). A file review of state records to determine the current status of the UST is recommended. Based on the results of the review, a subsurface soil characterization investigation may be necessary to determine if contamination is present and the extent of contamination originating from UST. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. The proposed route intersects Natural Areas/Reserves/Wildlife Refuge. Coordination with the following agencies – Ottawa National Wildlife Refuge; Oak Harbor Cons. Wildlife Restoration Fisheries; Pickerel Creek Wildlife Area; Wetlands Reserve Program (WRP) – Ottawa, Ohio – is required.

Transmission Line Risk Analysis

The various components of the project do not pose any significant risks to successfully implementing the proposed work. Greenfield portions are subject to the typical risks associated with relevant landowners that protest the project moving forward, and this particular greenfield line does encounter some populated areas.

The stringing of additional circuits on the existing lines should not pose much risk beyond the potential for some towers to be overloaded. These towers were likely designed for double circuit, so that risk is low.

Substation Risk Analysis

Lake Ave. Substation Expansion

Expand the existing 345 kV yard to south by 193'x74' to accommodate one additional 345 kV double-bus double-breaker line position with two new breakers and associated equipment.

Davis-Besse Substation Expansion

Expand the existing 345 kV yard to south by 537'x64' to accommodate one additional 345 kV breaker-and-a-half string with a total of three new breakers and associated equipment. Rearrange the existing 345 kV line terminations for the two new 345 kV line cut-ins.

Bay Shore substation expansion

Add one 345 kV, 5000A 63 kAIC circuit breaker to the existing ring bus to accommodate the new 345 kV line termination.

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.

Constructability Summary

This 345 kV build proposes 76 miles of greenfield (much of it paralleled), six miles of brownfield, and 21 miles using FE existing towers. That mix, and detailed analysis of the specific ROWs, earned 294 a medium risk for overall constructability.

Outage Review

The use of existing towers and the estimated, associated outages required to do so lead to a medium outage risk assessment.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 35**.

Table 35. Proposal 294 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Lake Ave substation expansion	6.00	22.80
2	Bay Shore-Davis-Besse 345 kV line	10.50	12.96
3	Davis-Besse substation expansion	8.00	28.03
4	Bay Shore substation expansion	1.50	7.39
5	Davis-Besse to Lake Ave (Brownfield portion)	3.59	7.65
6	Davis-Besse to Lake Ave 345 kV (Greenfield portion)	227.72	290.43
	Total	**257.30**	**369.26**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

The proposed in-service date of June 2030 is reasonable for the included scope of the project, considering the permitting, engineering and construction and land acquisition risks associated with the greenfield portions. Overall, a medium schedule risk is assessed.

Proposing Entity Experience and Capability Review

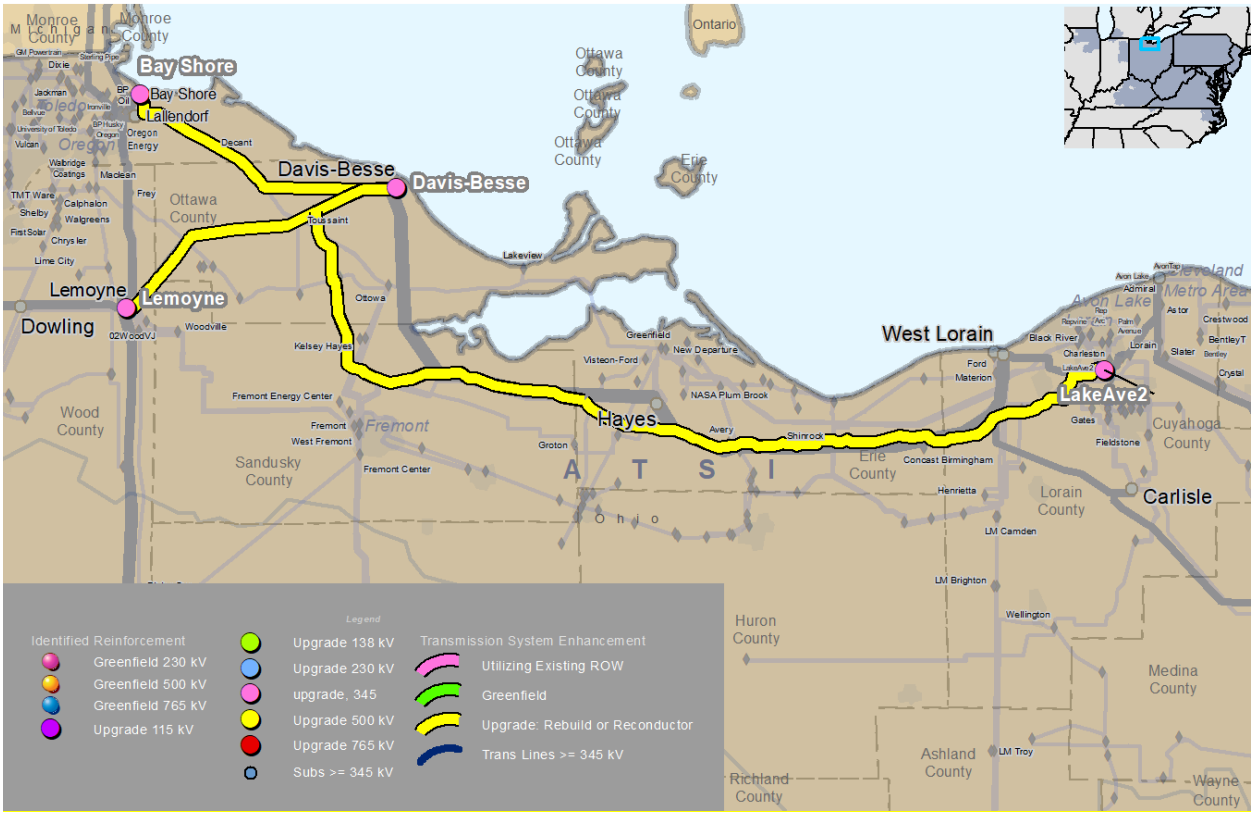
NextEra has significant experience with the proposed equipment and the capabilities to construct Proposal 294 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 357 – NEETMH (NextEra)

NextEra Proposal No. 357 (**Map 32**), described as Bay Shore-Davis-Besse-Lake Ave. + Lemoyne-Lake Ave. 345 kV, expands the four existing 345 kV substations (Bay Shore, Davis-Besse, Lemoyne and Lake Ave) to terminate the second circuit on existing open tower position along the existing Bayshore-Davis-Besse line, Davis-Besse to Lake Ave. 345 kV line and Lemoyne to Lake Ave. 345 kV line, which is combined with brownfield and greenfield portions. The greenfield portion will be on double circuit towers.

NextEra Proposal No. 357 has a total of eight components, including four substation upgrade components, one 70.1-mile greenfield transmission line component and three transmission line upgrade components.

Map 32. Proposal 357



*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 357 includes the following components:

- Component 1: Bay Shore substation expansion
- Component 2: Bay Shore-Davis-Besse 345 kV line

- Component 3: Davis-Besse substation expansion
- Component 4: Davis-Besse to Lake Ave. (Brownfield portion)
- Component 5: Lemoyne-Lake Ave. 345 kV (Brownfield portion)
- Component 6: Lemoyne substation expansion
- Component 7: Davis-Besse to Lake Ave. and Lemoyne to Lake Ave. 345 kV double circuit (Greenfield portion)
- Component 8: Lake Ave. substation expansion

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Davis-Besse to Lake Ave. and Lemoyne to Lake Ave. (Greenfield Portion) 345 kV Double Circuit

This component would cross approximately eight railroads with Norfolk Southern Railroad and CSXT; approximately 22 transmission lines with AMERICAN TRANSMISSION SYSTEMS, INC., OHIO EDISON CO, of which 15 crossings owners are not available; approximately 17 pipelines with BUCKEYE PARTNERS, Columbia Gas Trans Co, East Ohio Gas Co, and NEXUS Gas Transmission; and approximately 92 roads/highways in Lorain County, Erie County, Sandusky County and Ottawa County. It is anticipated that the proposal could require permits, consultations, clearances and authorizations from four counties in Ohio. State PUCO approval, DOT utility permits and driveway/local road permits are required. Proposing entity's land acquisition budget is significantly higher than cost estimate. Siting is backcountry (wooded and agricultural). The route does come in close proximity with some residential areas where there may be landowner opposition due to visual impacts.

Overall, the ROW risk is medium-high due to the mixed of greenfield and brownfield; the majority of the risk is the greenfield portion if the Davis-Besse-Lake Ave. 345 kV line, as it may be more complex as it nears the Lake Ave. sub where it's far more populated. ROW and land acquisition could be difficult.

Environmental Risk Analysis

Davis-Besse to Lake Ave. and Lemoyne to Lake Ave. (Greenfield Portion) 345 kV Double Circuit

The proposed component has the potential to impact environmental resources including streams, lakes and/or wetlands subject to USACE Section 404 and/or Section 10 permitting. Proposed route intersects 40 FEMA high-risk flood zones (100-year floodplain). Coordination with the floodplain administrator from the following Ohio jurisdictions will be required: Wood, Sandusky, Erie, Lorain and Ottawa. In addition, the proposed component intersects woodlands with the potential to serve as suitable habitat for federally listed Threatened & Endangered

Species and/or birds protected by the Migratory Bird Treaty Act (MBTA). Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. The proposed route intersects Natural Areas/Reserves/Wildlife Refuge(s): Ottawa National Wildlife Refuge and Pickerel Creek Wildlife Area. Coordination with the following agency – Ohio Department of Natural Resources – is required.

Transmission Line Risk Analysis

The various components of the project do not pose any significant risks to successfully implementing the proposed work. Greenfield portions are subject to the typical risks associated with relevant landowners that protest the project moving forward, and this particular greenfield line does encounter some populated areas. As a double circuit line, component 3S-4 will require taller structures that may face increased opposition.

The stringing of additional circuits on the existing lines should not pose much risk beyond the potential for some towers to be overloaded. These towers were likely designed for double circuit so that risk is low.

Substation Risk Analysis

Bay Shore Substation Expansion

Expand the existing 345 kV ring by adding an additional circuit breaker and line position. (Add one 345 kV, 5000A 63 kAIC circuit breaker to the existing ring bus configuration.)

Davis-Besse Substation Expansion

Expand the existing Davis Besse 345 kV yard by adding one 345 kV bay and two line positions. (Add three new 345 kV, 5000A 63 kAIC circuit breakers and one BAAH bay.)

Lemoyne Substation Expansion

Install one new 345 kV circuit breaker to create a position to terminate the new Lemoyne-Lake Ave. 345 kV line. (Add one 345 kV, 5000A 63 kAIC circuit breaker to the existing ring configuration. Relocate one existing 345 kV circuit breaker to complete the ring.)

Lake Ave. Substation Expansion

Expand the existing Lake Ave. 345 kV yard by adding two 345 kV BAAH bays and four line positions. (Add six new 345 kV, 5000A 63 kAIC circuit breakers.)

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.

Constructability Summary

Proposal 357 combines the ideas and connecting terminals of 294 and 533 in a very efficient fashion, optimizing shared space wherever possible. The ROW breakdown does still turn out to be a mix of paralleling, expansion and greenfield, which yields the medium risk in overall constructability when combined with the project's mileage.

Outage Review

The use of existing towers and the estimated, associated outages required to do so leads to a medium outage risk assessment.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 36**.

Table 36. Proposal 357 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Bay Shore substation expansion	1.50	7.39
2	Bay Shore-Davis-Besse 345 kV line	10.50	12.96
3	Davis-Besse substation expansion	8.00	28.03
4	Davis-Besse to Lake Ave (Brownfield portion)	3.59	7.65
5	Lemoyne-Lake Ave 345 kV (Brownfield portion)	8.10	9.54
6	Lemoyne substation expansion	1.50	17.04
7	Davis-Besse to Lake Ave and Lemoyne to Lake Ave 345 kV double circuit (Greenfield portion)	302.93	332.13
8	Lake Ave substation expansion	8.00	37.20
	Total	**344.12**	**451.94**

The total proposal cost estimate is within 21–30% of the independent cost estimate and is considered medium risk.

Schedule Review

The proposed in-service date of June 2030 is reasonable for the included scope of the project, considering the permitting, engineering and construction and land acquisition risks associated with the greenfield portions. Overall, a medium schedule risk is assessed.

Proposing Entity Experience and Capability Review

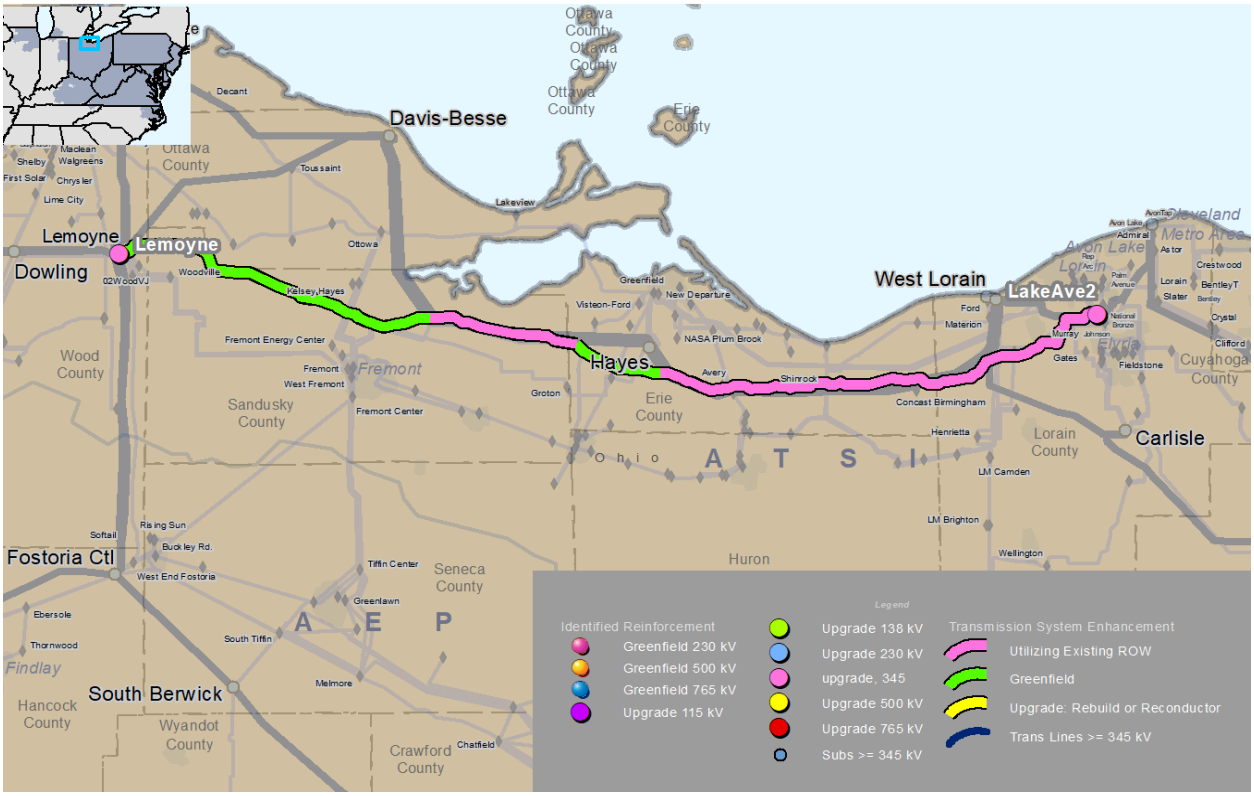
NextEra has significant experience with the proposed equipment and the capabilities to construct Proposal 357 as submitted. The proposing entity experience and capability risk is considered low.

Proposal 533 – NEETMH (NextEra)

NextEra Proposal No. 553 (**Map 33**), described as Lemoyne-Lake Ave. 345 kV, includes constructing a 76-mile, single circuit 345 kV line from ATSI's Lemoyne substation to Lake Ave. substation, installing one new 345 kV breaker at Lemoyne substation to terminate a new line, and adding a new bay at Lake Ave. substation to terminate new line.

NextEra Proposal No. 553 has a total of three components, which include two substation upgrade components and one 76-mile greenfield transmission line component.

Map 33. Proposal 533



*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 533 includes the following components for the Ohio solution:

- Component 1: Lemoyne-Lake Ave. 345 kV line
- Component 2: Lemoyne substation expansion
- Component 3: Lake Ave. substation expansion

Constructability Review

Right-of-Way/Land Usage Risk Analysis

Lemoyne-Lake Ave. 345 kV Line

The route runs east-west between the existing Lemoyne and Lake Ave. substations, located adjacent to the Ohio Turnpike and existing transmission corridors to the maximum extent practicable. This component will cross approximately six railway crossings with Conrail Railroad, Norfolk and Western Railroad and Baltimore and Ohio Railroad; approximately 99 roads and highways in Lorain, Ottawa, Sandusky, Erie and Wood counties; approximately 36 transmission lines owned by unknown entity, Ohio Power Co, CONSUMERS ENERGY CO, AMERICAN TRANSMISSION SYSTEMS, INC. and OHIO EDISON CO. It is anticipated that the proposal requires permits, consultations, clearances and authorizations from five counties in Ohio. State approval of electric transmission lines and DOT utility permits are required. Proposing entity's land acquisition budget is significantly higher than cost estimate. Siting is backcountry (wooded and agricultural). The route does come in close proximity with some residential areas where there may be landowner opposition due to visual impacts.

Overall ROW risk is medium-high due to the entire line route is greenfield; specifically, ROW acquisition may be difficult as it passes through populated area near Lake Ave. sub, and public opposition in this area may impose some challenges.

Environmental Risk Analysis

Lemoyne-Lake Ave. 345 kV Line

The proposed component has the potential to impact environmental resources including streams, lakes and/or wetlands subject to USACE Section 404 and/or Section 10 permitting. Proposed route intersects 39 FEMA high-risk flood zones (100-year floodplain). Coordination with the floodplain administrator from the following Ohio jurisdictions will be required: Wood, Sandusky, Erie, Lorain and Ottawa. In addition, the proposed component intersects woodlands with the potential to serve as suitable habitat for federally listed Threatened & Endangered Species and/or birds protected by the Migratory Bird Treaty Act (MBTA). Proposed route does not intersect designated critical habitat. However, there are federally listed endangered/threatened species with the potential to occur within the route corridor. Consultation with USFWS and state wildlife agency is needed to determine if the proposed project will have effects on protected species. The proposed route intersects with one recorded underground storage tank (UST). A file review of state records to determine the current status of the UST is recommended. Based on the results of the review, a subsurface soil characterization investigation may be necessary to determine if contamination is present and the extent of contamination originating from UST. The proposed route intersects Karst zones. Geotechnical studies are needed to verify subsurface conditions before digging and/or trenching. The proposed route intersects Natural Areas/Reserves/Wildlife Refuge(s): Ottawa National Wildlife

Refuge and Pickerel Creek Wildlife Area. Coordination with the following agencies – Ohio Department of Natural Resources – is required.

Transmission Line Risk Analysis

Lemoyne-Lake Ave. 345 kV line: A 76.1-mile 345 kV greenfield line

The component is feasible from a design and schedule perspective with most of the risk being standard risks associated with any greenfield EHV line. The 345 kV line does encounter some populated areas, and relevant landowners protesting for the project may impose a risk.

Overall, the component of this project does not pose any significant risks to successfully implementing the proposed work. Design and construction should be relatively routine given the terrain and density of most of the route.

Substation Risk Analysis

Proposal 533 includes two unique substation components as part of a larger three-component proposal, including work in in Northern Ohio. Summaries for the individual substation components are provided below:

Lemoyne Substation Expansion

Install one new 345 kV circuit breaker to create position to terminate new Lemoyne-Lake Ave. 345 kV line. (Add one 345 kV, 5000A 63 kAIC circuit breaker to the existing ring configuration.) Relocate one existing 345 kV breaker to complete ring.

Lake Ave. Substation Expansion

Expand the existing Lake Ave. 345 kV yard by adding one 345 kV bay and one line position. (Add two new 345 kV, 5000A and 63 kAIC circuit breakers.)

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.

Constructability Summary

Proposal 533 has similarities to 843 due to its terminal locations, but it does have to follow a different route. The non-incumbent proposer utilizes a ROW where over 40% will run parallel and expand existing ROW, and the remainder will be greenfield. That mix, at this length, leads to a medium overall constructability risk.

Outage Review

No significant outage risks were identified as a part of this proposal.

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. Additionally, where available, incumbent substation upgrade cost estimates were requested and incorporated into the independent cost estimate. 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 is contained in **Table 37**.

Table 37. Proposal 533 Cost Review

Component ID	Component Description	Proposal Cost Estimates ($M)	Independent Cost Estimates ($M)
1	Lemoyne-Lake Ave 345 kV line	194.58	304.32
2	Lemoyne substation expansion	1.50	17.04
3	Lake Ave substation expansion	6.00	22.80
	Total	**202.08**	**344.16**

The total proposal cost estimate is less than 41% of the independent cost estimate and is considered high risk.

Schedule Review

NextEra proposal No.533 includes an in-service date of June 2030. The overall schedule is reasonable for the proposed scope, including siting and ROW acquisition for the 345 kV greenfield line. The schedule risk is considered medium.

Proposing Entity Experience and Capability Review

NextEra has significant experience with the proposed equipment and the capabilities to construct Proposal 533 as submitted. The proposing entity experience and capability risk is considered low.

FINANCIAL ANALYSIS

Approach

Altogether, PJM received 94 proposals submitted by 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 was 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. PJM provided the consultant with a list of 26 selected proposals, some of which were sub-proposals as part of larger joint proposals. The proposals are categorized as either a Regional Cluster solution or an Ohio Cluster solution. Twenty of the 26 proposals were regional, with the remaining six proposals categorized as ATSI zone proposals. 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 [Capital Expenditure] 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 Workbooks – 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, was 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 have 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 PVRR 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** – Constructability Matrices of this report.

Cost Containment

Proposal Cost Containment Overview

The cost containment mechanisms for each proposal are defined by developer and are summarized in **Table 38** below:

Table 38. Overview of Cost Containment by Developer

Cap Type	NextEra (Regional)	NextEra (ATSI Zone)	LS Power	Dominion	Transource	FirstEnergy (Regional)	FirstEnergy (ATSI Zone)
Soft (Hybrid) Cost Cap[1]	✓	✓	✓	✓	✓	✓	No Cost Containment
True Cost Cap							
Revenue Requirement Cap							
ROE Cap (inclusive of adders)			✓				
Equity % Cap	✓[2]	✓	✓				
Schedule Guarantee							
O&M Cap							

s exclude AFUDC.

[2] NextEra's equity cap is only applicable to the in-service period.

Cap Excludes	Land & some components	Land costs[3]		All but E&D costs	All but E&D costs	All but E&D costs	
Modeling Cost Cap?	Yes	Yes	Yes	Yes	Yes	Yes	

Most of the 26 modeled proposals included some form of cost containment, except ATSI zone proposals 843 and 605, submitted by FirstEnergy. LS Power and NextEra provided a cap on Equity %, and LS Power capped ROE.

Detailed Cost Containment Review

Transource

Transource submitted four Regional proposals (665, 820, 286, 300) included in the Regional Cluster joint portfolios and one Ohio Cluster joint proposal (694).

Transource provided a hybrid cost cap, which only applies to E&D (Engineering & Design) costs. Each proposal's cap is set at the forecasted value for proposer E&D costs. For any proposer E&D costs that exceed their original cost estimate, the ROE earned on that incremental capital excludes the 50-basis-point RTO adder; i.e., ROE is reduced from 10% to 9.5% accordingly. Transource would still recover all depreciation expense and debt costs associated with the incremental capital spend. This cost containment offering was consistent across all Transource's Regional and Ohio Cluster proposals.

It should be noted that E&D costs make up a small portion of Transource's total costs and are exceeded by contingency costs. As such, even when capital costs are doubled, all E&D cost overages are simply "absorbed" by the contingency. As a result, there are no E&D cost overages left over on which to apply a reduced ROE. For this reason, Transource's hybrid cost cap is not triggered in any of the modeled sensitivities.

Dominion

Dominion (VEPCO) provided one proposal (967) as part of four of the regional joint proposals.

Dominion also provided a hybrid cost cap, which only applies to proposer E&D costs. Each proposal's cap is set at the forecasted value for E&D costs. For any E&D costs that exceed their original cost estimate, the ROE earned on that incremental capital excludes the 50-basis-point RTO adder and is reduced from 11.4% to 10.9% accordingly. Dominion would still recover all depreciation expense and debt costs associated with the incremental capital spend.

[3] NextEra Ohio Cluster proposals offer two separate hybrid cost caps: one for land costs (caps ROE on excess costs at 9.8%) and one for non-land costs (caps ROE on excess costs at 8.25%). The land cost cap was not modeled, due to immaterial impact.

Like Transource, Dominion's E&D costs make up a small portion of their total costs and are exceeded by contingency costs. As such, even when capital costs are increased by the maximum amount of 100% in the CapEx +100% and downside sensitivities, all E&D cost overages are absorbed by the contingency. As a result, there are no E&D cost overages left over on which to apply a reduced ROE. For this reason, Dominion's hybrid cost cap is also not triggered in any of the modeled sensitivities.

FirstEnergy

Two subsidiaries of FirstEnergy, TRAIL and ATSI, submitted proposals in this window.

FirstEnergy's TRAIL submitted four Regional proposals (708, 883, 907 and 977), three as part of the proposed joint portfolios and one as a standalone proposal (907). For all four proposals, TRAIL provided a hybrid cost cap, which only applies to E&D costs. Each proposal's cap is set at the forecasted value for E&D costs. For any E&D costs that exceed their original cost estimate, the ROE earned on that incremental capital excludes the 50-basis-point RTO adder and is reduced from 10.45% to 9.95% accordingly. FirstEnergy TRAIL would still recover all depreciation expense and debt costs associated with the incremental capital spend.

TRAIL's E&D costs make up a small portion of their total costs but are not exceeded by contingency costs. As such, when capital costs are increased by the maximum amount of 100% in the CapEx +100% and downside sensitivities, not all E&D cost overages are "absorbed" by the contingency. As a result, there are some E&D cost overages left over on which to apply a reduced ROE, albeit an exceedingly small amount.

FirstEnergy's ATSI (proposer) submitted two Ohio Cluster proposals (843 and 605). These proposals offered no cost containment.

LS Power

LS Power (CNTLTM) offered eight regional standalone proposals (78, 124, 317, 506, 622, 839, 898, 904).

LS Power provided a binding ROE cap of 10.3%, a binding equity percentage cap of 50%, and a hybrid cost cap for all its proposals. In its hybrid cost cap, for any capital expenditures that exceed their original cost estimate, LS Power will reduce its ROE on that incremental capital based on the amount of the exceedance. The ROE LS Power will request on incremental capital spend above the original cost estimate is reduced from 10% according to the tiers listed below:

- For capital cost overages of up to 25%, LS Power's ROE on the incremental capital spend would be 9%.
- For capital cost overages above 25% up to and including 50%, LS Power's ROE on the incremental capital spend would be 7.5%.

- For capital cost overages above 50%, LS Power's ROE on the incremental capital spend would be 6%.

In all cases, LS Power would still recover all depreciation expense and debt costs associated with the incremental capital spend.

NextEra

NextEra submitted three Regional proposals (146, 768 and 992) and three Ohio Cluster proposals (294, 357 and 533).

For its Regional proposals, NextEra provided a binding equity percentage cap of 50% and a hybrid cost cap, which excludes ROW and land acquisition costs, as well as certain project component costs.

In Regional proposal hybrid cost caps, NextEra will request an ROE percentage reduced from the base ROE of 10% according to the tiers listed below on incremental capital spend above the original cost estimate:

- For capital cost overages of up to 50%, NextEra's ROE on the incremental capital spend would be 8.8%.
- For capital cost overages above 50%, NextEra's ROE on the incremental capital spend would be 6%.

In both cases, NextEra would still recover all depreciation expense and debt costs associated with the incremental capital spend.

For its Ohio Cluster proposals, NextEra provided a binding equity percentage cap of 50% that excludes return on CWIP, a hybrid cost cap exclusive of ROW and land acquisition costs, and a land cost cap. For its hybrid cost cap on its ATSI zone proposals, the ROE NextEra will request on incremental capital spend above the original cost estimate is decreased from the base ROE of 10% to 8.25%. Again, NextEra would still recover all depreciation expense and debt costs associated with the incremental capital spend. For its land cost cap, NextEra will request an ROE of 9.8% on any land costs that exceed the original land cost estimate. As a modeling simplification, NextEra's land cost cap was not modeled due to its relatively immaterial impact. The land cost cap reduces ROE on land cost overages from 10% to 9.8%, which is only a 20 basis point reduction on incremental spend on land. For all of NextEra's proposals, uncapped costs have a base ROE of 10.1% as opposed to the base ROE of 10% on capped costs.

Note that all six NextEra proposals include substantial ongoing CapEx values, which are not covered by their cost containment measures but are included in the consultant's revenue requirement modeling and sensitivities.

Cost Containment Observations

As shown in the above section, developers submitted varying levels of cost containment.

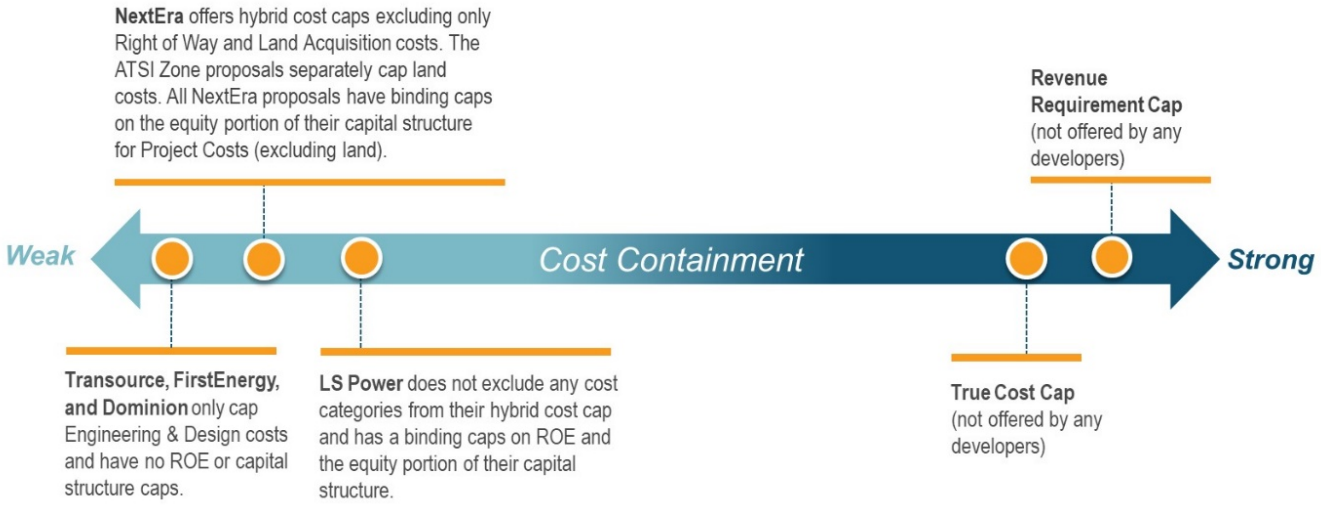
All eight LS Power proposals provide an ROE cap of 10.3% and an equity percentage cap of 50%. All six NextEra proposals also provide a 50% equity percentage cap. All 24 proposals offering cost containment provide a hybrid cost cap. Neither of FirstEnergy's ATSI zone proposals (843 and 605) offer any cost containment.

It is important to differentiate between a "true" cost cap and a "hybrid" cost cap. A true cost cap prevents the developer from requesting recovery in rates for depreciation expense, cost of debt or return on equity associated with incremental CapEx spent above the cost cap.

In contrast, a soft (hybrid) cost cap is one that allows the developer to recover depreciation expenses and cost of debt associated with incremental costs above the cost cap, while only the return on equity on the incremental CapEx is reduced. This is a significantly less effective cost cap. This is demonstrated in the Results and Key Observations section of this Financial Analysis portion of this overall report.

None of the proposers offer particularly strong cost containment, given the weakness of the soft (hybrid) cap. LS Power, combining a capped ROE, capped equity percentage and a hybrid cost cap on all expense types, and has the strongest containment package, followed by NextEra with an equity percentage cap and a hybrid cost cap that excludes only ROW and land acquisition. The other proposals are a distant third, with no containment other than a hybrid cap on only engineering and design costs. It is important to understand that while LS Power and NextEra's cost containment may be stronger than other proposers, all proposers offer weak cost containment that will not be very effective in protecting PJM customers from cost increases as illustrated in **Figure 1** below.

Figure 1. Cost Containment Observations by Developer



PJM's consultant also examined the conditions under which costs would be excluded from the hybrid cost caps, including force majeure, changes in laws or regulations, and other conditions beyond the control of the developer. The consultant found those exceptions to be generally reasonable and without significant differences among the proposers.

Proposers provided all cost data in real 2024 dollars, so actual cost caps ultimately need to be escalated to nominal costs at the in-service date. LS Power offered a specific methodology for such escalation using the Handy-Whitman Index. NextEra did not specify its cost cap escalation methodology, and the other proposers cite a 3% escalation for inflation. These different escalation methodologies can have an impact on caps that are otherwise equivalently expressed in 2024 dollars.

Finally, contingency (discussed in more detail in the following report section) has an impact on the implementation of the cost caps. In revenue requirement modeling, when testing the impact of potential cost increases, it is assumed that any contingency contained in the cost estimate "is used first" before the total cost increases. As a result, proposals with larger percentage contingencies see a larger proportion of the modeled cost increases absorbed before the cost cap levels are reached. As the next report section points out, LS Power contingency percentages are the highest, followed by NextEra and the other proposers.

Modeling Approach & Assumptions

Modeling Approach

To evaluate a proposal's lifetime cost to ratepayers, the consultant computed 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, and tax expenses and earn a fair return on its capital investments.[4] 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. The 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, the 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.

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

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.

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, the consultant applied several standardizing assumptions, summarized in **Table 39**, to ensure a fair comparison of present value outcomes:

Table 39. Baseline Model Assumptions

Discount Rate	6.81%
Inflation Rate	2.10%[5]
Earliest Capital Spend Start Date	1/1/2025
Date Used for Discounting	1/1/2025

The consultant escalated all dollar values provided by developers in 2024 to nominal using a 2.1% annual inflation rate.

Modeling Period Assumptions

Any CapEx submitted the year after the in-service date was moved to the final year of construction unless it was explicitly entered as ongoing CapEx. Additionally, O&M was not modeled until a project is placed in service.

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, the 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).

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

CapEx, Depreciation & Tax Assumptions

CapEx

Capital costs are collected from Attachment 7 submittals, which provides a year-by-year spend schedule broken down by cost element (engineering & design, materials and equipment, etc.).

The associated financing costs of construction are modeled using either return on Construction Work In Progress (CWIP) or Allowance for Funds Used During Construction (AFUDC) for each proposal. Both returns on CWIP and AFUDC are calculated using the developer-specific after-tax Weighted Average Cost of Capital (WACC). If a developer does not specify collecting a return on CWIP versus AFUDC, the 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 and adjusted for any non-depreciable plant (land) or net salvage value if provided by the developer.

Tax Depreciation

Each project uses the 15-Year Modified Accelerated Cost Recovery System (MACRS) mid-year convention schedule for tax depreciation. Some proposals with fourth-quarter Commercial Operation Dates (CODs) were required to use the Mid-Quarter 4 convention; others requested Mid-Quarter 2, and others assumed the half-year convention.

Working Capital Assumption

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 an industry-standard value.

Income Tax

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

O&M and Property Tax

O&M and property tax values were provided by developers. In instances where the developer provided or stated a relationship between capital expenditure/rate base and O&M/property tax, the consultant used this relationship to recalibrate O&M and property tax to align with the consultant-modified nominal capital expenditure values.

Deferred Taxes

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

Contingency

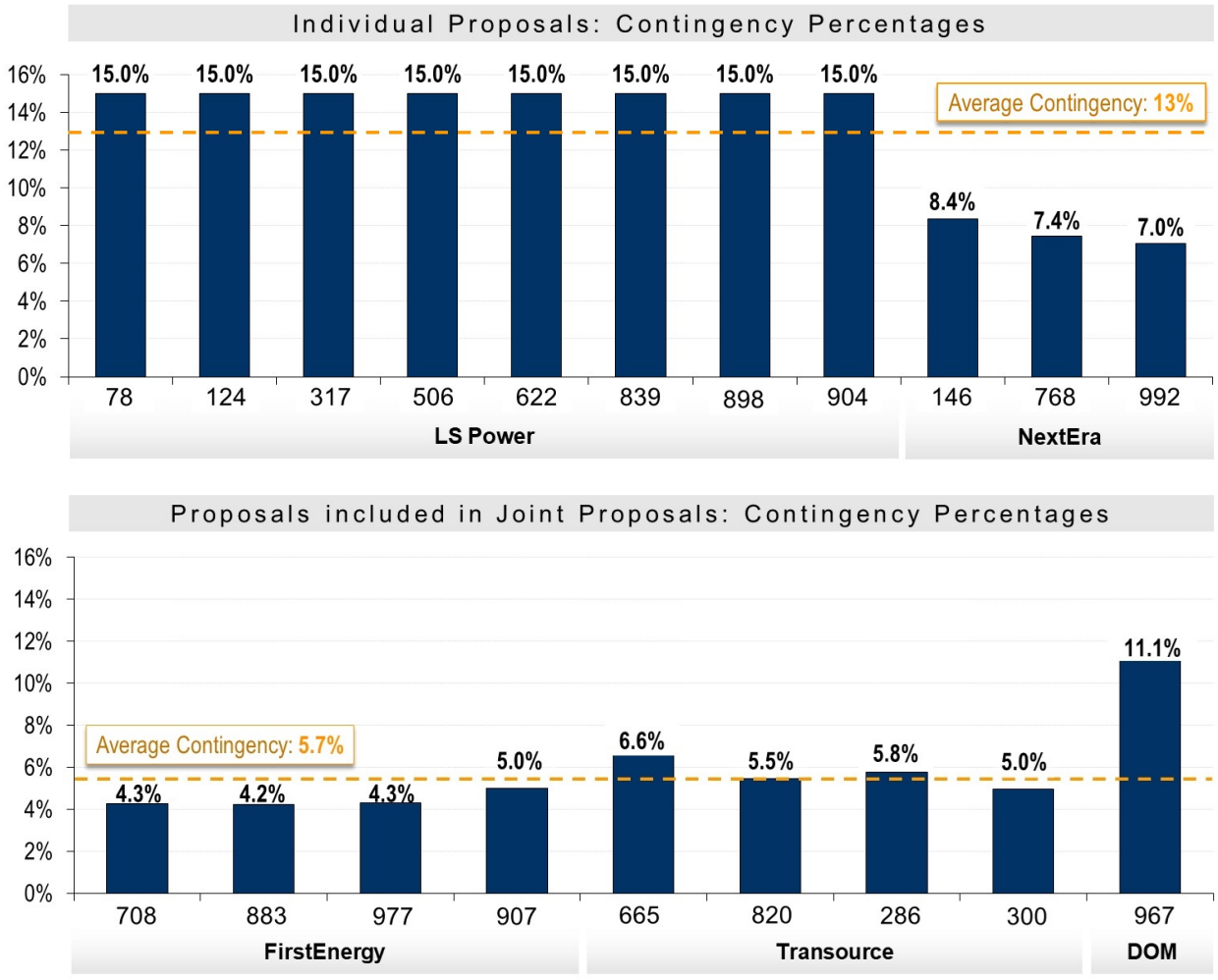
All proposers provided some level of contingency in their cost estimates. The Revenue Requirement Model provides a vehicle to compare the revenue requirement resulting from the various proposals' submitted contingency costs. The consultant did not choose to standardize contingency because of a belief that each proposer strategically developed its own level of contingency. 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. **Figure 2** below provides a comparison of regional project contingency levels by proposer. **Figure 3** does the same for ATSI zone proposals. All displayed 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 (henceforth contingency percentage), excluding WBO, ranges from 2.5–15%. The average contingency percentage for the regional and ATSI proposals is 13% and 5.7%, respectively; however, there is significant variation.

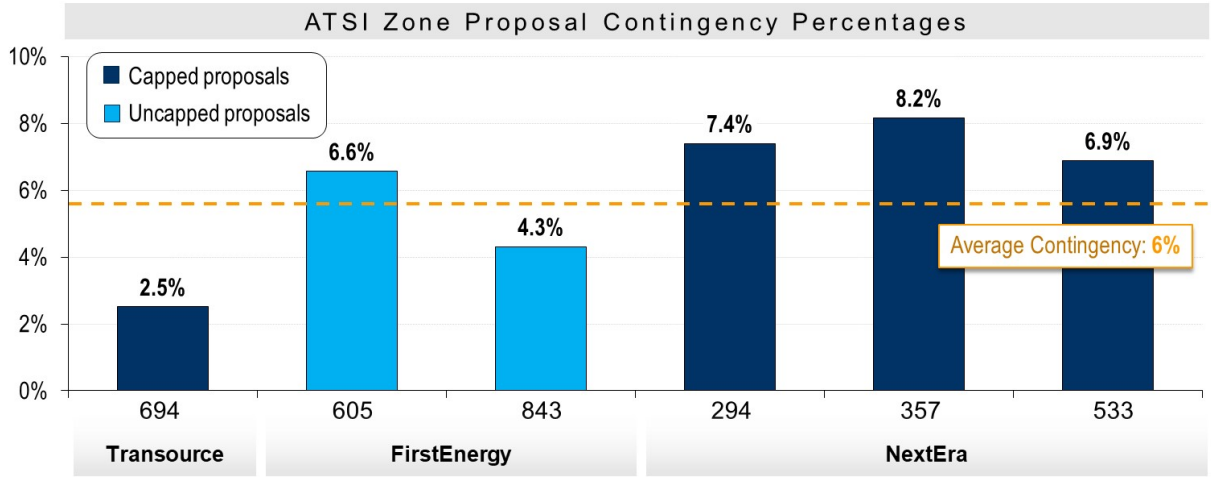
FirstEnergy proposals have an average contingency percentage of 4.5%, which is the lowest among proposers offering contingency estimates. Transource proposal contingencies range from 2.5% (ATSI zone proposals) to 6.6%, LS Power has a 15% contingency percentage for all projects, NextEra proposal contingency percentages range from 6.9% to 8.4%, and the Dominion proposal has a contingency percentage of 11.1%. The graphics below show detailed contingency percentage for proposer cost contained proposals.

Figure 2. Regional Cluster Proposal Contingencies



The Ohio Cluster proposals, including the only proposals that did not offer cost containment (FirstEnergy's proposals 605 and 843, which contingency percentages of 6.6% and 4.3%) are shown below.

Figure 3. Ohio Cluster Proposal Contingencies



For model sensitivities where capital cost increases, contingency is removed from capital cost prior to the 150% or 200% multiplier being applied (See Model Sensitivities section). This is because the consultant assumes that the contingency will be used to absorb project cost increases before the total cost increases. Once the contingency is fully exhausted, the sensitivity will increase the project cost accordingly, subject to cost containment.

Model Sensitivities

Eight sensitivities, summarized in **Table 40**, 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 40. 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)*

#	Sensitivity	Variable	Description
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)*
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

PVRR Comparative Analysis (Sensitivities)

This section will show all proposal modeling results within the same data set, presented both in the base case and for each sensitivity. This allows for comparative analysis when applicable.

Regional Proposals: Base Case PVRR Comparison

Figure 4 compares the base case costs of all regional proposals, grouped by proposer.

Figure 4. Regional Proposals: Base Case PVRR Comparison

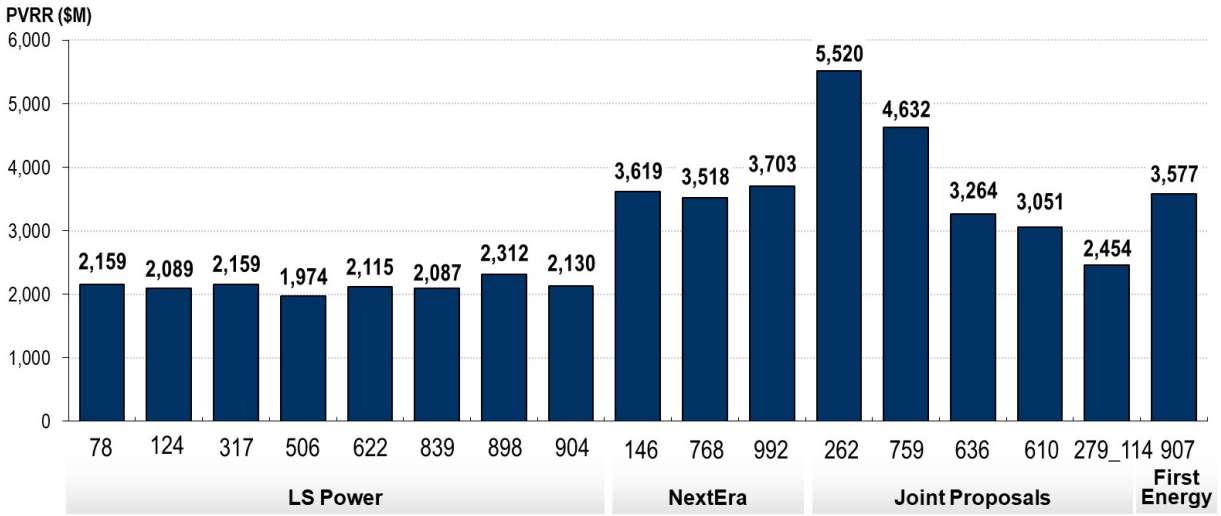
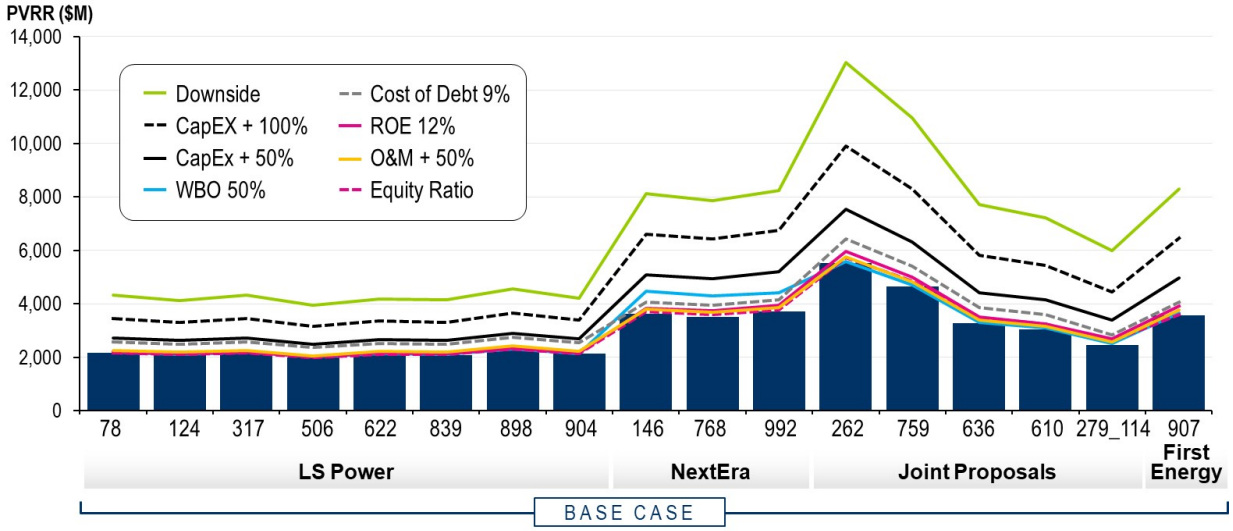


Figure 4 allows for comparison between baseline project costs, because the projects are not analogous (the PVRR modeled values are not complete representations of the combinations of proposals intended by the developers, but only a subset of proposals selected for the detailed financial analysis). Comparisons between projects are more meaningful when viewed in percentage difference from base case that will be provided in the **Figure 5** and **Figure 6**.

Figure 5 displays how proposal costs increase relative to base case values.

Figure 5. Regional Proposals Results: All Sensitivity PVRR Comparison



Finally, **Table 41** also shows how proposal costs increase relative to the base case across modeled sensitivities as a percent increase. For example, in the downside sensitivity, LS Power Proposal 78's costs double relative to the base case.

Table 41. Regional Proposals: All Sensitivities (Comparison to Base Case)

		PVRR vs. Base Case (%)								
Sensitivity:		**S 1**	**S 2**	**S 3**	**S 4**	**S 5**	**S 6**	**S 7**	**S 8**	**S 9**
Proposal #:		**Base Case**	**WBO 50%**	**CapEx +50%**	**CapEx +100%**	**ROE 12%**	**Cost of Debt 9%**	**Equity Ratio 60%**	**O&M +50%**	**Downside**
LS Power	**78**	0%	1%	26%	59%	2%	19%	0%	4%	100%
	124	0%	0%	25%	58%	2%	19%	0%	5%	97%
	317	0%	1%	26%	59%	2%	19%	0%	4%	100%
	506	0%	2%	26%	60%	2%	19%	0%	4%	100%
	622	0%	0%	26%	59%	2%	19%	0%	4%	98%
	839	0%	1%	26%	59%	2%	19%	0%	5%	98%
	898	0%	0%	26%	58%	2%	19%	0%	5%	98%
	904	0%	0%	26%	59%	2%	19%	0%	4%	98%
NextEra	**146**	0%	24%	41%	83%	6%	12%	3%	5%	124%
	768	0%	22%	41%	82%	6%	12%	2%	5%	124%
	992	0%	20%	41%	82%	6%	12%	2%	4%	123%

		PVRR vs. Base Case (%)								
Sensitivity:		**S 1**	**S 2**	**S 3**	**S 4**	**S 5**	**S 6**	**S 7**	**S 8**	**S 9**
Proposal #:		**Base Case**	**WBO 50%**	**CapEx +50%**	**CapEx +100%**	**ROE 12%**	**Cost of Debt 9%**	**Equity Ratio 60%**	**O&M +50%**	**Downside**
Joint Proposals	**262**	0%	1%	37%	79%	8%	17%	4%	5%	136%
	759	0%	2%	36%	79%	8%	17%	4%	4%	136%
	636	0%	1%	35%	78%	7%	18%	6%	4%	136%
	610	0%	2%	36%	78%	7%	18%	6%	4%	137%
	279_114	0%	3%	38%	81%	10%	16%	6%	5%	144%
First Energy	**907**	0%	2%	39%	81%	9%	14%	0%	6%	132%

What these relative comparisons show is that the joint proposals are the most volatile, within which Proposal 279/114 is impacted the most, across all sensitivities. For example, in the downside sensitivity, Joint Proposal 279/114's costs increased by 144%. This is contrasted with the least volatile proposal, LS Power Proposal 124, in which costs increased in the downside sensitivity by 97%.

The joint proposals by Dominion-FirstEnergy-Transource offer the weakest cost containment compared to other proposing entities. These joint proposals have the lowest contingency values, providing a smaller amount of reserves to absorb capital cost increases. They also offer no ROE or capital structure caps, exposing customers to cost of capital increases, and exclude all but E&D costs from their hybrid cost cap.

The NextEra proposals have similarly high divergence values from the base case, driven by modest contingency values, a hybrid cost cap and a 50% equity cap on a majority of capital costs. Regional NextEra proposals all have a substantial amount of WBO CapEx (46% to 56% of total CapEx), which impacts sensitivity performance.

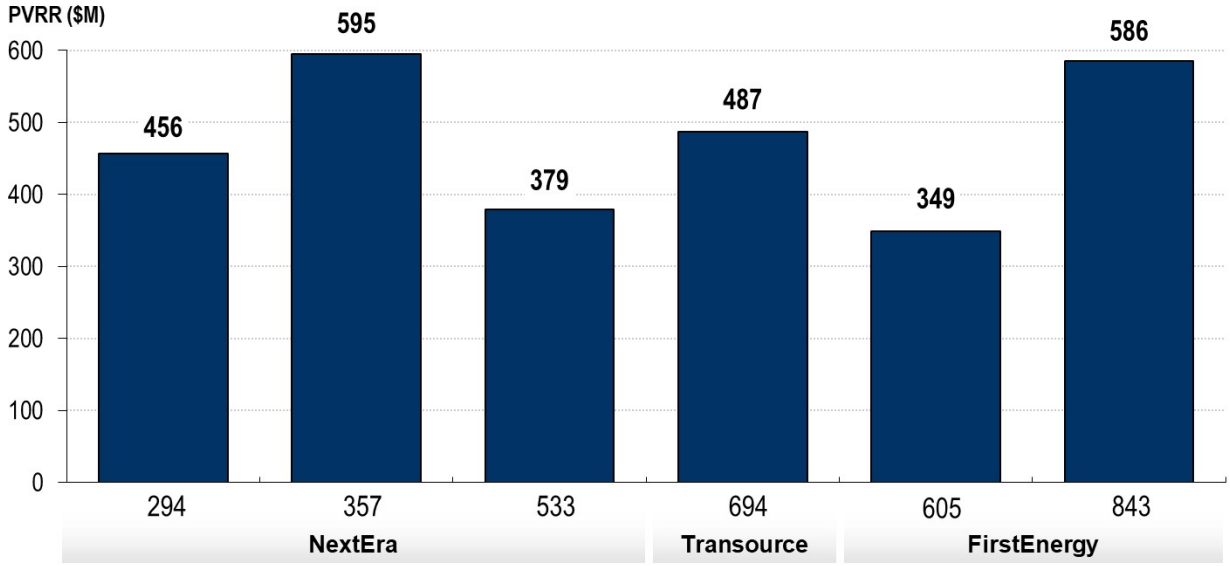
LS Power generally has the lowest variance across all sensitivities due to offering an ROE cap, an equity cap and its inclusion of all cost categories in its hybrid cost cap.

Overall, all proposals offer relatively weak cost containment. This can best be demonstrated by the downside case, as all proposals feature high divergence from the base case when each variable is flexed.

Ohio Cluster Proposals: PVRR Comparison

Figure 6 compares the base case costs of all Ohio Cluster proposals, grouped by proposer.

Figure 6. Ohio Cluster Proposals: Base Case PVRR Comparison



The Ohio Cluster projects are similar enough in scope to be comparable in terms of PVRR.

FirstEnergy's Proposal 605 is the best performing ATSI zone proposal in terms of cost, even without cost containment, due to its low base cost. It has the lowest PVRR in all modeled sensitivities.

NextEra's Proposal 533 performs second best in all sensitivities, with a slightly higher PVRR than 605 in each sensitivity, followed by Transource's 694.

FirstEnergy's 843 and NextEra's 357 perform similarly in most sensitivities.

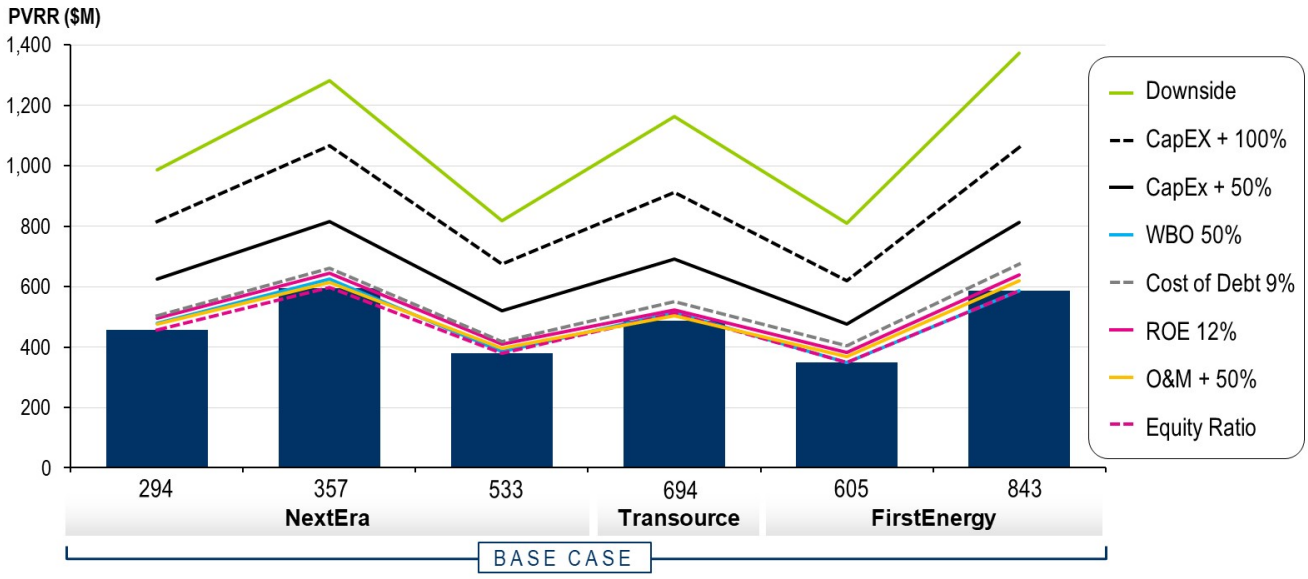
Table 42 shows the volatility of ATSI zone project costs across modeled sensitivities relative to base case costs. Costs are shown in millions of dollars, allowing for a simple comparison of absolute cost volatility.

Table 42. Ohio Cluster Proposal Results: All Sensitivities

		PVRR (in $M)								
Sensitivity:		S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9
Proposal #:		Base Case	WBO 50%	CapEx +50%	CapEx +100%	ROE 12%	Cost of Debt 9%	Equity Ratio 60%	O&M +50%	Downside
NextEra	294	456	478	626	816	494	505	458	475	987
	357	595	625	816	1,067	645	660	598	615	1,283
	533	379	385	520	676	411	419	381	396	818
Transource	694	487	514	693	912	524	549	512	504	1,164
First Energy	605	349	349	475	621	382	404	349	369	810
	843	586	586	813	1,062	640	675	586	619	1,374

Figure 7 also displays how proposal costs increase relative to base case values as well.

Figure 7. Ohio Cluster Proposals: All Sensitivity PVRR Comparison



Finally, **Table 43** also shows how Ohio Cluster proposal costs increase relative to the base case across modeled sensitivities as a percent increase. For example, in the downside sensitivity, NextEra Proposal 294's costs increase by 116% relative to its base case.

Table 43. Ohio Cluster Proposal Results: All Sensitivities (Comparison to Base Case)

		PVRR vs. Base Case (%)								
Sensitivity:		**S 1**	**S 2**	**S 3**	**S 4**	**S 5**	**S 6**	**S 7**	**S 8**	**S 9**
Proposal #:		**Base Case**	**WBO 50%**	**CapEx +50%**	**CapEx +100%**	**ROE 12%**	**Cost of Debt 9%**	**Equity Ratio 60%**	**O&M +50%**	**Downside**
NextEra	**294**	0%	5%	37%	79%	8%	11%	0%	4%	116%
	357	0%	5%	37%	79%	8%	11%	0%	3%	116%
	533	0%	1%	37%	78%	8%	10%	0%	5%	116%
Transource	**694**	0%	6%	42%	87%	8%	13%	5%	4%	139%
First Energy	**605**	0%	0%	36%	78%	10%	16%	0%	6%	132%
	843	0%	0%	39%	81%	9%	15%	0%	6%	135%

These graphics help show the relative strength of proposers' cost containment measures.

The NextEra proposals have similarly high divergence values from the base case, driven by modest contingency values, a hybrid cost cap and a 50% equity cap on a majority of capital costs. Ohio Cluster proposals have a more modest level of WBO CapEx compared to Regional proposals. This explains why NextEra Proposals 294, 357 and 533 have a much lower cost increase in the WBO 50% sensitivity (5% to 6%) than NextEra's Regional proposals (20% to 24%).

Transource's Proposal 694's hybrid cost cap only caps E&D costs, which are a small portion of total cost. Therefore, contingency absorbs all cost increases even in the CapEx +100% sensitivity. This points to very weak cost containment. Due to a small contingency, 694's downside results in a higher percentage increase (139%) than even 843 (135%), a proposal with no cost containment.

FirstEnergy's proposals 605 and 843 do not offer any cost containment. This leads to significant increases in CapEx flex sensitivities. However, these increases are not substantially higher than either the NextEra proposals or Transource's 694.

Overall, in the downside sensitivity, all Ohio Cluster proposals feature high divergence from the base case when each variable is flexed. These two facts highlight the relatively weak containment offered by all developers.

APPENDIX A – CONSTRUCTABILITY MATRICES

Risk Assessment Criteria

RISK ASSESSMENT	Cost Estimate Risks Proposal is within:	Cost Containment Risk	Schedule Risks	Constructability Risks	ROW / Land Acquisition Risk	Outage Coordination Risk Score	Proposing Entity Experience & Capability Risks
Low	**0-10%** of Independent Estimate	Hard Cost Cap (Project cost capped with no cost recovery above binding cost cap) with minimal exclusions.	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.	Pure Brownfield Rebuild/Reconductor/New Build within existing ROW (or property already owned by entity)	Ratings assessed based on PJM's assessment of complexity, impact and duration of outages required for development, including consideration of outage coordination plans proposed.	Entity has demonstrated significant experience & capability of developing and operating proposed facilities
Low-Medium	**11-20%** of Independent Estimate	Mix of Hard/Soft caps on Project components			Mostly brownfield with some greenfield (i.e. Uses/ Overlaps existing ROW but requires expansion or some new greenfield)		Entity has demonstrated limited experience & capability of developing and operating proposed facilities
Medium	**21-30%** of Independent Estimate	Soft Caps (No direct cap on Project costs, but indirect caps via reductions to ROE, and/ or incentives for cost overruns).			Moderate Mix of Green and Brownfield (i.e. Uses/Overlaps existing ROW but requires expansion or some new greenfield)		Entity has no experience operating proposed facilities, but has demonstrated some experience with developing proposed facilities.
Medium-High	**31-40%** of Independent Estimate	Minimal cost caps and/or excessive exclusions			Mostly Greenfield with some Brownfield (i.e. Uses/ Overlaps existing ROW but requires expansion or some new greenfield) OR Parallels existing ROW for entire alignment with no overlaps.		Entity has no experience developing and operating proposed facilities, but has provided a detailed & effective plan
High	**less than 40%** of Independent Estimate	No cost containment			Pure Greenfield		Entity has no experience developing and operating proposed facilities and has not provided a detailed & effective plan

	Cost Estimate Risks Proposal is within:	Cost Containment Risk	Schedule Risks	Constructability Risks	ROW / Land Acquisition Risk	Outage Coordination Risk Score	Proposing Entity Experience & Capability Risks
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.*			• *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.*			

Regional Cluster Constructability Matrix (Dominion, FirstEnergy & Transource Proposals)

2024 RTEP W1 Proposal Risk Assessments

							RISKS:								Ckt Miles		
		Proposal ID	Proposing Entity	Proposal Description	Proposal Cost Estimate	Independent Cost Estimate	Cost Estimate	Cost Containment	Schedule	Constructability	ROW / Land Acquisition	Outage Coordination	Proposing Entity Experience & Capability	Proposed In-Service Date	765 kV	500 kV	EHV Total
Applicable Proposal IDs for Joint Proposals	262	**708**	TRAIL	Amos - Welton Springs - Point of Rocks 765 kV Line	$1,944,988,294.77	$2,288,969,942.14	Low-Medium	Medium-High	High	High	Medium-High	Low	Low	12/1/2029	261	0	261
	759	**883**	TRAIL	Amos - Welton Spring 765 kV Line	$1,274,423,041.56	$1,481,832,613.63	Low-Medium	Medium-High	Medium-High	Medium-High	Medium-High	Low	Low	12/1/2029	175	0	175
	279	**286**	TRNSRC	Joshua Falls - Durandal	$350,251,158.00	$444,166,943.40	Medium	Medium-High	Medium	Medium	Medium	Low	Low	12/1/2029	64	0	64
	279, 114	**300**	TRNSRC	Yeat - Vontay	$381,728,557.00	$462,017,489.30	Low-Medium	Medium-High	Medium	Medium	Low-Medium	Medium	Low	12/1/2030	0	64	64

							RISKS:								Ckt Miles		
		Proposal ID	Proposing Entity	Proposal Description	Proposal Cost Estimate	Independent Cost Estimate	Cost Estimate	Cost Containment	Schedule	Constructability	ROW / Land Acquisition	Outage Coordination	Proposing Entity Experience & Capability	Proposed In-Service Date	765 kV	500 kV	EHV Total
	262, 636, 759	**665**	TRNSRC	Joshua Falls - Vontay - Morrisville South	$1,188,512,351.00	$1,447,464,979.70	Low-Medium	Medium-High	Medium-High	Medium	Medium	Low	Low	12/1/2029	146	0	146
	279, 610, 114	**820**	TRNSRC	Joshua Falls - Yeat	$1,016,895,559.00	$1,244,013,049.00	Low-Medium	Medium-High	Medium-High	Medium-High	Medium-High	Low	Low	12/1/2029	138	0	138
	262, 759, 636, 610	**967**	VEPCO	DVP Central Area Improvement for Portfolios	$1,189,775,296.32	$1,059,225,544.02	Low	Medium-High	Medium	Medium	Low-Medium	Medium	Low	12/1/2029	0	67	67
Applicable Proposal IDs for Joint Proposals	--	**907**	TRAIL	500 kV Expansion Plan	$2,838,900,776.05	$2,863,332,668.37	Low	Medium-High	High	High	Medium-High	Medium-High	Low	12/1/2029	0	395.8	395.8
	262	**977**	TRAIL	Belmont - Harrison 500 kV Line	$277,408,474.00	$300,964,888.00	Low	Medium-High	Medium	Medium	Medium	Low	Low	12/1/2029	0	56	56
	610, 636, 279,	**727**	KEYATC	Kammer - 502 Junction 765 kV Line	$ 292,459,887.36	$328,069,112.56	Low-Medium	High	Medium	Low-Medium	Low	Medium-High	Low	12/1/2029	41.9	0	41.9

							RISKS:								Ckt Miles		
	Proposal ID	Proposing Entity	Proposal Description	Proposal Cost Estimate	Independent Cost Estimate	Cost Estimate	Cost Containment	Schedule	Constructability	ROW / Land Acquisition	Outage Coordination	Proposing Entity Experience & Capability	Proposed In-Service Date	765 kV	500 kV	EHV Total
114																
279, 114	**617**	TRNSRC	AEP incumbent upgrades for Portfolio #4	$167,351,119.00	$180,439,693.65	Low	High	Medium-High	Medium-High	Medium	Medium	Low	12/1/2029	0	0	0
262, 759, 636, 610, 279, 114	**781**	VEPCO	500kV Solutions for Portfolios	$161,680,709.90	$148,845,694.89	Low	High	Low-Medium	Low-Medium	Low	Medium	Low	12/1/2029	0	0	0
--	**983**	VEPCO	500kV Safety Solutions	$2,839,364,040.68	$2,467,872,667.37	Low	High	Medium	Medium	Medium	Medium	Low	6/1/2029	0	0	0

Regional Cluster Constructability Matrix (LS Power and NextEra Proposals)

2024 RTEP W1 Proposal Risk Assessments

					RISKS:								Ckt Miles		
Proposal ID	Proposing Entity	Proposal Description	Proposal Cost Estimate	Independent Cost Estimate	Cost Estimate	Cost Containment	Schedule	Constructability	ROW / Land Acquisition	Outage Coordination	Proposing Entity Experience & Capability	Proposed In-Service Date	765 kV	500 kV	EHV Total
78	CNTLTM	F5 Solution	$1,897,054,166.00	$2,447,816,821.00	Medium	Medium	Medium-High	Medium-High	High	Low	Medium-High	6/1/2029	196.8	74.6	271.4
124	CNTLTM	F4 Solution	$1,810,831,815.00	$2,429,369,174.00	Medium	Medium	Medium-High	Medium-High	High	Low	Medium-High	6/1/2029	192.7	9.4	202.1
317	CNTLTM	F7 Solution	$1,896,758,766.00	$2,282,237,119.00	Low-Medium	Medium	Medium-High	Medium-High	High	Low	Medium-High	6/1/2029	130.9	147.4	278.3
506	CNTLTM	F6 Solution	$1,732,107,945.00	$2,133,496,643.00	Low-Medium	Medium	Medium-High	Medium-High	High	Low	Low	6/1/2029	0	273.7	273.7
622	CNTLTM	F2 Solution	$1,848,138,486.00	$2,309,384,160.00	Low-Medium	Medium	Medium-High	Medium-High	High	Low	Low	6/1/2029	0	268.3	268.3
839	CNTLTM	F8 Solution	$1,808,086,862.00	$2,415,299,238.00	Medium	Medium	Medium-High	Medium-High	High	Low	Medium-High	6/1/2029	196.5	9.4	205.9
898	CNTLTM	F3 Solution	$2,015,627,111.00	$2,463,579,545.00	Low-Medium	Medium	Medium-High	Medium-High	High	Low	Medium-High	6/1/2029	127.1	140.6	267.7
904	CNTLTM	F1 Solution	$1,864,623,351.00	$2,459,622,230.00	Medium	Medium	Medium-High	Medium-High	High	Low	Medium-High	6/1/2029	192.6	74.6	267.2
200	CNTLTM	Common Components	$439,753,860.00	$702,234,455.29	Medium-High	Medium-High	Medium-High	High	Medium	Medium	Low	6/1/2029	0	0	0

					RISKS:								Ckt Miles		
Proposal ID	Proposing Entity	Proposal Description	Proposal Cost Estimate	Independent Cost Estimate	Cost Estimate	Cost Containment	Schedule	Constructability	ROW / Land Acquisition	Outage Coordination	Proposing Entity Experience & Capability	Proposed In-Service Date	765 kV	500 kV	EHV Total
146	NEETMH	Axton - Joshua Falls 765 kV + Joshua Falls - Mt Ida 500 kV	$2,263,756,064.81	$2,822,691,098.80	Low-Medium	Medium	Medium-High	Medium-High	Medium-High	Medium-High	Medium-High	6/1/2030	76	230.5	306.5
768	NEETMH	Axton - Joshua Falls - Mt Ida	$2,191,007,184.00	$2,879,718,285.80	Medium	Medium	Medium-High	Medium-High	Medium-High	Medium-High	Medium-High	6/1/2030	145	161.5	306.5
992	NEETMH	Axton - Joshua Falls - Mt Ida 765 kV transmission lines + Link 500/230 kV substation	$2,256,234,092.60	$3,190,599,997.01	Medium	Medium	Medium-High	Medium-High	Medium-High	Medium-High	Medium-High	6/1/2030	145	156.93	301.93
944	NEETMH	Upgrades to AEP 138 kV and Dominion 230 kV transmission lines	$69,139,000.00	$417,160,000.00	High	High	Low	Low-Medium	Low	Medium	Low	6/1/2029	0	0	0

Ohio Cluster Constructability Matrix

2024 RTEP W1 Proposal Risk Assessments

					RISKS:								Ckt Miles		
Proposal ID	Proposing Entity	Proposal Description	Proposal Cost Estimate	Independent Cost Estimate	Cost Estimate	Cost Containment	Schedule	Constructability	ROW / Land Acquisition	Outage Coordination	Proposing Entity Experience & Capability	Proposed In-Service Date	765 kV	500 kV	EHV Total
694	TRNSRC	Fostoria Central - Lake Ave. 345 kV DC	$328,369,046.00	$448,294,086.49	Medium	Medium-High	Medium	Medium	High	Low	Low	12/1/2029	0	0	0
843	ATSI	Lemoyne - Lake Ave 345 kV Line	$455,038,571.00	$468,122,679.45	Low	High	Medium	Medium	Medium	Medium	Low	6/1/2029	0	0	0
605	ATSI	ATSI 138 kV Rebuild	$265,156,487.00	$266,273,438.00	Low	High	Low	Low	Low	Medium	Low	6/1/2029	0	0	0
294	NEETMH	Bay Shore - Davis-Besse - Lake Ave	$257,300,886.58	$369,256,820.42	Medium-High	Medium	Medium	Medium	Medium-High	Medium	Low	6/1/2030	0	0	0
357	NEETMH	Bay Shore - Davis-Besse - Lake Ave + Lemoyne - Lake Ave 345 kV	$344,117,143.00	$451,938,163.29	Medium	Medium	Medium	Medium	Medium-High	Medium	Low	6/1/2030	0	0	0
533	NEETMH	Lemoyne - Lake Ave 345 kV	$202,084,415.75	$344,156,240.59	High	Medium	Medium	Medium	Medium-High	Low	Low	6/1/2030	0	0	0

DOCUMENT REVISION HISTORY

12/20/2024 – V2 Revision 2 for January 7 TEAC Posting

11/27/2024 - V1: Original version posted