

Generation Interconnection Feasibility Study Report Queue Position AC1-093

The Interconnection Customer (IC) has proposed an 18.8 MW (7.1 MWC) solar generating facility to be located in Townsend, New Castle County, Delaware. PJM studied the AC1-093 project as an 18.8 MW injection into the Delmarva Power and Light Company (DPL) system at the Cedar 138 kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2020. The planned in-service date, as requested by the IC during the project kick-off call, is June 30, 2018. This date may not be attainable due to additional PJM studies and the Transmission Owner's construction schedule.

Point of Interconnection

The Interconnection Customer requested AC1-093 utilize the same Point of Interconnection as their prior queue projects AC1-091 and AC1-092 at DPL's Cedar Creek 138 kV Substation.

Transmission Owner Scope of Direct Connection Work

It is assumed that all of the Transmission Owners attachment facilities work was completed as part of the AC1-091 project so no additional work is required for AC1-093.

Required Relaying and Communications

New protection relays are required for the new terminal. An SEL-487 will be required for primary protection and an SEL-387 will be required for back-up protection. One 20" relay panel for each line terminal will be required for front line and back-up protection.

An SEL-451 relay on a 10" breaker control panel will be required for the control and operation of each new 138 kV circuit breaker.

The project will require re-wiring and adjustment of existing relay schemes to accommodate the new 138 kV terminal.

The cost of the required relay and communications is included in the Substation Interconnection Estimate.

Metering

Three phase 138 kV revenue metering points will need to be established. DPL will purchase and install all metering instrument transformers as well as construct a metering structure. The secondary wiring connections at the instrument transformers will be completed by DPL's metering technicians. The metering control cable and meter cabinets will be supplied and installed by DPL. DPL will install conduit for the control cable between the instrument transformers and the metering enclosure. The location of the metering enclosure will be determined in the construction phase. DPL will provide both the Primary and the Backup meters. DPL's meter technicians will program and install the Primary & Backup solid state multi-function meters for each new metering position. Each meter will be equipped with load profile, telemetry, and DNP outputs. The IC will be provided with one

meter DNP output for each meter. DPL will own the metering equipment for the interconnection point, unless the IC asserts its right to install, own, and operate the metering system.

The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each Company metering position to facilitate remote interrogation and data collection.

It is the IC's responsibility to send the data that PJM and DPL requires directly to PJM. The IC will grant permission for PJM to send DPL the following telemetry that the IC sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

The estimate for DPL to design, purchase, and install metering as specified in the aforementioned scope for metering is included in the Substation Interconnection Estimate.

Interconnection Customer Scope of Work

The Interconnection Customer is responsible for all design and construction related to activities on their side of the Point of Interconnection. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. Route selection, line design, and right-of-way acquisition of the direct connect facilities is not included in this report, and is the responsibility of the IC. The IC is also required to provide revenue metering and real-time telemetering data to PJM in conformance with the requirements contained in PJM Manuals M-01 and M-14 and the PJM Tariff.

DPL Interconnection Customer Scope of Direct Connection Work Requirements

- DPL requires that an IC circuit breaker is located within 500 feet of Cedar Creek substation to facilitate the relay protection scheme between DPL and the IC at the Point of Interconnection (POI).

Special Operating Requirements

1. DPL will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. Such disconnection may be facilitated by a generator breaker, or other method depending upon the specific circumstances and the evaluation by DPL.
2. DPL reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering and telecommunications facilities, owned by DPL.

Summer Peak Analysis - 2020

Transmission Network Impacts

Potential transmission network impacts are 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, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

1. (DP&L - DP&L) The NMEREDTH-AB2-135 TAP 69 kV line (from bus 232812 to bus 924820 ckt 1) loads from 92.11% to 95.1% (DC power flow) of its emergency rating (93 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 2.78 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'/* RED LION-CEDAR CREEK 230;RED LION-CARTANZA
230
OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1
OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1
END

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

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)

1. (DP&L - DP&L) The MILF_230-STEELE 230 kV line (from bus 232004 to bus 232000 ckt 1) loads from 164.61% to 166.88% (DC power flow) of its emergency rating (551 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 12.51 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'/* RED LION-CEDAR CREEK 230;RED LION-CARTANZA
230
OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1
OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1
END

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

2. (DP&L - DP&L) The MIDLTNTP-MT PLSNT 138 kV line (from bus 232106 to bus 232104 ckt 1) loads from 112.9% to 114.09% (DC power flow) of its emergency rating (348 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 4.13 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'/* RED LION-CEDAR CREEK 230; RED LION-CARTANZA
230
OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1
END

Please refer to Appendix 3 for a table containing the generators having contribution to this flowgate.

3. (DP&L - DP&L) The TOWNSEND-MIDLTNTTP 138 kV line (from bus 232107 to bus 232106 ckt 1) loads from 123.62% to 124.81% (DC power flow) of its emergency rating (348 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 4.13 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'/* RED LION-CEDAR CREEK 230;RED LION-CARTANZA 230
OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1
OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1
END

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

4. (DP&L - DP&L) The KENT-NMEREDTH 69 kV line (from bus 232215 to bus 232812 ckt 1) loads from 117.17% to 120.15% (DC power flow) of its emergency rating (93 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 2.78 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'/* RED LION-CEDAR CREEK 230;RED LION-CARTANZA 230
OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1
OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1
END

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

5. (DP&L - DP&L) The AB2-135 TAP-CHURC_69 69 kV line (from bus 924820 to bus 232203 ckt 1) loads from 142.83% to 145.82% (DC power flow) of its emergency rating (93 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 2.78 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'/* RED LION-CEDAR CREEK 230;RED LION-CARTANZA 230
OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1
OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1
END

Please refer to Appendix 6 for a table containing the generators having contribution to this flowgate.

6. (DP&L - DP&L) The AB2-135 TAP-CHURC_69 69 kV line (from bus 924820 to bus 232203 ckt 1) loads from 109.03% to 109.75% (DC power flow) of its emergency rating (93 MVA) for the line fault with failed breaker contingency outage of 'DP11'. This project contributes approximately 1.48 MW to the thermal violation.

CONTINGENCY 'DP11'/*STEELE BUS BREAKER TO MILFORD
DISCONNECT BRANCH FROM BUS 232004 TO BUS 232000 CKT 1/*MILFORD STEELE
230 230
DISCONNECT BRANCH FROM BUS 232000 TO BUS 232005 CKT 1/*STEELE VIENNA
230 230
END

Summer Peak Load Flow Analysis Reinforcements

New System Reinforcements

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

1. To mitigate the (DP&L) MEREDTH-AB2-135 TAP 69 kV line (from bus 232812 to bus 924820 ckt 1) overload will require increasing the emergency rating of the AB2-135 to New Meredith 69 kV line by rebuilding the circuit. The rebuild will include the installation of new poles and a new disconnect switch. The estimated cost to perform this work is **\$8,674,000** and will take **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)

1. To mitigate the (DP&L) MILF_230-STEELE 230 kV line (from bus 232004 to bus 232000 ckt 1) overload will require increasing the emergency rating of the Milford to Steele 230 kV line by rebuilding the circuit. The rebuild includes the replacement of poles. The estimate to perform this work is **\$43,965,000** and will take **4 years** to complete.
2. To mitigate the (DP&L) MIDLTNTP-MT PLSNT 138 kV line (from bus 232106 to bus 232104 ckt 1) overload will require increasing the emergency rating of the Townsend to Middletown Tap 138 kV line by rebuilding of a small section of the circuit. The rebuild includes the installation of new poles and the re-mounting of 138 kV disconnect switches. The estimate to perform this work is **\$800,000** and will take **18 months** to complete.
3. To mitigate the (DP&L) TOWNSEND-MIDLTNTP 138 kV line (from bus 232107 to bus 232106 ckt 1) overload will require increasing the emergency rating of the Townsend to Middletown Tap 138 kV line by rebuilding of a small section of the circuit. The rebuild includes the installation of

new poles and the re-mounting of 138 kV disconnect switches. The estimate to perform this work is **\$800,000** and will take **18 months** to complete.

4. To mitigate the (DP&L) KENT-NMEREDTH 69 kV line (from bus 232215 to bus 232812 ckt 1) overload will require increasing the emergency rating of the Kent to New Meredith 69 kV line by rebuilding of the circuit. The rebuild includes the installation of new poles, new disconnect switches, and new relays. The estimate to perform this work is **\$9,720,000** and will take **24-36 months** to complete.
- 5&6. To mitigate the (DP&L) AB2-135 TAP-CHURC_69 69 kV line (from bus 924820 to bus 232203 ckt 1) overloads will require increasing the emergency rating of the AB2-135 to Church 69 kV line by rebuilding the circuit. The rebuild includes the installation of new poles and a new disconnect switch. The estimate to perform this work is **\$8,674,000** and will take **3 years** to complete.

Steady-State Voltage Requirements

To be performed during later study phases.

Short Circuit

No issues identified.

Stability and Reactive Power Requirement

To be performed during later study phases.

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Facilities Study Estimate

7 months: \$100,000

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

None

Delmarva Power and Light Costs

Cost estimates will further be refined as a part of the Impact Study and Facilities Study for this project. The Interconnection Customer will be responsible for all costs incurred by DPL in connection with the AC1-093 project. Such costs may include, but are not limited to, any transmission system assets currently in DPL's rate base that are prematurely retired due to the AC1-093 project. PJM shall work with DPL to identify these retirement costs and any additional expenses. DPL reserves the right to reassess issues presented in this document and, upon appropriate justification, submit additional costs related to the AC1-093 project.

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(DP&L - DP&L) The NMEREDTH-AB2-135 TAP 69 kV line (from bus 232812 to bus 924820 ckt 1) loads from 92.11% to 95.1% (DC power flow) of its emergency rating (93 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 2.78 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'

/* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
232900	DEMECSMY	1.59
232851	DUP-SFR1	0.19
232923	MR1	1.32
232924	MR2	1.32
232910	NRG_G1	2.93
232911	NRG_G2	2.93
297077	V2-028 E	0.2
904212	V4-022E	0.21
232813	VAUGHN	0.16
901004	W1-003 E	0.3

901014	W1-004 E	0.3
901024	W1-005 E	0.3
901034	W1-006 E	0.3
901411	W1-062	1.69
907052	X1-032 E	0.26
907324	X1-096 E	5.97
913412	Y1-080 E	0.11
915542	Y3-058 E	0.6
920582	Z1-076 C	0.36
920583	Z1-076 E	0.58
920592	Z1-077 C	0.25
920593	Z1-077 E	0.41
917082	Z2-012 E	0.82
920763	Z2-076 E	0.15
920773	Z2-077 E	0.15
921122	AA1-059 C	0.28
921123	AA1-059 E	0.11
921592	AA1-140 C	0.58
921593	AA1-140 E	0.95
921602	AA1-141 C	0.38
921603	AA1-141 E	0.62
921872	AA2-069	41.18
922213	AA2-129 E	1.33
922222	AA2-130	0.13
922752	AB1-056 C OP	4.98
922753	AB1-056 E OP	14.19
922762	AB1-057 C	5.06
922763	AB1-057 E	14.42
923282	AB1-137 C	1.1
923283	AB1-137 E	0.47
923902	AB2-030 E	0.27
923931	AB2-033 C	0.47
923932	AB2-033 E	0.19
924361	AB2-084 C	0.25
924362	AB2-084 E	0.4
924681	AB2-120 C OP	2.53
924682	AB2-120 E OP	4.13
924781	AB2-130 C OP	3.13
924782	AB2-130 E OP	5.11
925091	AB2-166 C	0.14
925092	AB2-166 E	0.24
925101	AB2-167 C	0.35
925102	AB2-167 E	0.58
925231	AB2-177 C	0.17
925232	AB2-177 E	0.28

925261	AB2-180 C	0.9
925262	AB2-180 E	0.38
925381	AC1-009 C	0.5
925382	AC1-009 E	0.82
925531	AC1-028	0.25
925651	AC1-041 C	0.13
925652	AC1-041 E	0.21
925731	AC1-049 C	0.12
925732	AC1-049 E	0.19
925741	AC1-050 C	0.11
925742	AC1-050 E	0.18
925761	AC1-052 C	0.66
925762	AC1-052 E	0.27
926131	AC1-091 C	1.11
926132	AC1-091 E	1.82
926141	AC1-092 C	1.11
926142	AC1-092 E	1.82
926151	AC1-093 C	1.05
926152	AC1-093 E	1.73
926161	AC1-094 C	0.89
926162	AC1-094 E	1.46
926171	AC1-095 C	0.92
926172	AC1-095 E	0.69
926911	AC1-177	0.26
926931	AC1-180	0.38
927191	AC1-213 C	0.23
927192	AC1-213 E	0.12
927321	AC1-229 C	0.3
927322	AC1-229 E	0.49

Appendix 2

(DP&L - DP&L) The MILF_230-STEELE 230 kV line (from bus 232004 to bus 232000 ckt 1) loads from 164.61% to 166.88% (DC power flow) of its emergency rating (551 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 12.51 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'

/* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
232900	DEMECSMY	5.8
232616	GEN FOOD	2.12

232904	<i>IR4</i>	51.07
232923	<i>MR1</i>	12.53
232924	<i>MR2</i>	12.53
232922	<i>MR3</i>	14.25
232901	<i>NORTHST</i>	6.29
297077	<i>V2-028 E</i>	1.28
904212	<i>V4-022E</i>	1.52
901004	<i>W1-003 E</i>	2.22
901014	<i>W1-004 E</i>	2.22
901024	<i>W1-005 E</i>	2.22
901034	<i>W1-006 E</i>	2.22
901411	<i>W1-062</i>	6.16
903511	<i>W3-032A</i>	43.16
907052	<i>X1-032 E</i>	1.89
907324	<i>X1-096 E</i>	42.96
910572	<i>X3-008 E</i>	3.32
910592	<i>X3-015 E</i>	3.81
913412	<i>Y1-080 E</i>	0.68
915542	<i>Y3-058 E</i>	4.1
920582	<i>Z1-076 C</i>	2.64
920583	<i>Z1-076 E</i>	4.3
920592	<i>Z1-077 C</i>	1.88
920593	<i>Z1-077 E</i>	3.07
917082	<i>Z2-012 E</i>	6.09
920763	<i>Z2-076 E</i>	1.22
920773	<i>Z2-077 E</i>	1.22
921122	<i>AA1-059 C</i>	1.99
921123	<i>AA1-059 E</i>	0.79
921142	<i>AA1-061 C</i>	3.72
921143	<i>AA1-061 E</i>	1.83
921592	<i>AA1-140 C</i>	4.6
921593	<i>AA1-140 E</i>	7.51
921602	<i>AA1-141 C</i>	2.84
921603	<i>AA1-141 E</i>	4.63
921872	<i>AA2-069</i>	390.53
922213	<i>AA2-129 E</i>	9.83
922222	<i>AA2-130</i>	0.92
922752	<i>AB1-056 C OP</i>	41.89
922753	<i>AB1-056 E OP</i>	119.31
922762	<i>AB1-057 C</i>	42.55
922763	<i>AB1-057 E</i>	121.26
923282	<i>AB1-137 C</i>	8.78
923283	<i>AB1-137 E</i>	3.76
923902	<i>AB2-030 E</i>	1.96
923931	<i>AB2-033 C</i>	3.52

923932	AB2-033 E	1.39
924361	AB2-084 C	1.79
924362	AB2-084 E	2.93
924681	AB2-120 C OP	18.79
924682	AB2-120 E OP	30.65
924781	AB2-130 C OP	19.74
924782	AB2-130 E OP	32.21
924831	AB2-136 C OP	7.6
924832	AB2-136 E OP	10.79
925091	AB2-166 C	0.95
925092	AB2-166 E	1.66
925101	AB2-167 C	2.63
925102	AB2-167 E	4.31
925151	AB2-172 C OP	5.08
925152	AB2-172 E OP	8.29
925231	AB2-177 C	1.25
925232	AB2-177 E	2.04
925261	AB2-180 C	6.18
925262	AB2-180 E	2.65
925381	AC1-009 C	3.73
925382	AC1-009 E	6.09
925531	AC1-028	1.79
925651	AC1-041 C	0.95
925652	AC1-041 E	1.55
925731	AC1-049 C	0.91
925732	AC1-049 E	1.51
925741	AC1-050 C	0.74
925742	AC1-050 E	1.21
925761	AC1-052 C	4.91
925762	AC1-052 E	1.96
926131	AC1-091 C	4.99
926132	AC1-091 E	8.18
926141	AC1-092 C	4.99
926142	AC1-092 E	8.18
926151	AC1-093 C	4.72
926152	AC1-093 E	7.78
926161	AC1-094 C	3.99
926162	AC1-094 E	6.59
926171	AC1-095 C	4.13
926172	AC1-095 E	3.13
926911	AC1-177	1.85
926931	AC1-180	2.77
927031	AC1-190 C	9.61
927032	AC1-190 E	4.12
927191	AC1-213 C	1.65

927192	<i>AC1-213 E</i>	<i>0.85</i>
927311	<i>AC1-228 C</i>	<i>0.29</i>
927312	<i>AC1-228 E</i>	<i>0.51</i>
927321	<i>AC1-229 C</i>	<i>2.39</i>
927322	<i>AC1-229 E</i>	<i>3.89</i>

Appendix 3

(DP&L - DP&L) The MIDLTNTP-MT PLSNT 138 kV line (from bus 232106 to bus 232104 ckt 1) loads from 112.9% to 114.09% (DC power flow) of its emergency rating (348 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 4.13 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'

/* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
232900	DEMECSMY	2.08
232851	DUP-SFR1	0.39
232902	EASTMUNI	3.29
232923	MR1	3.37
232924	MR2	3.37
232910	NRG_G1	2.36
232911	NRG_G2	2.36
292089	T-011	0.16
297076	V2-028 C	0.09
297077	V2-028 E	0.75
904212	V4-022E	0.61
232813	VAUGHN	0.15
232919	VN10	0.55
901004	W1-003 E	0.89
901014	W1-004 E	0.89
901024	W1-005 E	0.89
901034	W1-006 E	0.89
901411	W1-062	2.21
907052	X1-032 E	0.79
907324	X1-096 E	18.29
910571	X3-008 C	0.31
910572	X3-008 E	2.68
910591	X3-015 C	0.29
910592	X3-015 E	2.52
910821	X3-066 C	0.16
910822	X3-066 E	1.41
913361	Y1-079 C	0.23
913362	Y1-079 E	1.96
913411	Y1-080 C	0.05
913412	Y1-080 E	0.43
915751	Y3-033	1.02

915752	Y3-033	38.64
915541	Y3-058 C	0.22
915542	Y3-058 E	1.86
920582	Z1-076 C	1.05
920583	Z1-076 E	1.71
920592	Z1-077 C	0.75
920593	Z1-077 E	1.22
916281	Z1-081 C	0.19
916282	Z1-081 E	1.65
917082	Z2-012 E	2.45
920763	Z2-076 E	0.4
920773	Z2-077 E	0.4
920812	Z2-097 C	1.57
920813	Z2-097 E	0.65
921122	AA1-059 C	0.85
921123	AA1-059 E	0.33
921142	AA1-061 C	2.88
921143	AA1-061 E	1.42
921442	AA1-110 C	1.78
921443	AA1-110 E	0.89
921592	AA1-140 C	1.52
921593	AA1-140 E	2.47
921602	AA1-141 C	1.13
921603	AA1-141 E	1.84
921872	AA2-069	104.95
922213	AA2-129 E	3.94
922222	AA2-130	0.39
922752	AB1-056 C OP	12.81
922753	AB1-056 E OP	36.48
922762	AB1-057 C	13.01
922763	AB1-057 E	37.08
923282	AB1-137 C	2.79
923283	AB1-137 E	1.2
923322	AB1-141 C OP	5.3
923323	AB1-141 E OP	2.47
923332	AB1-142 C OP	5.3
923333	AB1-142 E OP	2.47
923452	AB1-162 C OP	2.4
923453	AB1-162 E OP	3.92
923602	AB1-176 C	1.29
923603	AB1-176 E	2.12
923902	AB2-030 E	0.79
923921	AB2-032 C	5.34
923922	AB2-032 E	2.51
923931	AB2-033 C	1.41

923932	AB2-033 E	0.56
923951	AB2-036 C	11.73
923952	AB2-036 E	19.19
923961	AB2-037 C	12.75
923962	AB2-037 E	20.83
924191	AB2-063 C	2.87
924192	AB2-063 E	4.69
924361	AB2-084 C	0.75
924362	AB2-084 E	1.22
924681	AB2-120 C OP	7.5
924682	AB2-120 E OP	12.23
924781	AB2-130 C OP	7.74
924782	AB2-130 E OP	12.63
924801	AB2-133 C OP	14.21
924802	AB2-133 E OP	19.1
924821	AB2-135 C	12.06
924822	AB2-135 E	13.76
924831	AB2-136 C OP	5.2
924832	AB2-136 E OP	7.38
924881	AB2-142 C	1.14
924882	AB2-142 E	1.85
924971	AB2-153 C	2.98
924972	AB2-153 E	4.87
925091	AB2-166 C	0.4
925092	AB2-166 E	0.7
925101	AB2-167 C	1.05
925102	AB2-167 E	1.72
925151	AB2-172 C OP	4.11
925152	AB2-172 E OP	6.71
925231	AB2-177 C	0.49
925232	AB2-177 E	0.81
925251	AB2-179 C OP	26.3
925252	AB2-179 E OP	8.67
925261	AB2-180 C	2.8
925262	AB2-180 E	1.2
925271	AB2-185 C OP	4.42
925272	AB2-185 E OP	1.9
925381	AC1-009 C	1.5
925382	AC1-009 E	2.45
925531	AC1-028	0.76
925651	AC1-041 C	0.38
925652	AC1-041 E	0.61
925731	AC1-049 C	0.3
925732	AC1-049 E	0.5
925741	AC1-050 C	0.38

925742	AC1-050 E	0.63
925761	AC1-052 C	1.97
925762	AC1-052 E	0.79
926131	AC1-091 C	1.65
926132	AC1-091 E	2.7
926141	AC1-092 C	1.65
926142	AC1-092 E	2.7
926151	AC1-093 C	1.56
926152	AC1-093 E	2.57
926161	AC1-094 C	1.32
926162	AC1-094 E	2.18
926171	AC1-095 C	1.36
926172	AC1-095 E	1.03
926721	AC1-154 C	0.49
926722	AC1-154 E	0.82
926911	AC1-177	0.79
926931	AC1-180	1.18
927031	AC1-190 C	7.53
927032	AC1-190 E	3.23
927191	AC1-213 C	0.7
927192	AC1-213 E	0.36
927241	AC1-220 C OP	5.86
927242	AC1-220 E OP	4.16
927272	AC1-224 E	0.63
927311	AC1-228 C	0.24
927312	AC1-228 E	0.41
927321	AC1-229 C	0.76
927322	AC1-229 E	1.24

Appendix 4

(DP&L - DP&L) The TOWNSEND-MIDLTNTP 138 kV line (from bus 232107 to bus 232106 ckt 1) loads from 123.62% to 124.81% (DC power flow) of its emergency rating (348 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 4.13 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'

/* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
232900	DEMECSMY	2.08
232851	DUP-SFR1	0.39
232902	EASTMUNI	3.29

232923	MR1	3.37
232924	MR2	3.37
232910	NRG_G1	2.36
232911	NRG_G2	2.36
292089	T-011	0.16
297076	V2-028 C	0.09
297077	V2-028 E	0.75
904212	V4-022E	0.61
232813	VAUGHN	0.15
232919	VN10	0.55
901004	W1-003 E	0.89
901014	W1-004 E	0.89
901024	W1-005 E	0.89
901034	W1-006 E	0.89
901411	W1-062	2.21
907052	X1-032 E	0.79
907324	X1-096 E	18.29
910571	X3-008 C	0.31
910572	X3-008 E	2.68
910591	X3-015 C	0.29
910592	X3-015 E	2.52
910821	X3-066 C	0.16
910822	X3-066 E	1.41
913361	Y1-079 C	0.23
913362	Y1-079 E	1.96
913411	Y1-080 C	0.05
913412	Y1-080 E	0.43
915751	Y3-033	1.02
915752	Y3-033	38.64
915541	Y3-058 C	0.22
915542	Y3-058 E	1.86
920582	Z1-076 C	1.05
920583	Z1-076 E	1.71
920592	Z1-077 C	0.75
920593	Z1-077 E	1.22
916281	Z1-081 C	0.19
916282	Z1-081 E	1.65
917082	Z2-012 E	2.45
920763	Z2-076 E	0.4
920773	Z2-077 E	0.4
920812	Z2-097 C	1.57
920813	Z2-097 E	0.65
921122	AA1-059 C	0.85
921123	AA1-059 E	0.33
921142	AA1-061 C	2.88

921143	AA1-061 E	1.42
921442	AA1-110 C	1.78
921443	AA1-110 E	0.89
921592	AA1-140 C	1.52
921593	AA1-140 E	2.47
921602	AA1-141 C	1.13
921603	AA1-141 E	1.84
921872	AA2-069	104.95
922213	AA2-129 E	3.94
922222	AA2-130	0.39
922752	AB1-056 C OP	12.81
922753	AB1-056 E OP	36.48
922762	AB1-057 C	13.01
922763	AB1-057 E	37.08
923282	AB1-137 C	2.79
923283	AB1-137 E	1.2
923322	AB1-141 C OP	5.3
923323	AB1-141 E OP	2.47
923332	AB1-142 C OP	5.3
923333	AB1-142 E OP	2.47
923452	AB1-162 C OP	2.4
923453	AB1-162 E OP	3.92
923602	AB1-176 C	1.29
923603	AB1-176 E	2.12
923902	AB2-030 E	0.79
923921	AB2-032 C	5.34
923922	AB2-032 E	2.51
923931	AB2-033 C	1.41
923932	AB2-033 E	0.56
923951	AB2-036 C	11.73
923952	AB2-036 E	19.19
923961	AB2-037 C	12.75
923962	AB2-037 E	20.83
924191	AB2-063 C	2.87
924192	AB2-063 E	4.69
924361	AB2-084 C	0.75
924362	AB2-084 E	1.22
924681	AB2-120 C OP	7.5
924682	AB2-120 E OP	12.23
924781	AB2-130 C OP	7.74
924782	AB2-130 E OP	12.63
924801	AB2-133 C OP	14.21
924802	AB2-133 E OP	19.1
924821	AB2-135 C	12.06
924822	AB2-135 E	13.76

924831	AB2-136 C OP	5.2
924832	AB2-136 E OP	7.38
924881	AB2-142 C	1.14
924882	AB2-142 E	1.85
924971	AB2-153 C	2.98
924972	AB2-153 E	4.87
925091	AB2-166 C	0.4
925092	AB2-166 E	0.7
925101	AB2-167 C	1.05
925102	AB2-167 E	1.72
925151	AB2-172 C OP	4.11
925152	AB2-172 E OP	6.71
925231	AB2-177 C	0.49
925232	AB2-177 E	0.81
925251	AB2-179 C OP	26.3
925252	AB2-179 E OP	8.67
925261	AB2-180 C	2.8
925262	AB2-180 E	1.2
925271	AB2-185 C OP	4.42
925272	AB2-185 E OP	1.9
925381	AC1-009 C	1.5
925382	AC1-009 E	2.45
925531	AC1-028	0.76
925651	AC1-041 C	0.38
925652	AC1-041 E	0.61
925731	AC1-049 C	0.3
925732	AC1-049 E	0.5
925741	AC1-050 C	0.38
925742	AC1-050 E	0.63
925761	AC1-052 C	1.97
925762	AC1-052 E	0.79
926131	AC1-091 C	1.65
926132	AC1-091 E	2.7
926141	AC1-092 C	1.65
926142	AC1-092 E	2.7
926151	AC1-093 C	1.56
926152	AC1-093 E	2.57
926161	AC1-094 C	1.32
926162	AC1-094 E	2.18
926171	AC1-095 C	1.36
926172	AC1-095 E	1.03
926721	AC1-154 C	0.49
926722	AC1-154 E	0.82
926911	AC1-177	0.79
926931	AC1-180	1.18

927031	AC1-190 C	7.53
927032	AC1-190 E	3.23
927191	AC1-213 C	0.7
927192	AC1-213 E	0.36
927241	AC1-220 C OP	5.86
927242	AC1-220 E OP	4.16
927272	AC1-224 E	0.63
927311	AC1-228 C	0.24
927312	AC1-228 E	0.41
927321	AC1-229 C	0.76
927322	AC1-229 E	1.24

Appendix 5

(DP&L - DP&L) The KENT-NMEREDTH 69 kV line (from bus 232215 to bus 232812 ckt 1) loads from 117.17% to 120.15% (DC power flow) of its emergency rating (93 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 2.78 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'

/* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
232900	DEMECSMY	1.59
232851	DUP-SFR1	0.19
232923	MR1	1.32
232924	MR2	1.32
232910	NRG_G1	2.93
232911	NRG_G2	2.93
297077	V2-028 E	0.2
904212	V4-022E	0.21
232813	VAUGHN	0.16
901004	W1-003 E	0.3
901014	W1-004 E	0.3
901024	W1-005 E	0.3
901034	W1-006 E	0.3
901411	W1-062	1.69
907052	X1-032 E	0.26
907324	X1-096 E	5.97
913412	Y1-080 E	0.11
915542	Y3-058 E	0.6
920582	Z1-076 C	0.36
920583	Z1-076 E	0.58

920592	Z1-077 C	0.25
920593	Z1-077 E	0.41
917082	Z2-012 E	0.82
920763	Z2-076 E	0.15
920773	Z2-077 E	0.15
921122	AA1-059 C	0.28
921123	AA1-059 E	0.11
921592	AA1-140 C	0.58
921593	AA1-140 E	0.95
921602	AA1-141 C	0.38
921603	AA1-141 E	0.62
921872	AA2-069	41.18
922213	AA2-129 E	1.33
922222	AA2-130	0.13
922752	AB1-056 C OP	4.98
922753	AB1-056 E OP	14.19
922762	AB1-057 C	5.06
922763	AB1-057 E	14.42
923282	AB1-137 C	1.1
923283	AB1-137 E	0.47
923902	AB2-030 E	0.27
923931	AB2-033 C	0.47
923932	AB2-033 E	0.19
924361	AB2-084 C	0.25
924362	AB2-084 E	0.4
924681	AB2-120 C OP	2.53
924682	AB2-120 E OP	4.13
924781	AB2-130 C OP	3.13
924782	AB2-130 E OP	5.11
925091	AB2-166 C	0.14
925092	AB2-166 E	0.24
925101	AB2-167 C	0.35
925102	AB2-167 E	0.58
925231	AB2-177 C	0.17
925232	AB2-177 E	0.28
925261	AB2-180 C	0.9
925262	AB2-180 E	0.38
925381	AC1-009 C	0.5
925382	AC1-009 E	0.82
925531	AC1-028	0.25
925651	AC1-041 C	0.13
925652	AC1-041 E	0.21
925731	AC1-049 C	0.12
925732	AC1-049 E	0.19
925741	AC1-050 C	0.11

925742	AC1-050 E	0.18
925761	AC1-052 C	0.66
925762	AC1-052 E	0.27
926131	AC1-091 C	1.11
926132	AC1-091 E	1.82
926141	AC1-092 C	1.11
926142	AC1-092 E	1.82
926151	AC1-093 C	1.05
926152	AC1-093 E	1.73
926161	AC1-094 C	0.89
926162	AC1-094 E	1.46
926171	AC1-095 C	0.92
926172	AC1-095 E	0.69
926911	AC1-177	0.26
926931	AC1-180	0.38
927191	AC1-213 C	0.23
927192	AC1-213 E	0.12
927321	AC1-229 C	0.3
927322	AC1-229 E	0.49

Appendix 6

(DP&L - DP&L) The AB2-135 TAP-CHURC_69 69 kV line (from bus 924820 to bus 232203 ckt 1) loads from 142.83% to 145.82% (DC power flow) of its emergency rating (93 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 2.78 MW to the thermal violation.

CONTINGENCY 'DBL_4NC'

/* RED LION-CEDAR CREEK

230;RED LION-CARTANZA 230

OPEN LINE FROM BUS 231004 TO BUS 232002 CKT 1

OPEN LINE FROM BUS 231004 TO BUS 232003 CKT 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
232900	DEMECSMY	1.59
232851	DUP-SFR1	0.19
232923	MR1	1.32
232924	MR2	1.32
232910	NRG_G1	2.93
232911	NRG_G2	2.93
904212	V4-022E	0.21
232813	VAUGHN	0.16
901004	W1-003 E	0.3
901014	W1-004 E	0.3
901024	W1-005 E	0.3
901034	W1-006 E	0.3

901411	W1-062	1.69
907052	X1-032 E	0.26
907324	X1-096 E	5.97
915542	Y3-058 E	0.6
920582	Z1-076 C	0.36
920583	Z1-076 E	0.58
920592	Z1-077 C	0.25
920593	Z1-077 E	0.41
917082	Z2-012 E	0.82
920763	Z2-076 E	0.15
920773	Z2-077 E	0.15
921122	AA1-059 C	0.28
921123	AA1-059 E	0.11
921592	AA1-140 C	0.58
921593	AA1-140 E	0.95
921602	AA1-141 C	0.38
921603	AA1-141 E	0.62
921872	AA2-069	41.18
922213	AA2-129 E	1.33
922222	AA2-130	0.13
922752	AB1-056 C OP	4.98
922753	AB1-056 E OP	14.19
922762	AB1-057 C	5.06
922763	AB1-057 E	14.42
923282	AB1-137 C	1.1
923283	AB1-137 E	0.47
923902	AB2-030 E	0.27
923931	AB2-033 C	0.47
923932	AB2-033 E	0.19
924361	AB2-084 C	0.25
924362	AB2-084 E	0.4
924681	AB2-120 C OP	2.53
924682	AB2-120 E OP	4.13
924781	AB2-130 C OP	3.13
924782	AB2-130 E OP	5.11
924821	AB2-135 C	22.27
924822	AB2-135 E	25.4
925091	AB2-166 C	0.14
925092	AB2-166 E	0.24
925101	AB2-167 C	0.35
925102	AB2-167 E	0.58
925231	AB2-177 C	0.17
925232	AB2-177 E	0.28
925261	AB2-180 C	0.9
925262	AB2-180 E	0.38

925381	AC1-009 C	0.5
925382	AC1-009 E	0.82
925531	AC1-028	0.25
925651	AC1-041 C	0.13
925652	AC1-041 E	0.21
925731	AC1-049 C	0.12
925732	AC1-049 E	0.19
925761	AC1-052 C	0.66
925762	AC1-052 E	0.27
926131	AC1-091 C	1.11
926132	AC1-091 E	1.82
926141	AC1-092 C	1.11
926142	AC1-092 E	1.82
926151	AC1-093 C	1.05
926152	AC1-093 E	1.73
926161	AC1-094 C	0.89
926162	AC1-094 E	1.46
926171	AC1-095 C	0.92
926172	AC1-095 E	0.69
926911	AC1-177	0.26
926931	AC1-180	0.38
927191	AC1-213 C	0.23
927192	AC1-213 E	0.12
927321	AC1-229 C	0.3
927322	AC1-229 E	0.49