Generation Interconnection
Feasibility Study Report
Queue Position AB2-167

The Interconnection Customer (IC) has proposed a 14 MW (5.3 MWC) solar generating facility to be located in Worcester County, Maryland. PJM studied the AB2-167 project at both a Primary and Secondary Point of Interconnection. The study results are provided below. The planned in-service date, as requested by the IC during the project kick-off call, is November 1, 2017. This date is not attainable due to additional required PJM studies and Transmission Owner construction schedules.

Point(s) of Interconnection

The Interconnection Customer requested a Primary and Secondary Point of Interconnection (POI) be evaluated for the AB2-167 project.

Primary Point of Interconnection

The IC requested a distribution level interconnection for the Primary POI option. As a result, PJM studied the AB2-167 project into the Delmarva Power and Light Company (DPL) system at the Stockton 69 kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2020.

The AB2-167 project will interconnect with the Delmarva Power and Light distribution system as follows:

> The first 10 MWs will connect to a new T1 transformer via a new 25 kV express feeder to a new 69/25 kV substation; the next 4 MWs will connect to a new T2 transformer at the new substation via a new 25 kV express feeder.

Direct Connection Requirements

Criteria Limits for Distributed Energy Resource (DER) Connections to the ACE, DPL and Pepco Distribution Systems (less than 69kV)

1. Single Phase Limit

Any DER with a capacity that exceeds 100 kW shall be a balanced 3 phase system.

2. Voltage Limits

DER's are permitted to cause a voltage fluctuation of up to 2% at the Point of Interconnection, ½ the band width of any voltage regulator at its terminals, and ½ the net dead band of a switched capacitor bank at its connection point. When a DER is at maximum output, it shall not raise the feeder voltage above the ANSI C84.1 or state limit, whichever is more conservative.

3. Existing Distribution Circuit Capacity Limits

The aggregate limit of large (250 kW and over) generators running in parallel with a single, existing distribution circuit is 0.5 MWs on the 4kV, 3MWs on the 12 kV, 6 MWs on the 25 kV, and 10 MWs on the 34 kV.

4. Express Circuit Capacity Limits
Distributed generation installations which exceed the limit for an existing circuit require an express circuit.

The maximum generator size for express circuits shall be:

- 4 kV 0.5 MW
- 12 – 13.8 kV 10 MW
- 23 – 25 kV 10 MW
- 33.26 – 34.5 kV 15 MW

5. Distribution Power Transformer Limit
The aggregate limit of large (250 kW and over) generator injection to a single distribution transformer of 22.5 MVA nameplate or larger is 10 MWs. Transformers with nameplate ratings lower than 22.5 MVA will be given lower ratings on an individual basis. If the transformer rating is significantly greater than 40 MVA it may be possible to consider a greater generation capacity.

Adding a new transformer will be considered if there is no availability on any of the existing transformers and space is available in an existing substation. Any proposed transformers would be PHI's standard distribution transformer.

6. Express Circuit Length Limit
If there is no space for an additional transformer at the closest substation, the next closest substation will be considered. The length of an express circuit is limited to 5 miles, or for the sake of the feasibility study, 3.8 straight line miles to the substation. This simplification is used because the feasibility study phase does not allow for the time and resources to examine routes in detail (including existing pole lines, easements, ROW, and environmental issues etc.)

7. When a New Substation is Required
If a distribution express circuit can't be built from an existing substation for a project, it will be necessary to construct a new distribution substation with a standard ring bus design. It will be supplied by extending existing transmission lines. It is the developer's responsibility to verify eligibility of this configuration for solar renewable energy certificates.

All limits, given above in MWs, are subject to more detailed study to ensure feasibility.

Transmission Owner Scope of Work
Due to space constraints at the Stockton substation, the 25 kV system cannot be expanded to accommodate he AB2-167 project. Therefore, the AB2-167 project will require a new 69/25 kV substation. Estimates do not include the cost of right of way permits or any purchase of land that may be needed to build an express feeder and substation. Express feeder cannot exceed 5 miles.

TO work required to accommodate 10 MWs of generation on an express feeder from a new T1 transformer at the new 69/25 kV substation:

1. One new 37 MVA 69/25 kV transformer will be constructed.

2. One new 25 kV feeder terminal position will be constructed.
3. One new 69 kV feeder terminal position will be constructed.
4. The construction of a new 69kV, three breaker ring bus will be required
5. A utility operated recloser equipped with the proper relaying and communications will be required.
6. Utility grade primary metering will be required.
7. Generation telemetry and remote trip capability will be provided to the control center.
8. A detailed, time-based study may be performed during later study phases.
9. Protection, Planning, and other engineering departments will perform studies, design work, and prepare engineering estimates.
10. Direct transfer trip will be required. 48SM ADSS fiber optic cable will be required to provide the communication channel. 69 kV potential transformers will need to be installed.
11. The voltage regulators in the new substation should be specified to handle reverse power flow.

NEW Substation New T1			
477 AAC Express Feeder	2.5	Miles	$1,000,000
Fiber Installation			$125,000
Transformer			$3,000,000
69 & 25 kV Feeder Terminals			$600,000
69 kV Ring Bus			$3,000,000
Substation Relaying & 69 kV PTs			$300,000
Recloser & Metering			$80,000
SCADA Integration into EMS			$10,000
Dynamic Study			$50,000
Various Departments Work			$90,000
Subtotal Cost			$8,255,000
Approximate Total Cost with 15% Contingency			$9,493,250

The estimated time to complete this work is **36-48 months** after receipt of a fully executed interconnection agreement

TO work required to accommodate 4 MWs of generation on an express feeder from a new transformer T2 at a new substation:

1. One new 37 MVA 69/25 kV transformer will be constructed.
2. One new 25 kV feeder terminal position will be constructed.
3. One new 69 kV feeder terminal position will be constructed.
4. The construction of a new 69kV, three breaker ring bus will be required
5. A utility operated recloser equipped with the proper relaying and communications will be required.
6. Utility grade primary metering will be required.
7. Generation telemetry and remote trip capability will be provided to the control center.
8. A detailed, time-based study may be performed during later study phases.

9. Protection, Planning, and other engineering departments will perform studies, design work, and prepare engineering estimates.
10. Direct transfer trip will be required. 48SM ADSS fiber optic cable will be required to provide the communication channel. 69 kV potential transformers will need to be installed.
11. The voltage regulators in the new substation should be specified to handle reverse power flow.

NEW Substation New T2			
477 AAC Express Feeder	2.5	Miles	$1,000,000
Fiber Installation			$125,000
Transformer			$3,000,000
69 & 25 kV Feeder Terminals			$600,000
69 kV Ring Bus			Included in New T1
Substation Relaying & 69 kV PTs			$300,000
Recloser & Metering			$80,000
SCADA Integration into EMS			$10,000
Dynamic Study			$50,000
Various Departments Work			$90,000
Subtotal Cost			$5,255,000
Approximate Total Cost with 15% Contingency			$6,043,250

The estimated time to complete this work is **36-48 months** after receipt of a fully executed interconnection agreement

Interconnection Customer Scope of Work

The Interconnection Customer (IC) 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.

Protective relaying and metering design and installation must comply with PHI's applicable standards. 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.

The IC will purchase and install all metering instrument transformers as well as construct a metering structure per PHI's specifications. The secondary wiring connections at the instrument transformers will be completed by the interconnection customer's contractors and inspected by PHI, while the secondary wiring work at the metering enclosure will be completed by PHI's Meter technicians. The metering control cable and meter cabinets will be supplied by PHI and installed by the interconnection customer's contractors. PHI's meter technicians will program and install two solid state multi-function meters (Primary & Backup) for the new metering position. Each meter will be equipped with load profile, telemetry, and form-c pulse outputs. The ownership of metering

equipment purchased or installed by the IC shall be transferred to the Transmission Owner at Commercial Operation, unless the IC asserts its right to install, own and operate the metering system.

Equipment Requirements

Any transformers on the IC's side must be Wye grounded on the utility side or alternatively 3 phase potential transformers and a relay capable of detecting over/under voltage shall be installed to detect an undesirable condition on the high side of the IC's transformer.

The inverter at the DG location shall have the following capabilities:

- Voltage flicker reduction through dynamic VAR or fixed PF response
- Ramp rate control
- SCADA communications
- Curtailment or other mitigation ability if high voltage were to occur
- Low voltage and system disturbance ride through
- Ability to receive and respond to a transfer trip signal
- Ability to adjust PF or VARs based on utility signal
- Ability to Adjust Real Power Output based on utility signal

The inverter shall operate in accordance with the IEEE 1547 series of standards that have been approved. While inverters should be capable of voltage stabilization thru dynamic VAR response and capable of low voltage and system disturbance ride through, neither of these capabilities shall be implemented until such time that the IEEE 1547 series of standards are revised and approved to include standards for these capabilities. At such time as these revised standards become available, the PV owner/operator shall cooperate with the Company (the 'Company' referring to ACE, DPL, or PEPCO) to implement these capabilities with settings acceptable to the Company. It is the responsibility of the owner to secure the inverter from any unauthorized access (including physical and remote access) which could alter settings or adversely affect the inverter's ability to operate as required. Security measures should include utilizing secure password settings and/or physical locks on cabinet doors.

High Voltage Warning

Voltage received at the meter from the utility can be 104% or 105% of nominal. Normal operating procedures dictate that voltage at the substation be raised to the higher end of an acceptable bandwidth in order to provide adequate supply to distant customers. Transformers with no load taps should be used to reduce the voltage by 2.5% to avoid the possibility of inverter trips. Failure to account for this may result in lost energy production.

Additional Operating Requirements

1. The Company (DPL, ACE, Pepco) will require the capability to remotely disconnect the generator from the grid by communication from its System Operations facility. This will be accomplished with a line recloser.

2. It is the Interconnection Customer's responsibility to send the data that PJM and the Company requires directly to PJM. The Interconnection Customer will grant permission for PJM to send

the Company the following telemetry that the Interconnection Customer sends to PJM: real time MW, MVAR, volts, amperes, generator breaker status or inverter status, and interval MWH and MVARH.

3. 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.

4. A mutually acceptable means of interrupting and disconnecting the generator with a visible break, able to be tagged and locked out, shall be worked out with Company Distribution Engineering.

5. Company 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 Company.

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 PRESTON-TANYARD 69 kV line (from bus 232233 to bus 232821 ckt 1) loads from 74.61% to 76.33% (DC power flow) of its emergency rating (93 MVA) for the line fault with failed breaker contingency outage of 'DP11'. This project contributes approximately 1.61 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

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

2. (DP&L - DP&L) The TODD-PRESTON 69 kV line (from bus 232234 to bus 232233 ckt 1) loads from 80.63% to 82.36% (DC power flow) of its emergency rating (93 MVA) for the line fault with failed breaker contingency outage of 'DP11'. This project contributes approximately 1.61 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

   Please refer to Appendix 2 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 148.83% to 149.39% (DC power flow) of its emergency rating (551 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 6.94 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.

2. (DP&L - DP&L) The LORETTO 138/69 kV transformer (from bus 232127 to bus 232275 ckt 1) loads from 100.22% to 100.81% (DC power flow) of its emergency rating (71 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 0.93 MW to the thermal violation.

   CONTINGENCY 'DP56'/*LORETTO BUS BREAKER
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1/*LORETTO VIENNA 138 1380
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1/*LORETTO PINEY GROVE 138 138
   END

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

3. (DP&L - DP&L) The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) loads from 134.18% to 137.02% (DC power flow) of its emergency rating (143 MVA) for the line fault with failed breaker contingency outage of 'DP15'. This project contributes approximately 4.07 MW to the thermal violation.

   CONTINGENCY 'DP15'/*INDIAN RIVER BUS BREAKER TO PINEY GROVE
   DISCONNECT BRANCH FROM BUS 232007 TO BUS 232006 CKT 1/*PINEY GR INDRIV 4 230 230
   DISCONNECT BRANCH FROM BUS 232007 TO BUS 232128 CKT 1/*PINEY GR PINEY GR 230 138
   DISCONNECT BRANCH FROM BUS 232006 TO BUS 232004 CKT 1/*MILFORD INDIAN RIVER 230 230
   END

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

4. (DP&L - DP&L) The LORET_69-FRUITLND 69 kV line (from bus 232275 to bus 232288 ckt 1) loads from 110.32% to 111.6% (DC power flow) of its emergency rating (137 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 1.75 MW to the thermal violation.

   CONTINGENCY 'DP56'/*LORETTO BUS BREAKER
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1/*LORETTO VIENNA 138 1380
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1/*LORETTO PINEY GROVE 138 138
   END

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

5. (DP&L - DP&L) The FRUITLND-PEMBERTN 69 kV line (from bus 232288 to bus 232273 ckt 1) loads from 120.59% to 122.52% (DC power flow) of its emergency rating (91 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 1.75 MW to the thermal violation.

   CONTINGENCY 'DP56'/*LORETTO BUS BREAKER
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1/*LORETTO VIENNA 138 1380
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1/*LORETTO PINEY GROVE 138 138
   END

Please refer to Appendix 7 for a table containing the generators having contribution to this flowgate.

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) PRESTON-TANYARD 69 kV line (from bus 232233 to bus 232821 ckt 1) overload will require the replacement of a disconnect switch at Preston Substation. The estimate to perform this work is **$36,000** and will take approximately **1 year** to complete.

2. To mitigate the (DP&L) TODD-PRESTON 69 kV line (from bus 232234 to bus 232233 ckt 1) overload will require substation reinforcements at Preston Substation and Todd Substation. The estimate to perform this work is **$67,000** and will take approximately **1 year** 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 rebuilding of the circuit including the replacement of poles to increase the emergency rating. The estimate to perform this work is **$43,965,000** and will take **4 years** to complete.

2. To mitigate the (DP&L) LORETTO 138/69 kV transformer (from bus 232127 to bus 232275 ckt 1) overload will require replacement of the Loretto AT1 autotransformer, which requires the reconfiguration of the 138 kV and 69 kV buses at Loretto Substation. The estimate to perform this work is **$4,377,000** and will take approximately **2 years** to complete.

3. To mitigate the (DP&L) The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) overload will require rebuilding of the Piney Grove – Mount Hermon 69 kV transmission line and substation reinforcements at Piney Grove Substation and Mount Hermon Substation. The estimate to perform this work is **$9,688,000** and will take approximately **3 years** to complete.

4. To mitigate the (DP&L) LORET_69-FRUITLND 69 kV line (from bus 232275 to bus 232288 ckt 1) overload will require rebuilding of the Loretto – Fruitland 69 kV transmission line and substation reinforcements at Loretto Substation and Fruitland Substation. The estimate to perform this work is **$7,196,000** and will take approximately **3 years** to complete.

5. To mitigate the (DP&L) FRUITLND-PEMBERTN 69 kV line (from bus 232288 to bus 232273 ckt 1) overload will require completion of PJM Supplemental Project s0820. Current estimated completion date is December 31, 2016.

   Note: Queue project AB2-084 is not expected to have cost responsibility for this network upgrade due to cost allocation rules.

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).

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.

1. (DP&L - DP&L) The PINEY138-LORETTO 138 kV line (from bus 232128 to bus 232127 ckt 1) loads from 122.03% to 124.58% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13713'. This project contributes approximately 4.05 MW to the thermal violation.

   CONTINGENCY 'CKT 13713'
   OPEN LINE FROM BUS 232129 TO BUS 232127 CIRCUIT 1/KINGS CREEK - LORETTO 138
   END

2. (DP&L - DP&L) The POCOMOKE-T-144 TAP 138 kV line (from bus 232130 to bus 886230 ckt 1) loads from 95.77% to 97.55% (DC power flow) of its emergency rating (247 MVA) for the

single line contingency outage of 'CKT 13764_B'. This project contributes approximately 4.41 MW to the thermal violation.

CONTINGENCY 'CKT 13764_B'
OPEN LINE FROM BUS 924680 TO BUS 232128 CIRCUIT 1/AB2-120 TAP - PINEY GROVE 138
END

3. (DP&L - DP&L) The N_CHURCH-AB2-120 TAP 138 kV line (from bus 232131 to bus 924680 ckt 1) loads from 118.41% to 120.31% (DC power flow) of its emergency rating (226 MVA) for the single line contingency outage of 'CKT 13713'. This project contributes approximately 4.3 MW to the thermal violation.

   CONTINGENCY 'CKT 13713'
   OPEN LINE FROM BUS 232129 TO BUS 232127 CIRCUIT 1/KINGS CREEK - LORETTO 138
   END

4. (DP&L - DP&L) The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) loads from 133.79% to 136.65% (DC power flow) of its emergency rating (143 MVA) for the single line contingency outage of 'CKT 23002'. This project contributes approximately 4.09 MW to the thermal violation.

   CONTINGENCY 'CKT 23002'
   DISCONNECT BUS 232007/INDIAN RIVER - PINEY GROVE 230 & PNY GRV AT-20 XFMER
   END

5. (DP&L - DP&L) The SHORT 1-LAUREL 69 kV line (from bus 232828 to bus 232249 ckt 1) loads from 100.33% to 102.94% (DC power flow) of its emergency rating (57 MVA) for the single line contingency outage of 'CKT 23002'. This project contributes approximately 1.49 MW to the thermal violation.

   CONTINGENCY 'CKT 23002'
   DISCONNECT BUS 232007/INDIAN RIVER - PINEY GROVE 230 & PNY GRV AT-20 XFMER
   END

6. (DP&L - DP&L) The T-144 TAP-COSTEN 138 kV line (from bus 886230 to bus 232807 ckt 1) loads from 95.77% to 97.55% (DC power flow) of its emergency rating (247 MVA) for the single line contingency outage of 'CKT 13764_B'. This project contributes approximately 4.41 MW to the thermal violation.

   CONTINGENCY 'CKT 13764_B'
   OPEN LINE FROM BUS 924680 TO BUS 232128 CIRCUIT 1/AB2-120 TAP - PINEY GROVE 138

END

7. (DP&L - DP&L) The AB2-120 TAP-PINEY138 138 kV line (from bus 924680 to bus 232128 ckt 1) loads from 146.29% to 148.19% (DC power flow) of its emergency rating (226 MVA) for the single line contingency outage of 'CKT 13713'. This project contributes approximately 4.3 MW to the thermal violation.

   CONTINGENCY 'CKT 13713'
   OPEN LINE FROM BUS 232129 TO BUS 232127 CIRCUIT 1/KINGS CREEK - LORETTO 138
   END

8. (DP&L - DP&L) The AB2-120 TAP-PINEY138 138 kV line (from bus 924680 to bus 232128 ckt 1) loads from 118.92% to 120.45% (DC power flow) of its normal rating (172 MVA) for non-contingency condition. This project contributes approximately 2.63 MW to the thermal violation.

Secondary Point of Interconnection

PJM studied the AB2-167 project into the Delmarva Power and Light Company (DPL) system at the Stockton 69 kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2020.

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 PRESTON-TANYARD 69 kV line (from bus 232233 to bus 232821 ckt 1) loads from 74.61% to 76.33% (DC power flow) of its emergency rating (93 MVA) for the line fault with failed breaker contingency outage of 'DP11'. This project contributes approximately 1.61 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

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

2. (DP&L - DP&L) The TODD-PRESTON 69 kV line (from bus 232234 to bus 232233 ckt 1) loads from 80.63% to 82.36% (DC power flow) of its emergency rating (93 MVA) for the line fault with failed breaker contingency outage of 'DP11'. This project contributes approximately 1.61 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

   Please refer to Appendix 2 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 148.83% to 149.39% (DC power flow) of its emergency rating (551 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 6.94 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.

2. (DP&L - DP&L) The LORETTO 138/69 kV transformer (from bus 232127 to bus 232275 ckt 1) loads from 100.22% to 100.81% (DC power flow) of its emergency rating (71 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 0.93 MW to the thermal violation.

   CONTINGENCY 'DP56'/*LORETTO BUS BREAKER
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1/*LORETTO VIENNA 138 1380

DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1/*LORETTO PINEY GROVE 138 138
END

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

3. (DP&L - DP&L) The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) loads from 134.18% to 137.02% (DC power flow) of its emergency rating (143 MVA) for the line fault with failed breaker contingency outage of 'DP15'. This project contributes approximately 4.07 MW to the thermal violation.

   CONTINGENCY 'DP15'/*INDIAN RIVER BUS BREAKER TO PINEY GROVE
   DISCONNECT BRANCH FROM BUS 232007 TO BUS 232006 CKT 1/*PINEY GR INDRIV 4 230 230
   DISCONNECT BRANCH FROM BUS 232007 TO BUS 232128 CKT 1/*PINEY GR PINEY GR 230 138
   DISCONNECT BRANCH FROM BUS 232006 TO BUS 232004 CKT 1/*MILFORD INDIAN RIVER 230 230
   END

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

4. (DP&L - DP&L) The LORET_69-FRUITLND 69 kV line (from bus 232275 to bus 232288 ckt 1) loads from 110.32% to 111.6% (DC power flow) of its emergency rating (137 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 1.75 MW to the thermal violation.

   CONTINGENCY 'DP56'/*LORETTO BUS BREAKER
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1/*LORETTO VIENNA 138 1380
   DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1/*LORETTO PINEY GROVE 138 138
   END

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

5. (DP&L - DP&L) The FRUITLND-PEMBERTN 69 kV line (from bus 232288 to bus 232273 ckt 1) loads from 120.59% to 122.52% (DC power flow) of its emergency rating (91 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 1.75 MW to the thermal violation.

   CONTINGENCY 'DP56'/*LORETTO BUS BREAKER

DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1/*LORETTO VIENNA 138 1380
DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1/*LORETTO PINEY GROVE 138 138
END

Please refer to Appendix 7 for a table containing the generators having contribution to this flowgate.

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.

1. (DP&L - DP&L) The PINEY138-LORETTO 138 kV line (from bus 232128 to bus 232127 ckt 1) loads from 122.03% to 124.58% (DC power flow) of its emergency rating (159 MVA) for the single line contingency outage of 'CKT 13713'. This project contributes approximately 4.05 MW to the thermal violation.

   CONTINGENCY 'CKT 13713'
   OPEN LINE FROM BUS 232129 TO BUS 232127 CIRCUIT 1/KINGS CREEK - LORETTO 138
   END

2. (DP&L - DP&L) The POCOMOKE-T-144 TAP 138 kV line (from bus 232130 to bus 886230 ckt 1) loads from 95.77% to 97.55% (DC power flow) of its emergency rating (247 MVA) for the single line contingency outage of 'CKT 13764_B'. This project contributes approximately 4.41 MW to the thermal violation.

   CONTINGENCY 'CKT 13764_B'
   OPEN LINE FROM BUS 924680 TO BUS 232128 CIRCUIT 1/AB2-120 TAP - PINEY GROVE 138
   END

3. (DP&L - DP&L) The N_CHURCH-AB2-120 TAP 138 kV line (from bus 232131 to bus 924680 ckt 1) loads from 118.41% to 120.31% (DC power flow) of its emergency rating (226 MVA) for the single line contingency outage of 'CKT 13713'. This project contributes approximately 4.3 MW to the thermal violation.

   CONTINGENCY 'CKT 13713'

OPEN LINE FROM BUS 232129 TO BUS 232127 CIRCUIT 1/KINGS CREEK - LORETTO 138
END

4. (DP&L - DP&L) The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) loads from 133.79% to 136.65% (DC power flow) of its emergency rating (143 MVA) for the single line contingency outage of 'CKT 23002'. This project contributes approximately 4.09 MW to the thermal violation.

   CONTINGENCY 'CKT 23002'
   DISCONNECT BUS 232007/INDIAN RIVER - PINEY GROVE 230 & PNY GRV AT-20 XFMER
   END

5. (DP&L - DP&L) The SHORT 1-LAUREL 69 kV line (from bus 232828 to bus 232249 ckt 1) loads from 100.33% to 102.94% (DC power flow) of its emergency rating (57 MVA) for the single line contingency outage of 'CKT 23002'. This project contributes approximately 1.49 MW to the thermal violation.

   CONTINGENCY 'CKT 23002'
   DISCONNECT BUS 232007/INDIAN RIVER - PINEY GROVE 230 & PNY GRV AT-20 XFMER
   END

6. (DP&L - DP&L) The T-144 TAP-COSTEN 138 kV line (from bus 886230 to bus 232807 ckt 1) loads from 95.77% to 97.55% (DC power flow) of its emergency rating (247 MVA) for the single line contingency outage of 'CKT 13764_B'. This project contributes approximately 4.41 MW to the thermal violation.

   CONTINGENCY 'CKT 13764_B'
   OPEN LINE FROM BUS 924680 TO BUS 232128 CIRCUIT 1/AB2-120 TAP - PINEY GROVE 138
   END

7. (DP&L - DP&L) The AB2-120 TAP-PINEY138 138 kV line (from bus 924680 to bus 232128 ckt 1) loads from 146.29% to 148.19% (DC power flow) of its emergency rating (226 MVA) for the single line contingency outage of 'CKT 13713'. This project contributes approximately 4.3 MW to the thermal violation.

   CONTINGENCY 'CKT 13713'
   OPEN LINE FROM BUS 232129 TO BUS 232127 CIRCUIT 1/KINGS CREEK - LORETTO 138
   END

8. (DP&L - DP&L) The AB2-120 TAP-PINEY138 138 kV line (from bus 924680 to bus 232128 ckt 1) loads from 118.92% to 120.45% (DC power flow) of its normal rating (172 MVA) for non-contingency condition. This project contributes approximately 2.63 MW to the thermal violation.

Facilities Study Estimate

7 months; $50,000

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 PRESTON-TANYARD 69 kV line (from bus 232233 to bus 232821 ckt 1) loads from 74.61% to 76.33% (DC power flow) of its emergency rating (93 MVA) for the line fault with failed breaker contingency outage of 'DP11'. This project contributes approximately 1.61 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

Bus Number	*Bus Name*	*Full Contribution*
232926	*CRISFLD1*	*0.24*
293670	*O-025 C*	*0.16*
297076	*V2-028 C*	*0.1*
297077	*V2-028 E*	*0.81*
904212	*V4-022E*	*0.36*
232919	*VN10*	*0.61*
232907	*VN8*	*4.45*
901003	*W1-003 C*	*0.07*
901004	*W1-003 E*	*0.52*
901013	*W1-004 C*	*0.07*
901014	*W1-004 E*	*0.52*

901023	*W1-005 C*	*0.07*
901024	*W1-005 E*	*0.52*
901033	*W1-006 C*	*< 0.01*
901034	*W1-006 E*	*0.52*
907052	*X1-032 E*	*0.47*
907323	*X1-096 C*	*0.46*
907324	*X1-096 E*	*11.19*
910571	*X3-008 C*	*0.57*
910572	*X3-008 E*	*4.78*
910591	*X3-015 C*	*0.41*
910592	*X3-015 E*	*3.43*
913411	*Y1-080 C*	*0.07*
913412	*Y1-080 E*	*0.56*
915541	*Y3-058 C*	*0.17*
915542	*Y3-058 E*	*1.43*
920582	*Z1-076 C*	*0.61*
920583	*Z1-076 E*	*1.*
920592	*Z1-077 C*	*0.44*
920593	*Z1-077 E*	*0.71*
916441	*Z1-100*	*0.09*
916451	*Z1-101*	*0.09*
916461	*Z1-102*	*0.09*
920602	*Z1-103*	*0.09*
917082	*Z2-012 E*	*1.42*
920763	*Z2-076 E*	*0.18*
920773	*Z2-077 E*	*0.18*
920952	*AA1-025*	*0.08*
920962	*AA1-026*	*0.08*
920972	*AA1-027*	*0.08*
920982	*AA1-028*	*0.08*
921122	*AA1-059 C*	*0.52*
921123	*AA1-059 E*	*0.2*
921142	*AA1-061 C*	*4.87*
921143	*AA1-061 E*	*2.4*
918831	*AA1-102*	*0.88*
921592	*AA1-140 C*	*0.67*
921593	*AA1-140 E*	*1.1*
921602	*AA1-141 C*	*0.65*
921603	*AA1-141 E*	*1.07*
922213	*AA2-129 E*	*2.29*
922222	*AA2-130*	*0.24*
922752	*AB1-056 C OP*	*4.91*
922753	*AB1-056 E OP*	*14.*
922762	*AB1-057 C*	*4.99*
922763	*AB1-057 E*	*14.23*

923282	*AB1-137 C*	*1.14*
923283	*AB1-137 E*	*0.49*
923902	*AB2-030 E*	*0.46*
923931	*AB2-033 C*	*0.82*
923932	*AB2-033 E*	*0.33*
924361	*AB2-084 C*	*0.45*
924362	*AB2-084 E*	*0.73*
924461	*AB2-095 C*	*1.16*
924462	*AB2-095 E*	*1.89*
924681	*AB2-120 C OP*	*4.32*
924682	*AB2-120 E OP*	*7.04*
924781	*AB2-130 C OP*	*4.57*
924782	*AB2-130 E OP*	*7.46*
924831	*AB2-136 C OP*	*7.47*
924832	*AB2-136 E OP*	*10.6*
925071	*AB2-164 C OP*	*0.87*
925072	*AB2-164 E OP*	*1.42*
925081	*AB2-165 C OP*	*0.87*
925082	*AB2-165 E OP*	*1.42*
925091	*AB2-166 C*	*0.26*
925092	*AB2-166 E*	*0.45*
925101	*AB2-167 C*	*0.61*
925102	*AB2-167 E*	*1.*
925151	*AB2-172 C OP*	*7.33*
925152	*AB2-172 E OP*	*11.96*
925231	*AB2-177 C*	*0.29*
925232	*AB2-177 E*	*0.47*
925261	*AB2-180 C*	*2.15*
925262	*AB2-180 E*	*0.92*
925311	*AB2-192 C OP*	*0.87*
925312	*AB2-192 E OP*	*1.42*

Appendix 2

(DP&L - DP&L) The TODD-PRESTON 69 kV line (from bus 232234 to bus 232233 ckt 1) loads from 80.63% to 82.36% (DC power flow) of its emergency rating (93 MVA) for the line fault with failed breaker contingency outage of 'DP11'. This project contributes approximately 1.61 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
```

Bus Number	*Bus Name*	*Full Contribution*
232926	*CRISFLD1*	*0.24*
293670	*O-025 C*	*0.16*
297076	*V2-028 C*	*0.1*
297077	*V2-028 E*	*0.81*
904212	*V4-022E*	*0.36*
232919	*VN10*	*0.61*
232907	*VN8*	*4.45*
901003	*W1-003 C*	*0.07*
901004	*W1-003 E*	*0.52*
901013	*W1-004 C*	*0.07*
901014	*W1-004 E*	*0.52*
901023	*W1-005 C*	*0.07*
901024	*W1-005 E*	*0.52*
901033	*W1-006 C*	*< 0.01*
901034	*W1-006 E*	*0.52*
907052	*X1-032 E*	*0.47*
907323	*X1-096 C*	*0.46*
907324	*X1-096 E*	*11.19*
910571	*X3-008 C*	*0.57*
910572	*X3-008 E*	*4.78*
910591	*X3-015 C*	*0.41*
910592	*X3-015 E*	*3.43*
913411	*Y1-080 C*	*0.07*
913412	*Y1-080 E*	*0.56*
915541	*Y3-058 C*	*0.17*
915542	*Y3-058 E*	*1.43*
920582	*Z1-076 C*	*0.61*
920583	*Z1-076 E*	*1.*
920592	*Z1-077 C*	*0.44*
920593	*Z1-077 E*	*0.71*
916441	*Z1-100*	*0.09*
916451	*Z1-101*	*0.09*
916461	*Z1-102*	*0.09*
920602	*Z1-103*	*0.09*
917082	*Z2-012 E*	*1.42*
920763	*Z2-076 E*	*0.18*
920773	*Z2-077 E*	*0.18*
920952	*AA1-025*	*0.08*
920962	*AA1-026*	*0.08*
920972	*AA1-027*	*0.08*
920982	*AA1-028*	*0.08*
921122	*AA1-059 C*	*0.52*
921123	*AA1-059 E*	*0.2*

921142	*AA1-061 C*	*4.87*
921143	*AA1-061 E*	*2.4*
918831	*AA1-102*	*0.88*
921592	*AA1-140 C*	*0.67*
921593	*AA1-140 E*	*1.1*
921602	*AA1-141 C*	*0.65*
921603	*AA1-141 E*	*1.07*
922213	*AA2-129 E*	*2.29*
922222	*AA2-130*	*0.24*
922752	*AB1-056 C OP*	*4.91*
922753	*AB1-056 E OP*	*14.*
922762	*AB1-057 C*	*4.99*
922763	*AB1-057 E*	*14.23*
923282	*AB1-137 C*	*1.14*
923283	*AB1-137 E*	*0.49*
923902	*AB2-030 E*	*0.46*
923931	*AB2-033 C*	*0.82*
923932	*AB2-033 E*	*0.33*
924361	*AB2-084 C*	*0.45*
924362	*AB2-084 E*	*0.73*
924461	*AB2-095 C*	*1.16*
924462	*AB2-095 E*	*1.89*
924681	*AB2-120 C OP*	*4.32*
924682	*AB2-120 E OP*	*7.04*
924781	*AB2-130 C OP*	*4.57*
924782	*AB2-130 E OP*	*7.46*
924831	*AB2-136 C OP*	*7.47*
924832	*AB2-136 E OP*	*10.6*
925071	*AB2-164 C OP*	*0.87*
925072	*AB2-164 E OP*	*1.42*
925081	*AB2-165 C OP*	*0.87*
925082	*AB2-165 E OP*	*1.42*
925091	*AB2-166 C*	*0.26*
925092	*AB2-166 E*	*0.45*
925101	*AB2-167 C*	*0.61*
925102	*AB2-167 E*	*1.*
925151	*AB2-172 C OP*	*7.33*
925152	*AB2-172 E OP*	*11.96*
925231	*AB2-177 C*	*0.29*
925232	*AB2-177 E*	*0.47*
925261	*AB2-180 C*	*2.15*
925262	*AB2-180 E*	*0.92*
925311	*AB2-192 C OP*	*0.87*
925312	*AB2-192 E OP*	*1.42*

Appendix 3

(DP&L - DP&L) The MILF_230-STEELE 230 kV line (from bus 232004 to bus 232000 ckt 1) loads from 148.83% to 149.39% (DC power flow) of its emergency rating (551 MVA) for the tower line contingency outage of 'DBL_4NC'. This project contributes approximately 6.94 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

Bus Number	*Bus Name*	*Full Contribution*
232900	*DEMECSMY*	*5.99*
232616	*GEN FOOD*	*2.19*
232904	*IR4*	*52.79*
232923	*MR1*	*12.53*
232924	*MR2*	*12.53*
232922	*MR3*	*14.73*
232901	*NORTHST*	*6.5*
297077	*V2-028 E*	*1.28*
904212	*V4-022E*	*1.52*
901004	*W1-003 E*	*2.22*
901014	*W1-004 E*	*2.22*
901024	*W1-005 E*	*2.22*
901034	*W1-006 E*	*2.22*
901411	*W1-062*	*6.37*
903511	*W3-032A*	*44.61*
907052	*X1-032 E*	*1.89*
907324	*X1-096 E*	*42.96*
910572	*X3-008 E*	*3.32*
910592	*X3-015 E*	*3.81*
913412	*Y1-080 E*	*0.68*
920543	*Y3-054 E*	*8.3*
915542	*Y3-058 E*	*4.1*
920582	*Z1-076 C*	*2.64*
920583	*Z1-076 E*	*4.3*
920592	*Z1-077 C*	*1.88*
920593	*Z1-077 E*	*3.07*
917082	*Z2-012 E*	*6.09*
920763	*Z2-076 E*	*1.22*
920773	*Z2-077 E*	*1.22*
921122	*AA1-059 C*	*1.99*
921123	*AA1-059 E*	*0.79*

921142	*AA1-061 C*	*3.72*
921143	*AA1-061 E*	*1.83*
921592	*AA1-140 C*	*4.6*
921593	*AA1-140 E*	*7.51*
921602	*AA1-141 C*	*2.84*
921603	*AA1-141 E*	*4.63*
921872	*AA2-069*	*390.51*
922213	*AA2-129 E*	*9.83*
922222	*AA2-130*	*0.92*
922752	*AB1-056 C OP*	*41.89*
922753	*AB1-056 E OP*	*119.3*
922762	*AB1-057 C*	*42.54*
922763	*AB1-057 E*	*121.26*
923282	*AB1-137 C*	*8.78*
923283	*AB1-137 E*	*3.76*
923902	*AB2-030 E*	*1.96*
923931	*AB2-033 C*	*3.52*
923932	*AB2-033 E*	*1.39*
924361	*AB2-084 C*	*1.79*
924362	*AB2-084 E*	*2.93*
924461	*AB2-095 C*	*6.46*
924462	*AB2-095 E*	*10.53*
924681	*AB2-120 C OP*	*18.81*
924682	*AB2-120 E OP*	*30.7*
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*
925071	*AB2-164 C OP*	*3.73*
925072	*AB2-164 E OP*	*6.09*
925081	*AB2-165 C OP*	*3.73*
925082	*AB2-165 E OP*	*6.09*
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*
925311	*AB2-192 C OP*	*3.73*
925312	*AB2-192 E OP*	*6.09*

Appendix 4

(DP&L - DP&L) The LORETTO 138/69 kV transformer (from bus 232127 to bus 232275 ckt 1) loads from 100.22% to 100.81% (DC power flow) of its emergency rating (71 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 0.93 MW to the thermal violation.

CONTINGENCY 'DP56' /*LORETTO BUS BREAKER
DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1 /*LORETTO VIENNA 138 1380
DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1 /*LORETTO PINEY GROVE 138 138
END

Bus Number	*Bus Name*	*Full Contribution*
232926	*CRISFLD1*	*0.34*
904212	*V4-022E*	*0.28*
901004	*W1-003 E*	*0.43*
901014	*W1-004 E*	*0.43*
901024	*W1-005 E*	*0.43*
901034	*W1-006 E*	*0.43*
907052	*X1-032 E*	*0.58*
907323	*X1-096 C*	*0.66*
907324	*X1-096 E*	*16.04*
920582	*Z1-076 C*	*0.35*
920583	*Z1-076 E*	*0.57*
920592	*Z1-077 C*	*0.25*
920593	*Z1-077 E*	*0.41*
917082	*Z2-012 E*	*1.14*
921122	*AA1-059 C*	*0.74*
921123	*AA1-059 E*	*0.29*
918831	*AA1-102*	*1.27*
922213	*AA2-129 E*	*1.83*
922222	*AA2-130*	*0.35*
923902	*AB2-030 E*	*0.37*
923931	*AB2-033 C*	*0.66*
923932	*AB2-033 E*	*0.26*
924361	*AB2-084 C*	*0.55*
924362	*AB2-084 E*	*0.9*
924681	*AB2-120 C OP*	*3.12*
924682	*AB2-120 E OP*	*5.1*
925071	*AB2-164 C OP*	*0.7*
925072	*AB2-164 E OP*	*1.14*
925081	*AB2-165 C OP*	*0.7*
925082	*AB2-165 E OP*	*1.14*

925101	*AB2-167 C*	*0.35*
925102	*AB2-167 E*	*0.58*
925311	*AB2-192 C OP*	*0.7*
925312	*AB2-192 E OP*	*1.14*

Appendix 5

(DP&L - DP&L) The PINEY_69-M HERMON 69 kV line (from bus 232274 to bus 232272 ckt 1) loads from 134.18% to 137.02% (DC power flow) of its emergency rating (143 MVA) for the line fault with failed breaker contingency outage of 'DP15'. This project contributes approximately 4.07 MW to the thermal violation.

CONTINGENCY 'DP15' /*INDIAN RIVER BUS BREAKER TO PINEY GROVE
DISCONNECT BRANCH FROM BUS 232007 TO BUS 232006 CKT 1 /*PINEY GR INDRIV 4 230 230
DISCONNECT BRANCH FROM BUS 232007 TO BUS 232128 CKT 1 /*PINEY GR PINEY GR 230 138
DISCONNECT BRANCH FROM BUS 232006 TO BUS 232004 CKT 1 /*MILFORD INDIAN RIVER 230 230
END

Bus Number	*Bus Name*	*Full Contribution*
232905	*BAYVIEW1*	*0.59*
232926	*CRISFLD1*	*0.36*
232912	*OH NUG1*	*2.1*
232913	*OH NUG2*	*2.07*
232914	*OH NUG3*	*2.1*
232915	*OH NUG4*	*2.1*
232916	*OH NUG5*	*2.1*
232917	*OH NUG6*	*2.09*
232918	*OH NUG7*	*2.09*
232921	*TASLEY2G*	*1.46*
904210	*V4-022C*	*0.09*
904212	*V4-022E*	*0.75*
901003	*W1-003 C*	*0.15*
901004	*W1-003 E*	*1.07*
901013	*W1-004 C*	*0.15*
901014	*W1-004 E*	*1.07*
901023	*W1-005 C*	*0.15*
901024	*W1-005 E*	*1.07*
901033	*W1-006 C*	*< 0.01*
901034	*W1-006 E*	*1.07*
907052	*X1-032 E*	*0.82*
907323	*X1-096 C*	*0.71*
907324	*X1-096 E*	*17.31*
920582	*Z1-076 C*	*1.54*
920583	*Z1-076 E*	*2.52*
920592	*Z1-077 C*	*1.1*
920593	*Z1-077 E*	*1.8*

916441	*Z1-100*	*0.19*
916451	*Z1-101*	*0.19*
916461	*Z1-102*	*0.19*
920602	*Z1-103*	*0.19*
917081	*Z2-012 C*	*0.36*
917082	*Z2-012 E*	*2.99*
920952	*AA1-025*	*0.17*
920962	*AA1-026*	*0.17*
920972	*AA1-027*	*0.17*
920982	*AA1-028*	*0.17*
921122	*AA1-059 C*	*0.8*
921123	*AA1-059 E*	*0.32*
918831	*AA1-102*	*1.37*
921602	*AA1-141 C*	*1.86*
921603	*AA1-141 E*	*3.04*
922213	*AA2-129 E*	*4.76*
922222	*AA2-130*	*0.37*
923902	*AB2-030 E*	*0.97*
923931	*AB2-033 C*	*1.73*
923932	*AB2-033 E*	*0.68*
924361	*AB2-084 C*	*0.78*
924362	*AB2-084 E*	*1.27*
924681	*AB2-120 C OP*	*9.21*
924682	*AB2-120 E OP*	*15.02*
925071	*AB2-164 C OP*	*1.83*
925072	*AB2-164 E OP*	*2.99*
925081	*AB2-165 C OP*	*1.83*
925082	*AB2-165 E OP*	*2.99*
925101	*AB2-167 C*	*1.54*
925102	*AB2-167 E*	*2.53*
925231	*AB2-177 C*	*0.82*
925232	*AB2-177 E*	*1.34*
925311	*AB2-192 C OP*	*1.83*
925312	*AB2-192 E OP*	*2.99*

Appendix 6

(DP&L - DP&L) The LORET_69-FRUITLND 69 kV line (from bus 232275 to bus 232288 ckt 1) loads from 110.32% to 111.6% (DC power flow) of its emergency rating (137 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 1.75 MW to the thermal violation.

CONTINGENCY 'DP56' /*LORETTO BUS BREAKER
DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1 /*LORETTO VIENNA 138 1380

DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1 /*LORETTO PINEY GROVE 138 138
END

Bus Number	*Bus Name*	*Full Contribution*
232905	*BAYVIEW1*	*0.42*
232926	*CRISFLD1*	*0.64*
232912	*OH NUG1*	*1.52*
232913	*OH NUG2*	*1.5*
232914	*OH NUG3*	*1.52*
232915	*OH NUG4*	*1.52*
232916	*OH NUG5*	*1.52*
232917	*OH NUG6*	*1.52*
232918	*OH NUG7*	*1.51*
232921	*TASLEY2G*	*1.05*
904210	*V4-022C*	*0.06*
904212	*V4-022E*	*0.54*
901003	*W1-003 C*	*0.12*
901004	*W1-003 E*	*0.82*
901013	*W1-004 C*	*0.12*
901014	*W1-004 E*	*0.82*
901023	*W1-005 C*	*0.12*
901024	*W1-005 E*	*0.82*
901033	*W1-006 C*	*< 0.01*
901034	*W1-006 E*	*0.82*
907052	*X1-032 E*	*1.1*
907323	*X1-096 C*	*1.25*
907324	*X1-096 E*	*30.34*
920582	*Z1-076 C*	*0.67*
920583	*Z1-076 E*	*1.09*
920592	*Z1-077 C*	*0.48*
920593	*Z1-077 E*	*0.78*
916441	*Z1-100*	*0.15*
916451	*Z1-101*	*0.15*
916461	*Z1-102*	*0.15*
920602	*Z1-103*	*0.15*
917081	*Z2-012 C*	*0.26*
917082	*Z2-012 E*	*2.15*
920952	*AA1-025*	*0.13*
920962	*AA1-026*	*0.13*
920972	*AA1-027*	*0.13*
920982	*AA1-028*	*0.13*
921122	*AA1-059 C*	*1.4*
921123	*AA1-059 E*	*0.55*
918831	*AA1-102*	*2.4*

921602	*AA1-141 C*	*0.52*
921603	*AA1-141 E*	*0.85*
922213	*AA2-129 E*	*3.46*
922222	*AA2-130*	*0.65*
923902	*AB2-030 E*	*0.69*
923931	*AB2-033 C*	*1.24*
923932	*AB2-033 E*	*0.49*
924361	*AB2-084 C*	*1.04*
924362	*AB2-084 E*	*1.7*
924681	*AB2-120 C OP*	*5.91*
924682	*AB2-120 E OP*	*9.64*
925071	*AB2-164 C OP*	*1.32*
925072	*AB2-164 E OP*	*2.15*
925081	*AB2-165 C OP*	*1.32*
925082	*AB2-165 E OP*	*2.15*
925101	*AB2-167 C*	*0.66*
925102	*AB2-167 E*	*1.09*
925231	*AB2-177 C*	*0.23*
925232	*AB2-177 E*	*0.38*
925311	*AB2-192 C OP*	*1.32*
925312	*AB2-192 E OP*	*2.15*

Appendix 7

(DP&L - DP&L) The FRUITLND-PEMBERTN 69 kV line (from bus 232288 to bus 232273 ckt 1) loads from 120.59% to 122.52% (DC power flow) of its emergency rating (91 MVA) for the line fault with failed breaker contingency outage of 'DP56'. This project contributes approximately 1.75 MW to the thermal violation.

```
CONTINGENCY 'DP56'                                    /*LORETTO BUS BREAKER
  DISCONNECT BRANCH FROM BUS 232127 TO BUS 232117 CKT 1          /*LORETTO
VIENNA 138 1380
  DISCONNECT BRANCH FROM BUS 232127 TO BUS 232128 CKT 1          /*LORETTO
PINEY GROVE 138 138
  END
```

Bus Number	*Bus Name*	*Full Contribution*
232905	*BAYVIEW1*	*0.42*
232926	*CRISFLD1*	*0.64*
232912	*OH NUG1*	*1.52*
232913	*OH NUG2*	*1.5*
232914	*OH NUG3*	*1.52*
232915	*OH NUG4*	*1.52*
232916	*OH NUG5*	*1.52*
232917	*OH NUG6*	*1.52*

232918	*OH NUG7*	*1.51*
232921	*TASLEY2G*	*1.05*
904210	*V4-022C*	*0.06*
904212	*V4-022E*	*0.54*
901003	*W1-003 C*	*0.12*
901004	*W1-003 E*	*0.82*
901013	*W1-004 C*	*0.12*
901014	*W1-004 E*	*0.82*
901023	*W1-005 C*	*0.12*
901024	*W1-005 E*	*0.82*
901033	*W1-006 C*	*< 0.01*
901034	*W1-006 E*	*0.82*
907052	*X1-032 E*	*1.1*
907323	*X1-096 C*	*1.25*
907324	*X1-096 E*	*30.34*
920582	*Z1-076 C*	*0.67*
920583	*Z1-076 E*	*1.09*
920592	*Z1-077 C*	*0.48*
920593	*Z1-077 E*	*0.78*
916441	*Z1-100*	*0.15*
916451	*Z1-101*	*0.15*
916461	*Z1-102*	*0.15*
920602	*Z1-103*	*0.15*
917081	*Z2-012 C*	*0.26*
917082	*Z2-012 E*	*2.15*
920952	*AA1-025*	*0.13*
920962	*AA1-026*	*0.13*
920972	*AA1-027*	*0.13*
920982	*AA1-028*	*0.13*
921122	*AA1-059 C*	*1.4*
921123	*AA1-059 E*	*0.55*
918831	*AA1-102*	*2.4*
921602	*AA1-141 C*	*0.52*
921603	*AA1-141 E*	*0.85*
922213	*AA2-129 E*	*3.46*
922222	*AA2-130*	*0.65*
923902	*AB2-030 E*	*0.69*
923931	*AB2-033 C*	*1.24*
923932	*AB2-033 E*	*0.49*
924361	*AB2-084 C*	*1.04*
924362	*AB2-084 E*	*1.7*
924681	*AB2-120 C OP*	*5.91*
924682	*AB2-120 E OP*	*9.64*
925071	*AB2-164 C OP*	*1.32*
925072	*AB2-164 E OP*	*2.15*

925081	*AB2-165 C OP*	*1.32*
925082	*AB2-165 E OP*	*2.15*
925101	*AB2-167 C*	*0.66*
925102	*AB2-167 E*	*1.09*
925231	*AB2-177 C*	*0.23*
925232	*AB2-177 E*	*0.38*
925311	*AB2-192 C OP*	*1.32*
925312	*AB2-192 E OP*	*2.15*