PJM Generator Interconnection

V1-031 Possum Point 230-kV

1000 MW Capacity

Feasibility Study Report

July 2009
DMS #548053v1A

Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff §36.2 and the Feasibility Study Agreement between Interconnection Customer (IC) and PJM Interconnection, LLC (PJM) (Transmission Provider).

Preface

The intent of a Feasibility Study is to determine a plan, with cost and construction time estimates, to allow the subject generation interconnection project to inject into the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications for the appropriate transmission owner.

In some instances Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

Potential Network Impacts

At the request of IC, this project was studied with the primary interconnection option into the 230 kV system and a secondary option into the 500 kV system.

Option 1: 230 kV Option

PJM Queue Project V1-031 Option 1 was studied as a 1000 MW Capacity injection at Possum Point 230 kV substation in the Dominion area. V1-031 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. The 6POSSUM -6WOODB A 230 kV line (from bus 14074 to bus 14096 ckt 1) loads from 84.1% to 108% (DC power flow) of its rating (678.679992675781 MVA) for the single line contingency ('LN 2001'). This project contributes approximately 162.19 MW to cause the thermal violation.

```
CONTINGENCY 'LN 2001'                          /* OCCOQUAN - POSSUM POINT
OPEN BRANCH FROM BUS 14067 TO BUS 14094 CKT 1  /* OCCOQUAN TO WOODBRIDGE
OPEN BRANCH FROM BUS 14074 TO BUS 14094 CKT 1  /* POSSUM PT TO WOODBRIDGE
END
```

2. The 6POSSUM -6DUMFRES 230 kV line (from bus 14074 to bus 14029 ckt 1) loads from 85.7% to 107.64% (DC power flow) of its rating (595.02001953125 MVA) for the single line contingency ('LN 237'). This project contributes approximately 130.56 MW to cause the thermal violation.

```
CONTINGENCY 'LN 237'                           /* BRADDOCK - POSSUM POINT
OPEN BRANCH FROM BUS 14009 TO BUS 14054 CKT 1  /* BRADDOCK TO KEENE MILL TX 1
OPEN BRANCH FROM BUS 14054 TO BUS 14057 CKT 1  /* KEENE MILL TO LAKE RIDGE
OPEN BRANCH FROM BUS 14057 TO BUS 14074 CKT 1  /* LAKE RIDGE TO POSSUM  PT
END
```

3. The 6OCCOQUN -6O X 230 kV line (from bus 14067 to bus 14068 ckt 1) loads from 70.69% to 106.47% (DC power flow) of its normal rating (748.239990234375 MVA) for the single line contingency ('LN 215'). This project contributes approximately 267.72 MW to cause the thermal violation.

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CONTINGENCY 'LN 215'                           /* HAYFIELD - POSSUM POINT
OPEN BRANCH FROM BUS 14046 TO BUS 14096 CKT 1  /* HAYFIELD TO WOODBRIDGE
OPEN BRANCH FROM BUS 14096 TO BUS 14074 CKT 1  /* WOODBRIDGE TO POSSUM PT
END
```

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

4. The 6POSSUM -6WOODBR 230 kV line (from bus 14074 to bus 14094 ckt 1) loads from 73.15% to 104.8% (DC power flow) of its rating (938.599975585938 MVA) for the tower line contingency ('237&2022'). This project contributes approximately 297.1 MW to cause the thermal violation.

```
CONTINGENCY '237&2022'                         /* LN 237 & 2022
OPEN BRANCH FROM BUS 14009 TO BUS 14054 CKT 1  /* 237 BRADDOCK - KEENE MILL
OPEN BRANCH FROM BUS 14054 TO BUS 14057 CKT 1  /* 237 KEENE MILL - LAKERIDGE
OPEN BRANCH FROM BUS 14057 TO BUS 14074 CKT 1  /* 237 LAKERIDGE - POSSUM
OPEN BRANCH FROM BUS 14077 TO BUS 14058 CKT 1  /* 2022 RAVENSWORTH - LAKERIDGE
OPEN BRANCH FROM BUS 14058 TO BUS 14029 CKT 1  /* 2022 LAKERIDGE - DUMFRIES
OPEN BRANCH FROM BUS 14029 TO BUS 14074 CKT 1  /* 2022 DUMFRIES - POSSUM
END
```

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None.

Short Circuit Analysis

Analysis found 27 new breakers, to be over-duty in the Dominion transmission area. The new over-duty breakers are listed below for option 1:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With v1-031_opt1_Dom	Duty Percent Without v1-031_opt1_Dom	Duty Percent Difference	Note
314074	POSSUM POINT 230.kV	H9T237	S	116.90%	97.20%	19.70%	New Overduty
314074	POSSUM POINT 230.kV	H892	S	114.70%	95.50%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	H8T2078	S	114.70%	95.50%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	H992	S	114.70%	95.50%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G6BTGT	S	113.80%	94.70%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	GT92	S	113.80%	94.70%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	23792	S	113.60%	94.60%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	202292	S	113.30%	94.30%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	252T2022	S	113.30%	94.30%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	21592	S	113.10%	94.10%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	G5T215	S	113.10%	94.10%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	25292	S	112.20%	93.00%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G492	S	112.20%	93.00%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G592	S	112.20%	93.00%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G6A92	S	112.20%	93.00%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G6B92	S	112.20%	93.00%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	XT2078	S	112.20%	93.00%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	200192	S	110.40%	91.20%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	207892	S	110.40%	91.20%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G6S92	S	110.40%	91.20%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G4T2001	S	110.00%	90.70%	19.30%	New Overduty
42	OX 230.kV	22042	S	102.30%	99.20%	3.10%	New Overduty
42	OX 230.kV	220T2063	S	102.30%	99.20%	3.10%	New Overduty
42	OX 230.kV	24842	S	101.30%	98.30%	3.00%	New Overduty
42	OX 230.kV	248T2013	S	101.30%	98.30%	3.00%	New Overduty
42	OX 230.kV	24342	S	101.10%	98.20%	2.90%	New Overduty
42	OX 230.kV	243T2097	S	101.10%	98.20%	2.90%	New Overduty

Stability and Reactive Power Requirement

To be determined at the System Impact Study.

Dominion Study Results

Dominion assessed the impact on the Dominion Transmission System that the proposed 1000 MW injection of new generation capacity would have at the Possum Point 230 kV Substation. The system was assessed using the Summer 2013 RTEP case provided to Dominion by PJM for this analysis. This analysis did include the impacts of the generation capacity for all higher order queue generators within the Dominion Transmission System. When performing a generation analysis, Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions) and import/export system conditions. Dominion Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. For import/export studies Dominion considers a transmission facility overloaded if it exceeded 100% of its emergency rating. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at: http://www.dom.com.

As part of its generation impact analysis Dominion routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions and stressed system conditions. For the V1-031 evaluation two different assessments were conducted.

1) The first being when local generation including the proposed V1-031 Facility is operated at their maximum capability. The result of this study is shown below in Table A.

Table A: Pmax System Conditions

Overloaded Element	Element's Operating #	Contingency Label	Base-Line Loading (MVA)	Base-Line + V1-031
14029 6DUMFRES 230.00 14058 6LAKER A 230.00 1	2022 Line	LN 2001	449.6	95.50% 600MVA
14029 6DUMFRES 230.00 14074 6POSSUM 230.00 1	2022 Line	LN 237	547.4	109.10% 692MVA
14039 6GALLW A 230.00 14068 6OX 230.00 1	2097 Line	LN 207	571	95.60% 614MVA
14046 6HAYFLD 230.00 14870 6ENGPRVG 230.00 1	215 Line	LN 2001	515.7	96.10% 698MVA
14052 6IDYLWOD 230.00 14100 6IDYLWO2 230.00 1	Idylwood Bus	LN 2035	644.6	96.00% 757MVA
14054 6KEENE M 230.00 14057 6LAKERD 230.00 1	237 Line	LN 2022	460.4	94.20% 593MVA
14057 6LAKERD 230.00 14074 6POSSUM 230.00 1	237 Line	LN 2022	499.8	101.10% 632MVA
14058 6LAKER A 230.00 14077 6RVNWRTH 230.00 1	2022 Line	LN 237	463.1	96.30% 606MVA
14067 6OCCOQUN 230.00 14068 6OX 230.00 1	2013 Line	LN 215	593.3	111.20% 891MVA
14067 6OCCOQUN 230.00 14094 6WOODBR 230.00 1	2001 Line	LN 215	603.1	124.90% 906MVA
14072 6PL VIEW 230.00 7001 DICKERSN 230.00 1	203 Line	LN 558B	963.8	94.80% 1149MVA
14074 6POSSUM 230.00 14094 6WOODBR 230.00 1	2001 Line	LN 215	665.1	101.50% 971MVA
14074 6POSSUM 230.00 14096 6WOODB A 230.00 1	215 Line	LN 2001	637.4	112.90% 822MVA
14096 6WOODB A 230.00 14870 6ENGPRVG 230.00 1	215 Line	LN 2001	565.9	103.30% 747MVA

Key: Overload Solution
Reconductor
Wreck & Rebuild
New Construction
Upgrade Bus

As shown above in Table A, the impact of the V1-031 generator under single contingency conditions results in thermal overloads of several 230kV line sections and the 230kV Bus at Idylwood.

2) The second being import and export conditions into and out of the Dominion System. Any new facility that is interconnected with the Dominion System should not significantly decrement FCITC between utilities. The results of these studies can be found in Tables B and C.

Table B: Import Study Results

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table C: Export Study Results

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Dominion's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies are indicate that the proposed generation facility will not impact Dominion's import or export capability.

Option 1 Interconnection Requirements

The following provides the estimated cost and schedule for the Non-Direct and Direct Connection Network Upgrades and the Attachment Facilities:

Non – Direct Connection Network Upgrades

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

The results of these studies, as indicated above in Table A, show that several 230kV line sections and the 230kV bus at Idylwood will be overloaded. To reliably interconnect the proposed generation with the Dominion Transmission System, the following upgrades will be required:

- Wreck and rebuild 30 miles of double circuit 230kV transmission line structures (lines 2022, 2097 and 237). This will cost an estimated $60 million and will take 48 months to complete.

- Reconductor 35 miles of 230kV transmission line for an estimated cost of $14 million (lines 215, 2001 and 2013). This work is estimated to take 30 to 36 months to complete
- Construct a 2nd 230kV transmission line from Pleasant View to Dickerson (line 203). Construction of this 10 mile 230kV transmission line, excluding right-of-way, is estimated to cost $10 million and will take 5 years to complete.
- Replace the 230kV tie breaker and terminal equipment at Idylwood's 230kV bus. This will cost an estimated $500,000 and will take 16 to 24 months to complete.
- Replace the twenty-seven overduty 230kV breakers. This will cost an estimated $350,000 per breaker and will take approximate 36 months to complete.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None.

Direct Connection Network Upgrades

To reliably interconnect the proposed generation at Possum Point's 230kV Substation, it will be necessary to install five additional 230kV breakers in a breaker-and-a-half bus arrangement as shown in Attachment 1. Due to space limitations these new facilities will need to be Gas Insulated Switchgear (GIS). The installation of these breakers and associated equipment is estimated to cost $10 million and take 24 to 30 months to complete. Breaker duty studies are indicating that every 230 kV breaker at Possum Point needs to be replaced. Final engineering studies may indicate that space limitations at the Possum Point Site may require that the existing 230 kV substation be converted to GIS. If this occurs an additional $40 million will be required.

Attachment Facilities

The proposed layout and attachment facilities for the 230kV option # 1 are illustrated in Attachment 1. The estimated cost of these facilities which also includes metering, protection equipment along with three 0.5 mile 230kV lines is $1.8 Million and is estimated to take 24 months to complete.

Option 2: 500 kV Option

PJM Queue Project V1-031 was also studied as a 1000 MW Capacity injection at Possum Point 500 kV substation in the Dominion area. Project V1-031 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

None.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None.

Short Circuit Analysis

Analysis found four new breakers, to be over-duty in the Dominion transmission area. The new over-duty breakers are listed below for option 2:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With v1-031_opt1_Dom	Duty Percent Without v1-031_opt1_Dom	Duty Percent Difference	Note
42	OX 230.kV	22042	S	100.80%	99.30%	1.50%	New Overduty
42	OX 230.kV	220T2063	S	100.80%	99.30%	1.50%	New Overduty
688	POSS PT CAP 230.kV	SC192	S	116.90%	103.10%	13.80%	Over 100%, > 3% contribution
899	OX L242 230.kV	L242	S	109.10%	105.80%	3.30%	Over 100%, > 3% contribution

Stability and Reactive Power Requirement

To be determined at the System Impact Study.

Dominion Study Results

Dominion assessed the impact on the Dominion Transmission System that the proposed 1000 MW injection of new generation capacity would have at the Possum Point 500 kV Substation. The system was assessed using the Summer 2013 RTEP case provided to Dominion by PJM for this analysis. This analysis did include the impacts of the generation capacity for all higher order queue generators within the Dominion Transmission System. When performing a generation analysis, Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions) and import/export system conditions. Dominion Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. For import/export studies Dominion considers a transmission facility overloaded if it exceeded 100% of its emergency rating. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at: http://www.dom.com.

As part of its generation impact analysis Dominion routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions and stressed system conditions. For the V1-031 evaluation three different assessments were conducted.

1) The first being when local generation including the proposed V1-031 Facility is operated at their maximum capability. The result of this study is shown below:

   None.

2) The second being a stressed system condition where the largest generator in the area is unavailable. Because the V1-031 generator is located on the 230kV system between Richmond and Northern Virginia, Possum Pt. Unit#5 is considered the most critical generating unit in the area. The impact of V1-031 was studied with the outage of Possum Point Unit #5. The result of this study is shown below in Table A.

   Table A: Stressed System Conditions

Overloaded Element	Element's Operating #	Contingency Label	Base-Line Loading (MVA)	Base-Line + V1-031
14138 6MINE RD 230.00 14197 6LDYSMT1 230.00 1	256 Line	LN 2032	 843.1	96.30% 913MVA

Key: Overload Solution
R/P Switches

   As shown in Table A, the impact of the V1-031 generator under single contingency conditions results in a thermal overload of the 230kV line section Mine Road to Ladysmith.

3) The third being import and export conditions into and out of the Dominion System. Any new facility that is interconnected with the Dominion System should not significantly decrement FCITC between utilities. The results of these studies can be found in Tables B and C.

Table B: Stressed System Conditions

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table C: Export Study Results

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Dominion's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies are indicate that the proposed generation facility will not impact Dominion's import or export capability.

Option 2 Interconnection Requirements

The following provides the estimated cost and schedule for the Non-Direct and Direct Connection Network Upgrades and the Attachment Facilities:

Non – Direct Connection Network Upgrades

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

The results of these studies, as indicated above in Table A, show that the 230 kV line section Mine Road to Ladysmith will be overloaded. To reliably interconnect the proposed generation with the Dominion Transmission System, this line section will need to be upgraded to handle the additional capacity.

To alleviate this thermal overload, the switches on the line section Mind Road to Ladysmith will need to be replaced. The estimated cost of this work is $300,000 and is estimated to take 12 months.

The four over duty 230kV breakers will need to be replaced. This will cost an estimated $350,000 per breaker and will take approximate 24 months to complete.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None.

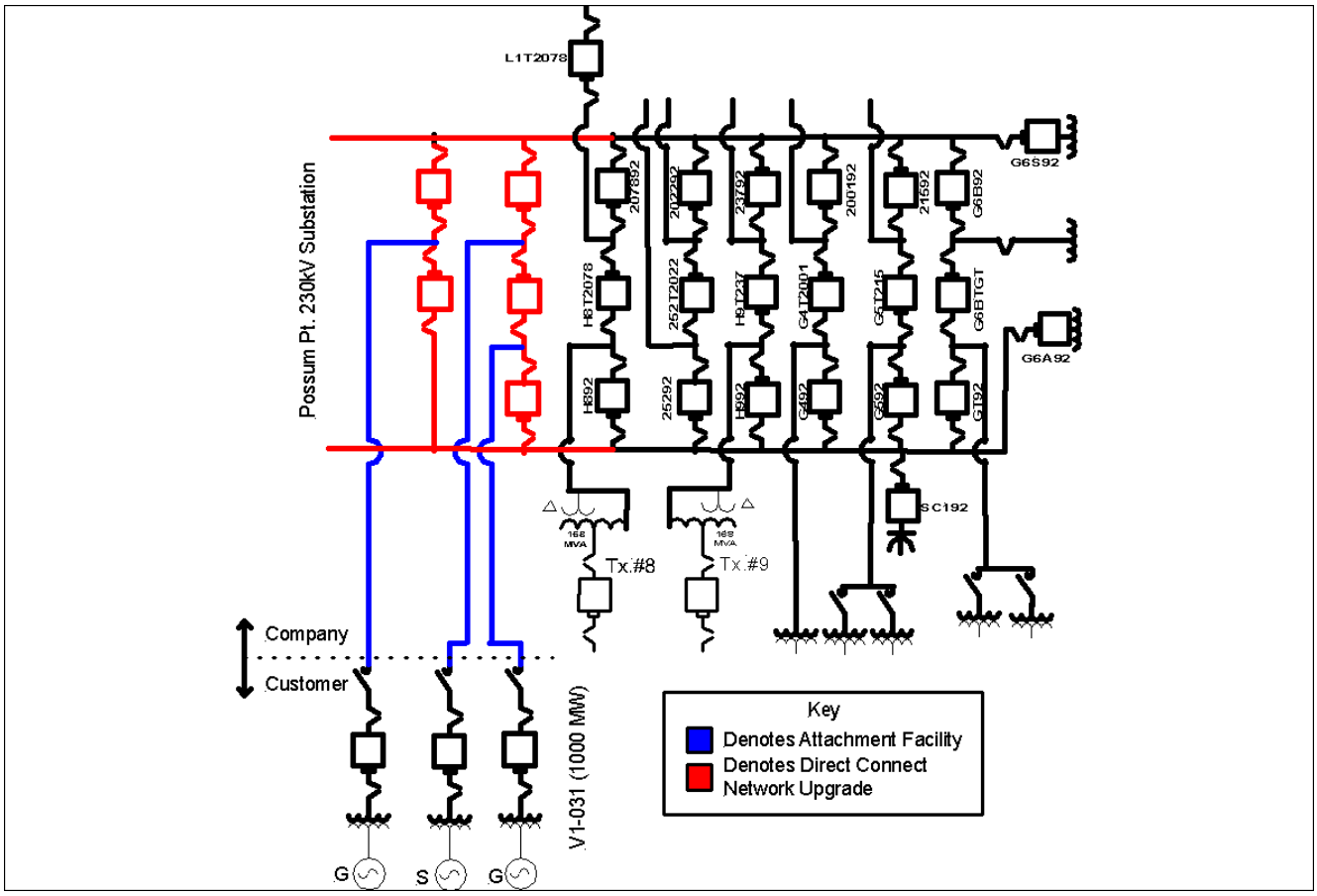
Direct Connection Network Upgrades

To reliably interconnect the proposed generation at Possum Point's 500kV Substation, it will be necessary to install 3 additional 500kV breakers in a breaker-and-a-half bus arrangement as shown below in Attachment 2. Due to space limitations these new facilities will need to be Gas Insulated Switchgear (GIS). The installation of these breakers and associated equipment is estimated to cost $11 million and take 24 to 30 months to complete.

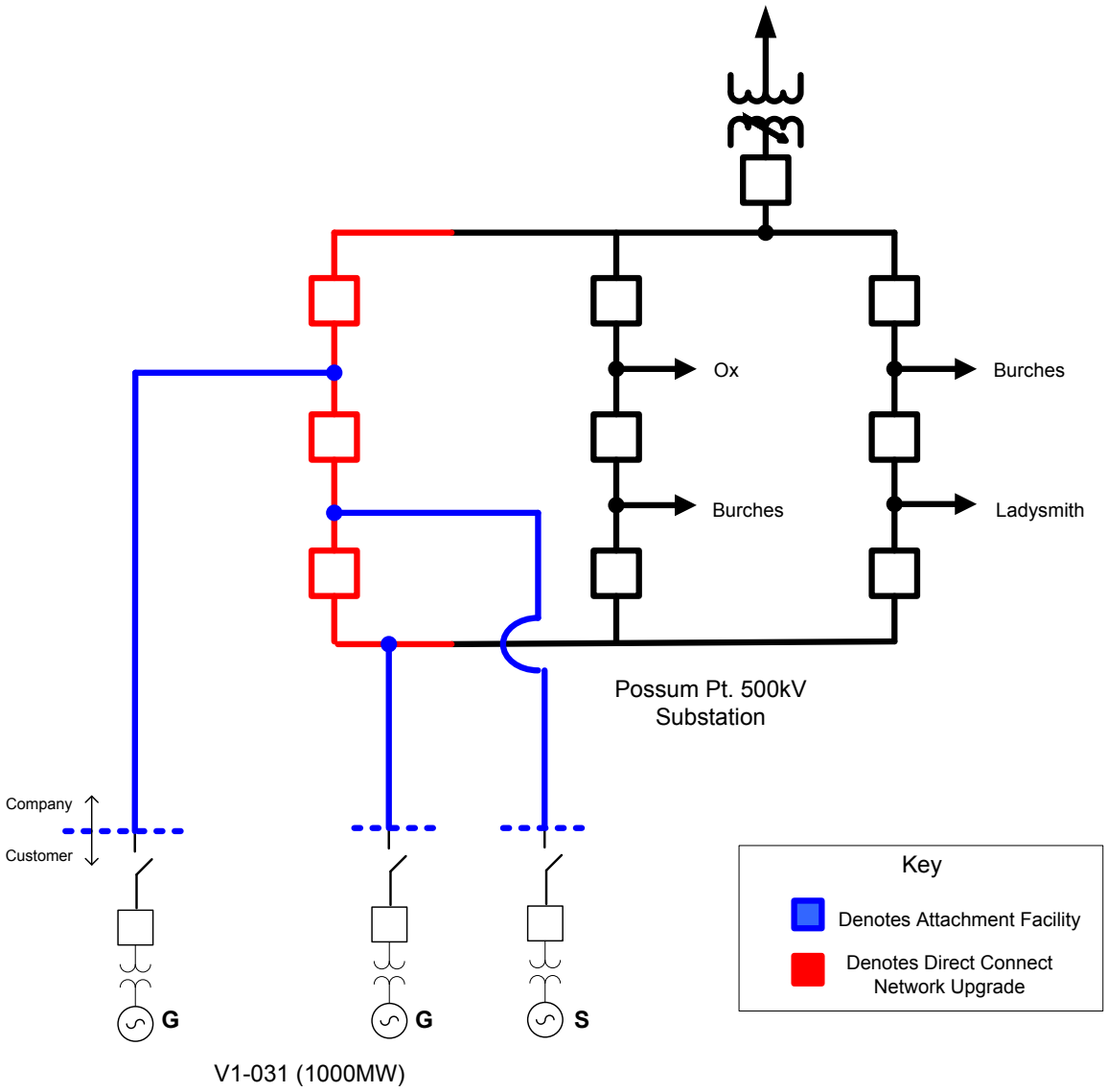
Attachment Facilities

The proposed layout and attachment facilities for the 500kV option are illustrated in Attachment 2. The estimated cost of these facilities which also includes metering, protection equipment along with three 0.5 mile 500kV lines is $3 million and is estimated to take 24 months to complete.

Attachment 1: 230 kV Option Single Line



Attachment 2: 500 kV Option Single Line



PJM Generator Interconnection

V1-031 Possum Point 230-kV

1000 MW Capacity

Feasibility Study Report

July 2009
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Introduction

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In some instances Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

Potential Network Impacts

At the request of IC, this project was studied with the primary interconnection option into the 230 kV system and a secondary option into the 500 kV system.

Option 1: 230 kV Option

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Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

1. The 6POSSUM -6WOODB A 230 kV line (from bus 14074 to bus 14096 ckt 1) loads from 84.1% to 108% (DC power flow) of its rating (678.679992675781 MVA) for the single line contingency ('LN 2001'). This project contributes approximately 162.19 MW to cause the thermal violation.

```
CONTINGENCY 'LN 2001'                          /* OCCOQUAN - POSSUM POINT
OPEN BRANCH FROM BUS 14067 TO BUS 14094 CKT 1  /* OCCOQUAN TO WOODBRIDGE
OPEN BRANCH FROM BUS 14074 TO BUS 14094 CKT 1  /* POSSUM PT TO WOODBRIDGE
END
```

2. The 6POSSUM -6DUMFRES 230 kV line (from bus 14074 to bus 14029 ckt 1) loads from 85.7% to 107.64% (DC power flow) of its rating (595.02001953125 MVA) for the single line contingency ('LN 237'). This project contributes approximately 130.56 MW to cause the thermal violation.

```
CONTINGENCY 'LN 237'                           /* BRADDOCK - POSSUM POINT
OPEN BRANCH FROM BUS 14009 TO BUS 14054 CKT 1  /* BRADDOCK TO KEENE MILL TX 1
OPEN BRANCH FROM BUS 14054 TO BUS 14057 CKT 1  /* KEENE MILL TO LAKE RIDGE
OPEN BRANCH FROM BUS 14057 TO BUS 14074 CKT 1  /* LAKE RIDGE TO POSSUM  PT
END
```

3. The 6OCCOQUN -6O X 230 kV line (from bus 14067 to bus 14068 ckt 1) loads from 70.69% to 106.47% (DC power flow) of its normal rating (748.239990234375 MVA) for the single line contingency ('LN 215'). This project contributes approximately 267.72 MW to cause the thermal violation.

```
CONTINGENCY 'LN 215'                           /* HAYFIELD - POSSUM POINT
OPEN BRANCH FROM BUS 14046 TO BUS 14096 CKT 1  /* HAYFIELD TO WOODBRIDGE
OPEN BRANCH FROM BUS 14096 TO BUS 14074 CKT 1  /* WOODBRIDGE TO POSSUM PT
END
```

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

4. The 6POSSUM -6WOODBR 230 kV line (from bus 14074 to bus 14094 ckt 1) loads from 73.15% to 104.8% (DC power flow) of its rating (938.599975585938 MVA) for the tower line contingency ('237&2022'). This project contributes approximately 297.1 MW to cause the thermal violation.

```
CONTINGENCY '237&2022'                         /* LN 237 & 2022
OPEN BRANCH FROM BUS 14009 TO BUS 14054 CKT 1  /* 237 BRADDOCK - KEENE MILL
OPEN BRANCH FROM BUS 14054 TO BUS 14057 CKT 1  /* 237 KEENE MILL - LAKERIDGE
OPEN BRANCH FROM BUS 14057 TO BUS 14074 CKT 1  /* 237 LAKERIDGE - POSSUM
OPEN BRANCH FROM BUS 14077 TO BUS 14058 CKT 1  /* 2022 RAVENSWORTH - LAKERIDGE
OPEN BRANCH FROM BUS 14058 TO BUS 14029 CKT 1  /* 2022 LAKERIDGE - DUMFRIES
OPEN BRANCH FROM BUS 14029 TO BUS 14074 CKT 1  /* 2022 DUMFRIES - POSSUM
END
```

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None.

Short Circuit Analysis

Analysis found 25 new breakers, to be over-duty in the Dominion transmission area. The new over-duty breakers are listed below for option 1:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With v1-031_opt1_Dom	Duty Percent Without v1-031_opt1_Dom	Duty Percent Difference	Note
314074	POSSUM POINT 230.kV	H9T237	S	116.90%	97.30%	19.60%	New Overduty
314074	POSSUM POINT 230.kV	H992	S	114.70%	95.50%	19.20%	New Overduty
314074	POSSUM POINT 230.kV	G6BTGT	S	113.80%	94.70%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	GT92	S	113.80%	94.70%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	23792	S	113.60%	94.60%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	202292	S	113.30%	94.30%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	252T2022	S	113.30%	94.30%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	21592	S	113.10%	94.10%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	G5T215	S	113.10%	94.10%	19.00%	New Overduty
314074	POSSUM POINT 230.kV	25292	S	112.20%	93.10%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	G492	S	112.20%	93.10%	19.10%	New Overduty

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With v1-031_opt1_Dom	Duty Percent Without v1-031_opt1_Dom	Duty Percent Difference	Note
314074	POSSUM POINT 230.kV	G592	S	112.20%	93.10%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	G6A92	S	112.20%	93.10%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	G6B92	S	112.20%	93.10%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	XT2078	S	112.20%	93.10%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	200192	S	110.40%	91.30%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	207892	S	110.40%	91.30%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	G6S92	S	110.40%	91.30%	19.10%	New Overduty
314074	POSSUM POINT 230.kV	G4T2001	S	110.00%	90.80%	19.20%	New Overduty
42	OX 230.kV	22042	S	102.30%	99.30%	3.00%	New Overduty
42	OX 230.kV	220T2063	S	102.30%	99.30%	3.00%	New Overduty
42	OX 230.kV	24842	S	101.30%	98.40%	2.90%	New Overduty
42	OX 230.kV	248T2013	S	101.30%	98.40%	2.90%	New Overduty
42	OX 230.kV	24342	S	101.10%	98.30%	2.80%	New Overduty
42	OX 230.kV	243T2097	S	101.10%	98.30%	2.80%	New Overduty

Stability and Reactive Power Requirement

To be determined at the System Impact Study.

Dominion Study Results

Dominion assessed the impact on the Dominion Transmission System that the proposed 1000 MW injection of new generation capacity would have at the Possum Point 230 kV Substation. The system was assessed using the Summer 2013 RTEP case provided to Dominion by PJM for this analysis. This analysis did include the impacts of the generation capacity for all higher order queue generators within the Dominion Transmission System. When performing a generation analysis, Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions) and import/export system conditions. Dominion Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. For import/export studies Dominion considers a transmission facility overloaded if it exceeded 100% of its emergency rating. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at: http://www.dom.com.

As part of its generation impact analysis Dominion routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions and stressed system conditions. For the V1-031 evaluation two different assessments were conducted.

1) The first being when local generation including the proposed V1-031 Facility is operated at their maximum capability. The result of this study is shown below in Table A.

Table A: Pmax System Conditions

Overloaded Element	Element's Operating #	Contingency Label	Base-Line Loading (MVA)	Base-Line + V1-031
14029 6DUMFRES 230.00 14058 6LAKER A 230.00 1	2022 Line	LN 2001	449.6	95.50% 600MVA
14029 6DUMFRES 230.00 14074 6POSSUM 230.00 1	2022 Line	LN 237	547.4	109.10% 692MVA
14039 6GALLW A 230.00 14068 6OX 230.00 1	2097 Line	LN 207	571	95.60% 614MVA
14046 6HAYFLD 230.00 14870 6ENGPRVG 230.00 1	215 Line	LN 2001	515.7	96.10% 698MVA
14052 6IDYLWOD 230.00 14100 6IDYLWO2 230.00 1	Idylwood Bus	LN 2035	644.6	96.00% 757MVA
14054 6KEENE M 230.00 14057 6LAKERD 230.00 1	237 Line	LN 2022	460.4	94.20% 593MVA
14057 6LAKERD 230.00 14074 6POSSUM 230.00 1	237 Line	LN 2022	499.8	101.10% 632MVA
14058 6LAKER A 230.00 14077 6RVNWRTH 230.00 1	2022 Line	LN 237	463.1	96.30% 606MVA
14067 6OCCOQUN 230.00 14068 6OX 230.00 1	2013 Line	LN 215	593.3	111.20% 891MVA
14067 6OCCOQUN 230.00 14094 6WOODBR 230.00 1	2001 Line	LN 215	603.1	124.90% 906MVA
14072 6PL VIEW 230.00 7001 DICKERSN 230.00 1	203 Line	LN 558B	963.8	94.80% 1149MVA
14074 6POSSUM 230.00 14094 6WOODBR 230.00 1	2001 Line	LN 215	665.1	101.50% 971MVA
14074 6POSSUM 230.00 14096 6WOODB A 230.00 1	215 Line	LN 2001	637.4	112.90% 822MVA
14096 6WOODB A 230.00 14870 6ENGPRVG 230.00 1	215 Line	LN 2001	565.9	103.30% 747MVA

Key: Overload Solution
Reconductor
Wreck & Rebuild
New Construction
Upgrade Bus

As shown above in Table A, the impact of the V1-031 generator under single contingency conditions results in thermal overloads of several 230kV line sections and the 230kV Bus at Idylwood.

2) The second being import and export conditions into and out of the Dominion System. Any new facility that is interconnected with the Dominion System should not significantly decrement FCITC between utilities. The results of these studies can be found in Tables B and C.

Table B: Import Study Results

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table C: Export Study Results

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Dominion's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies are indicate that the proposed generation facility will not impact Dominion's import or export capability.

Option 1 Interconnection Requirements

The following provides the estimated cost and schedule for the Non-Direct and Direct Connection Network Upgrades and the Attachment Facilities:

Non – Direct Connection Network Upgrades

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

The results of these studies, as indicated above in Table A, show that several 230kV line sections and the 230kV bus at Idylwood will be overloaded. To reliably interconnect the proposed generation with the Dominion Transmission System, the following upgrades will be required:

- Wreck and rebuild 30 miles of double circuit 230kV transmission line structures (lines 2022, 2097 and 237). This will cost an estimated $60 million and will take 48 months to complete.

- Reconductor 35 miles of 230kV transmission line for an estimated cost of $14 million (lines 215, 2001 and 2013). This work is estimated to take 30 to 36 months to complete
- Construct a 2nd 230kV transmission line from Pleasant View to Dickerson (line 203). Construction of this 10 mile 230kV transmission line, excluding right-of-way, is estimated to cost $10 million and will take 5 years to complete.
- Replace the 230kV tie breaker and terminal equipment at Idylwood's 230kV bus. This will cost an estimated $500,000 and will take 16 to 24 months to complete.
- Replace the twenty-five overduty 230kV breakers. This will cost an estimated $350,000 per breaker and will take approximate 36 months to complete.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None.

Direct Connection Network Upgrades

To reliably interconnect the proposed generation at Possum Point's 230kV Substation, it will be necessary to install five additional 230kV breakers in a breaker-and-a-half bus arrangement as shown in Attachment 1. Due to space limitations these new facilities will need to be Gas Insulated Switchgear (GIS). The installation of these breakers and associated equipment is estimated to cost $10 million and take 24 to 30 months to complete. Breaker duty studies are indicating that every 230 kV breaker at Possum Point needs to be replaced. Final engineering studies may indicate that space limitations at the Possum Point Site may require that the existing 230 kV substation be converted to GIS. If this occurs an additional $40 million will be required.

Attachment Facilities

The proposed layout and attachment facilities for the 230kV option # 1 are illustrated in Attachment 1. The estimated cost of these facilities which also includes metering, protection equipment along with three 0.5 mile 230kV lines is $1.8 Million and is estimated to take 24 months to complete.

Option 2: 500 kV Option

PJM Queue Project V1-031 was also studied as a 1000 MW Capacity injection at Possum Point 500 kV substation in the Dominion area. Project V1-031 was evaluated for compliance with reliability criteria for summer peak conditions in 2013. Potential network impacts were as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies only for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

None.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None.

Short Circuit Analysis

Analysis found four new breakers, to be over-duty in the Dominion transmission area. The new over-duty breakers are listed below for option 2:

BUS_NO	BUS	BREAKER	Rating Type	Duty Percent With v1-031_opt1_Dom	Duty Percent Without v1-031_opt1_Dom	Duty Percent Difference	Note
42	OX 230.kV	22042	S	100.80%	99.30%	1.50%	New Overduty
42	OX 230.kV	220T2063	S	100.80%	99.30%	1.50%	New Overduty
688	POSS PT CAP 230.kV	SC192	S	116.90%	103.10%	13.80%	Over 100%, > 3% contribution
899	OX L242 230.kV	L242	S	109.10%	105.80%	3.30%	Over 100%, > 3% contribution

Stability and Reactive Power Requirement

To be determined at the System Impact Study.

Dominion Study Results

Dominion assessed the impact on the Dominion Transmission System that the proposed 1000 MW injection of new generation capacity would have at the Possum Point 500 kV Substation. The system was assessed using the Summer 2013 RTEP case provided to Dominion by PJM for this analysis. This analysis did include the impacts of the generation capacity for all higher order queue generators within the Dominion Transmission System. When performing a generation analysis, Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions) and import/export system conditions. Dominion Criteria considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. For import/export studies Dominion considers a transmission facility overloaded if it exceeded 100% of its emergency rating. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at: http://www.dom.com.

As part of its generation impact analysis Dominion routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions and stressed system conditions. For the V1-031 evaluation three different assessments were conducted.

1) The first being when local generation including the proposed V1-031 Facility is operated at their maximum capability. The result of this study is shown below:

   None.

2) The second being a stressed system condition where the largest generator in the area is unavailable. Because the V1-031 generator is located on the 230kV system between Richmond and Northern Virginia, Possum Pt. Unit#5 is considered the most critical generating unit in the area. The impact of V1-031 was studied with the outage of Possum Point Unit #5. The result of this study is shown below in Table A.

   Table A: Stressed System Conditions

Overloaded Element	Element's Operating #	Contingency Label	Base-Line Loading (MVA)	Base-Line + V1-031
14138 6MINE RD 230.00 14197 6LDYSMT1 230.00 1	256 Line	LN 2032	 843.1	96.30% 913MVA

Key: Overload Solution
R/P Switches

   As shown in Table A, the impact of the V1-031 generator under single contingency conditions results in a thermal overload of the 230kV line section Mine Road to Ladysmith.

3) The third being import and export conditions into and out of the Dominion System. Any new facility that is interconnected with the Dominion System should not significantly decrement FCITC between utilities. The results of these studies can be found in Tables B and C.

Table B: Stressed System Conditions

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table C: Export Study Results

Area	Summer 2013	Summer 2013 with V1-031	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Dominion's Planning Criteria indicates a need to have approximately 2000 MW of import and export capability. The results of these import and export studies are indicate that the proposed generation facility will not impact Dominion's import or export capability.

Option 2 Interconnection Requirements

The following provides the estimated cost and schedule for the Non-Direct and Direct Connection Network Upgrades and the Attachment Facilities:

Non – Direct Connection Network Upgrades

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

The results of these studies, as indicated above in Table A, show that the 230 kV line section Mine Road to Ladysmith will be overloaded. To reliably interconnect the proposed generation with the Dominion Transmission System, this line section will need to be upgraded to handle the additional capacity.

To alleviate this thermal overload, the switches on the line section Mind Road to Ladysmith will need to be replaced. The estimated cost of this work is $300,000 and is estimated to take 12 months.

The four over duty 230kV breakers will need to be replaced. This will cost an estimated $350,000 per breaker and will take approximate 24 months to complete.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None.

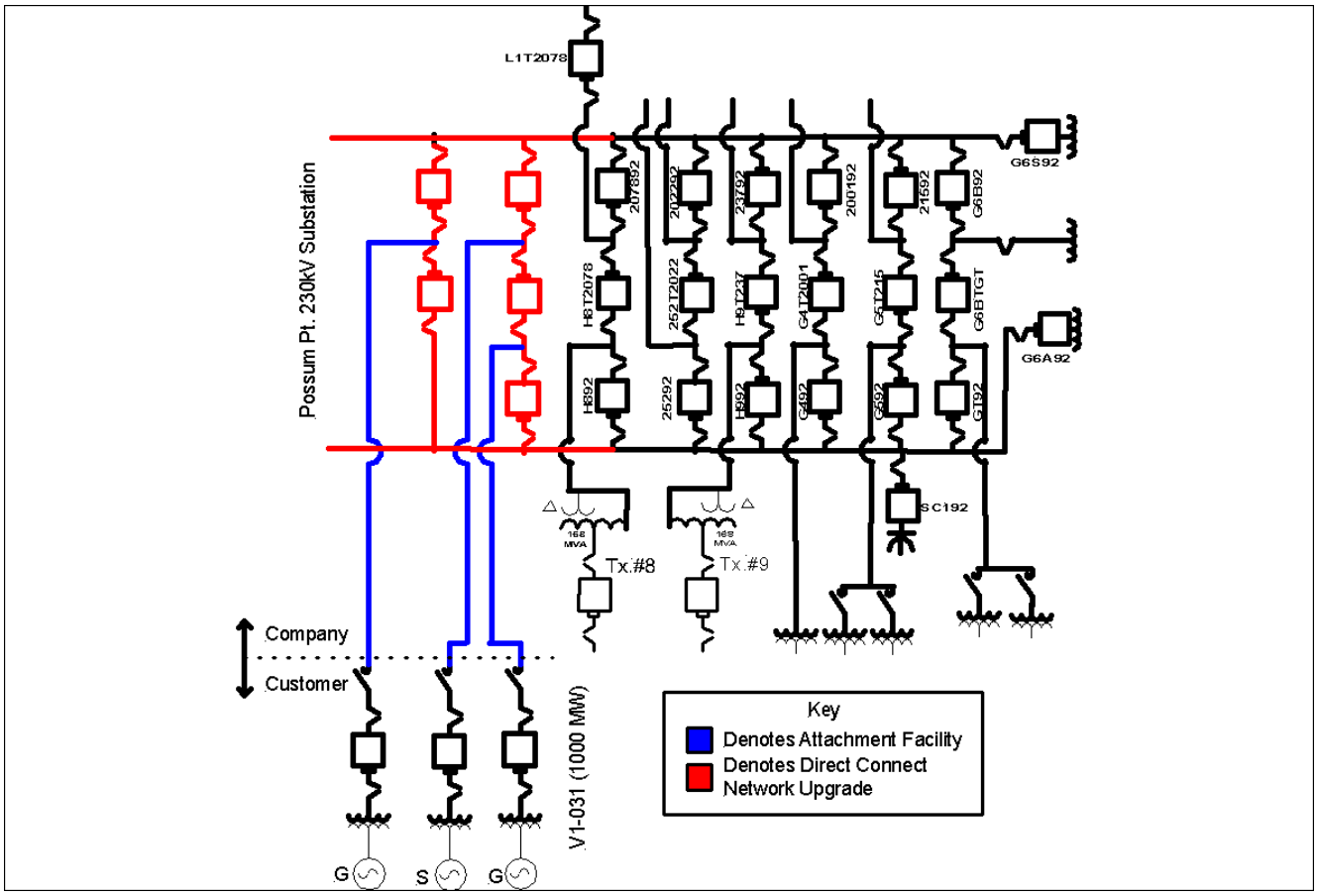
Direct Connection Network Upgrades

To reliably interconnect the proposed generation at Possum Point's 500kV Substation, it will be necessary to install 3 additional 500kV breakers in a breaker-and-a-half bus arrangement as shown below in Attachment 2. Due to space limitations these new facilities will need to be Gas Insulated Switchgear (GIS). The installation of these breakers and associated equipment is estimated to cost $11 million and take 24 to 30 months to complete.

Attachment Facilities

The proposed layout and attachment facilities for the 500kV option are illustrated in Attachment 2. The estimated cost of these facilities which also includes metering, protection equipment along with three 0.5 mile 500kV lines is $3 million and is estimated to take 24 months to complete.

Attachment 1: 230 kV Option Single Line



Attachment 2: 500 kV Option Single Line