Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD1-098

Dixon—McGirr

June 1, 2018

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement.

For Local and Network Upgrades which are required due to overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost less than $5,000,000, the cost of the Local and Network Upgrades will be shared by all proposed projects which have been assigned a Queue Position in the New Services Queue in which the need for the Local and Network Upgrades was identified. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects. •

For Local and Network Upgrades which are required due to the overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost of $5,000,000 or greater, the cost of the Local and Network Upgrades will be allocated according to the order of the New Service Requests in the New Services Queue and the MW contribution of each individual Interconnection Request for those projects which cause or contribute to the need for the Local or Network Upgrades. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

Cost allocation rules can be found in PJM Manual 14A, Attachment B. 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 Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

PJM utilizes manufacturer models to ensure the performance of turbines is properly captured during the simulations performed for stability verification. Turbine manufacturers provide such models to their customers. The list of manufacturer models PJM has already validated is contained in Attachment G-2 of Manual 14A. Manufacturer models may be updated from time to time, for various reasons such as to reflect changes to the control systems or to more accurately

represent the capabilities turbines and controls which are currently available in the field. Additionally, as new turbine models are developed, turbine manufacturers provide such new models which must be used in the conduct of these studies. PJM needs adequate time to evaluate the new models in order to reduce delays to the System Impact Study process timeline for the Interconnection Customer as well as other Interconnection Customers in the study group. Therefore, PJM will require that any Interconnection Customer with a new manufacturer model must supply that model to PJM, along with a $10,000 fully refundable deposit, no later than three (3) months prior to the starting date of the System Impact Study (See Section 2.2.2. of Manual 14A for starting dates) for the Interconnection Request which shall specify the use of the new model. The Interconnection Customer will be required to submit a completed dynamic model study request form (Attachment G-1 of Manual 14A) in order to document the request for the study.

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.

General

Queue AD1-098 Dixon—McGirr project is a proposal to connect a 100 Energy (57.8 MW Capacity) ground mounted tracking solar photovoltaic facility to be located in Lee County, IL. The IC has proposed a service date for this project of December 2020.

It is proposed in the Interconnection Request (Attachment N) that the primary point of interconnection to be studied on the TSS 107 Dixon (red) to TSS 169 McGirr Road Line 10714 line, 23.7 miles from Dixon and 1.3 miles west from McGirr. They have requested a secondary POI at TSS 169 McGirr Road.

Impacts on the MISO member transmission systems are not included in this analysis, but will be included in the Impact Study Phase.

This Generation Interconnection Feasibility Study provides analysis results to aid the IC in assessing the practicality and cost of incorporating the facility into the PJM system. This study was limited to load flow analyses of probable contingencies. If the IC elects to pursue a System Impact Study, a more comprehensive analysis will be performed.

Primary Point of Interconnection (Option-1)

The Interconnection Customer (IC) AD1-098, a 100MW solar facility, proposes to interconnect with the ComEd transmission system by tying into the Dixon-McGirr Road 138kV Line 10714.

Attachment Facilities

The IC AD1-098 generator lead would interconnect to a new 138kV Interconnection Substation. This interconnection would require one 138kV line MOD, a dead-end structure and revenue metering as shown in the one line diagram.

The cost for the attachment facilities is estimated at $1M.

Scope of Work	Cost Estimate
Installation of one 138kV line MOD, one dead-end structure and one set of revenue metering (see notes below on cost estimate)	$1,000,000

Direct Connection Network Upgrades

In order to accommodate interconnection of AD1-098, a new 138kV Interconnection Substation would need to be built close to the Dixon-McGirr Road 138kV Line 10714 approximately 1.4 miles from the McGirr Road TSS 169.

The scope of work includes the installation of three 138kV circuit breakers in a "breaker-and-a-half" bus configuration and cutting in the Interconnection Substation to the Dixon-McGirr Road 138kV Line 10714, as shown in the one line diagram below.

The IC is responsible for constructing all of the facilities on the IC side of the point of interconnection outside of the substation. It will be the IC's responsibility to obtain the site for the Interconnection Substation and right-of-way between the Interconnection Substation and the 138kV transmission line.

In the event that the IC exercises the option to build the interconnecting substation, the IC will be required to construct all interconnection facilities that will be turned over to ComEd in accordance with ComEd published standards.

ComEd would design, engineer and construct the tie in of the Interconnection Substation to the Dixon-McGirr Road 138kV Line 10714.

The preliminary cost estimate for Direct Connection Network Upgrade is given in the following tables.

For Option to Build Direct Connection cost estimates:

Scope of Work	Cost Estimate
Installation of a new 138kV substation as described above	N/A
Transmission line tie in work (foundations, structures, conductors)	$ 2,000,000
ComEd oversight and testing	$ 1,000,000
Total Cost Estimate (see notes below on cost estimate)	$ 3,000,000

For ComEd building the interconnecting substation cost estimates:

Scope of Work	Cost Estimate
Installation of a new 138kV substation as described above	$15,000,000
Transmission line tie in work (foundations, structures, conductors)	$ 2,000,000
Total Cost Estimate (see notes below on cost estimate)	$ 17,000,000

ComEd would take approximately 24-months to construct the substation and transmission line work after the ISA / ICSA are signed.

Non-Direct Connection Network Upgrades

The integration of the new 138kV Interconnection Substation would require relay/communications/SCADA upgrades at the TSS 107 Dixon and TSS 169 McGirr Road substations. The ComEd cost is given below:

Scope of Work	Cost Estimate
Relay/communications/SCADA upgrades at TSS 107 Dixon substation	$ 750,000
Relay/communications/SCADA upgrades at TSS 169 McGirr Road TSS 169 substation	$ 750,000
Total Cost Estimate (see notes below on cost estimate)	$ 1,500,000

Notes on Cost Estimate:

1) These estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided by the IC.

2) There were no site visits performed for these estimates. There may be costs related to specific site related issues that are not identified in these estimates. The site reviews will be performed during the Facilities Study or during detailed engineering.

3) These estimates are not a guarantee of the maximum amount payable by the IC and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, IC will be responsible for paying all actual costs of ComEd's work.

4) The IC is responsible for all engineering, procurement, testing and construction of all equipment on the IC's side of the Point of Interconnection (POI).

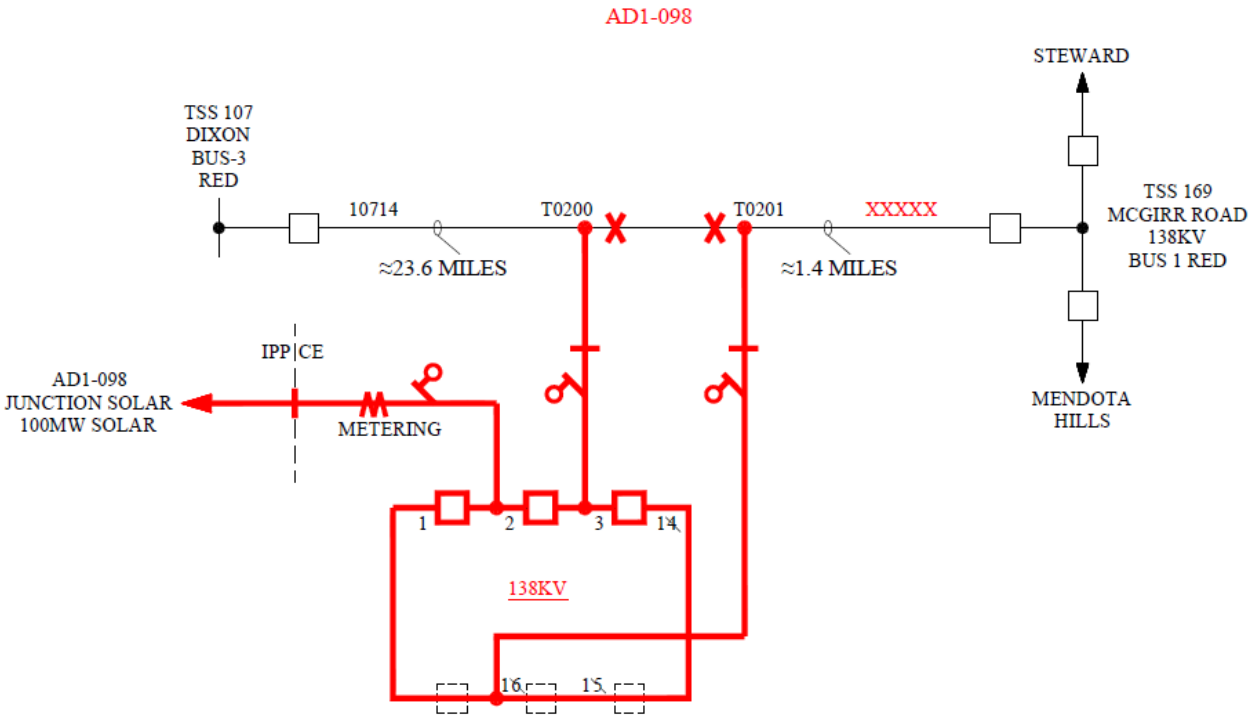

Figure 1. Single Line Diagram for Option 1

Network Impacts for the Primary POI

The Queue Project AD1-098 was evaluated as a 100.0 MW (Capacity 57.8 MW) injection tapping Dixon to McGirr Rd 138kV line in the ComEd area. Project AD1-098 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-098 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

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)

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)

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.35% to 158.51% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 14.19 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 270607 TO BUS 270630 CKT 1          / COLLI; 765 PLANO; 765
 END
```

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

2. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.16% to 158.32% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 14.24 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT4-5__'
 TRIP BRANCH FROM BUS 275168 TO BUS 270607 CKT 1          / COLLI;2M 345 COLLI; 765
 TRIP BRANCH FROM BUS 275168 TO BUS 270697 CKT 1          / COLLI;2M 345 COLLI; R 345
 TRIP BRANCH FROM BUS 275168 TO BUS 275268 CKT 1          / COLLI;2M 345 COLLI;2C 33
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
```

```
END
```

3. (CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 142.18% to 142.36% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.61 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

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

4. (CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 145.2% to 145.39% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.92 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

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

5. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 142.18% to 142.36% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.61 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

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

6. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 145.2% to 145.39% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.92 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
```

```
TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
END
```

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

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

No issues identified

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

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. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.15% to 158.31% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 14.23 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

2. (CE - CE) The DIXON ; R-DIXON ; B 138 kV line (from bus 271333 to bus 271332 ckt 1) loads from 110.83% to 126.92% (**DC power flow**) of its emergency rating (332 MVA) for the single line contingency outage of 'COMED_P1-2_138-L11323_R-R-A'. This project contributes approximately 53.39 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L11323_R-R-A'
 TRIP BRANCH FROM BUS 271680 TO BUS 272756 CKT 1          / HAUME; B 138 W DEK;3T 138
 TRIP BRANCH FROM BUS 272730 TO BUS 271558 CKT 1          / WATER;3B 138 GLIDD; B 138
 TRIP BRANCH FROM BUS 272730 TO BUS 272728 CKT 1          / WATER;3B 138 WATER; B 138
 TRIP BRANCH FROM BUS 272756 TO BUS 272730 CKT 1          / W DEK;3T 138 WATER;3B 138
 TRIP BRANCH FROM BUS 272756 TO BUS 934940 CKT 1          / W DEK;3T 138 AD1-126 TAP 138
 END
```

3. (CE - CE) The GLIDDEN ;BT-SUGAR GRV; B 138 kV line (from bus 271560 to bus 272522 ckt 1) loads from 86.4% to 96.12% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of 'COMED_P1-2_138-L11301_R-R'. This project contributes approximately 25.58 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L11301_R-R'
 TRIP BRANCH FROM BUS 272728 TO BUS 272445 CKT 1          / WATER; B 138 SANDW; R 138
 END
```

4. (CE - CE) The HAUMESSER; B-W DEKALB ;3T 138 kV line (from bus 271680 to bus 272756 ckt 1) loads from 113.67% to 135.78% (**DC power flow**) of its emergency rating (452 MVA) for the single line contingency outage of 'COMED_P1-2_138-L10714_R-R-A'. This project contributes approximately 99.94 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L10714_R-R-A'
 TRIP BRANCH FROM BUS 271333 TO BUS 934700 CKT 1          / DIXON; R 138 AD1-098 TAP 138
 END
```

5. (CE - CE) The HAUMESSER; B-W DEKALB ;3T 138 kV line (from bus 271680 to bus 272756 ckt 1) loads from 107.14% to 118.97% (**DC power flow**) of its normal rating (438 MVA) for non-contingency condition. This project contributes approximately 51.62 MW to the thermal violation.

6. (CE - CE) The ESS H445 ;3B-STEWARD ; B 138 kV line (from bus 272362 to bus 272516 ckt 1) loads from 107.88% to 127.5% (**DC power flow**) of its emergency rating (197 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 38.59 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1          / H440 ;RT 138 STEWA; B 138
 END
```

7. (CE - CE) The ESS H440 ; R-ESS H440N ;R 138 kV line (from bus 272363 to bus 272364 ckt 1) loads from 88.9% to 105.98% (**DC power flow**) of its emergency rating (226 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 38.6 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1          / H440 ;RT 138 STEWA; B 138
 END
```

8. (CE - CE) The ESS H440N ;R-ESS H445 ;3B 138 kV line (from bus 272364 to bus 272362 ckt 1) loads from 88.83% to 105.92% (**DC power flow**) of its emergency rating (226 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 38.59 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1              / H440 ;RT 138 STEWA; B 138
 END
```

9. (CE - CE) The ESS H440 ;RT-ESS H440 ; R 138 kV line (from bus 272365 to bus 272363 ckt 1) loads from 112.22% to 131.85% (**DC power flow**) of its emergency rating (197 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 38.6 MW to the thermal violation.

CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1 / H440 ;RT 138 STEWA; B 138
 END

10. (CE - CE) The WATERMAN ;3B-GLIDDEN ; B 138 kV line (from bus 272730 to bus 271558 ckt 1) loads from 81.88% to 91.53% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P2-1_113-L11323__'. This project contributes approximately 43.22 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_113-L11323__'
 TRIP BRANCH FROM BUS 272730 TO BUS 272728 CKT 1              / WATER;3B 138 WATER; B 138
 END
```

11. (CE - CE) The WATERMAN ;3B-WATERMAN ; B 138 kV line (from bus 272730 to bus 272728 ckt 1) loads from 80.73% to 96.98% (**DC power flow**) of its emergency rating (504 MVA) for the single line contingency outage of 'COMED_P1-2_138-L10714_R-R-A'. This project contributes approximately 81.68 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L10714_R-R-A'
 TRIP BRANCH FROM BUS 271333 TO BUS 934700 CKT 1              / DIXON; R 138 AD1-098 TAP 138
 END
```

12. (CE - CE) The W DEKALB ;3T-WATERMAN ;3B 138 kV line (from bus 272756 to bus 272730 ckt 1) loads from 105.71% to 127.82% (**DC power flow**) of its emergency rating (452 MVA) for the single line contingency outage of 'COMED_P1-2_138-L10714_R-R-A'. This project contributes approximately 99.94 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L10714_R-R-A'
 TRIP BRANCH FROM BUS 271333 TO BUS 934700 CKT 1              / DIXON; R 138 AD1-098 TAP 138
 END
```

13. (CE - CE) The W DEKALB ;3T-WATERMAN ;3B 138 kV line (from bus 272756 to bus 272730 ckt 1) loads from 95.85% to 107.29% (**DC power flow**) of its normal rating (452 MVA) for non-contingency condition. This project contributes approximately 51.62 MW to the thermal violation.

14. (CE - CE) The AD1-098 TAP-DIXON ; R 138 kV line (from bus 934700 to bus 271333 ckt 1) loads from 114.43% to 136.69% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P2-1_094-L11323__'. This project contributes approximately 99.94 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_094-L11323__'
 TRIP BRANCH FROM BUS 271680 TO BUS 272756 CKT 1              / HAUME; B 138 W DEK;3T 138
 END
```

Light Load Analysis - 2021

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

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

None

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

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)

None

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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.35% to 158.51% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 14.19 MW to the thermal violation.

AEP:
(1) The 40.64 mile section of line will have to reconductored/rebuilt to mitigate the overload. Estimated Cost is $80.42 million.
(2)This is a CE -AEP tie line, therefore PJM is going to coordinate this upgrade with CE as well as to make sure that this equipment will not set a limit lower than what is specified here.

(3)Replace the Olive switches to line risers, estimated cost: 100,000.
(4) An Engineering study need to be conducted to determine if the relay compliance trip limits settings can be adjusted to mitigate the overload, Estimated Cost: $25,000.New relay packages will be required if the settings cannot be adjusted, Estimated cost:$600,000.
An Approximate construction time would be 24 to 36 months after signing an interconnection agreement.

2. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.16% to 158.32% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 14.24 MW to the thermal violation.

Same as Contribution to Previously Identified #1

3. (CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 142.18% to 142.36% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.61 MW to the thermal violation.

COMED:
ComEd post contingency facility overloaded by this event is Tr. 93 @ Station 112 Wilton Center. The upgrade will be to build out the 765kV ring bus at Wilton Center, installation of two 765 kV Bus Tie Circuit Breakers (BT 6-8 & 8-2) along with a relocation of 765kV L11216 from bus 6 to bus 8. Preliminary estimate for upgrade is $8M with an estimated construction time line of 24 months. Note, the rating for Tr. 93 at Wilton Center will remain current however with this upgrade the 112-65-BT5-6 contingency file will no longer include the Wilton Center Tr. 94 and will allow both transformers to remain in service eliminating the overload.

4. (CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 145.2% to 145.39% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.92 MW to the thermal violation.

COMED:
ComEd TSS 112 Tr. 94 SLD & ALDR ratings are 1601 MVA & 1841 MVA. The post contingency flow for this event exceeds the ratings therefore an upgrade is required. The proposed upgrade will be to install a third transformer at Wilton Center. Upgrades include expansion on the 765kV & 345kV buses at Wilton Center. The preliminary estimate for this upgrade is $15.2M with a preliminary construction time line of 24-30 months.

5. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 142.18% to 142.36% (**DC power flow**) of its load dump rating (1379 MVA) for the

line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.61 MW to the thermal violation.

Same as Contribution to Previously Identified #3

6. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 145.2% to 145.39% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.92 MW to the thermal violation.

Same as Contribution to Previously Identified #4

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

(MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.35% to 158.51% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 14.19 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 270607 TO BUS 270630 CKT 1          / COLLI; 765 PLANO; 765
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.*
932012	*AC2-007 E*	*1.87*
932881	*AC2-115 1*	*2.84*
932891	*AC2-115 2*	*2.84*
932921	*AC2-116*	*1.*
932931	*AC2-117*	*6.18*
933341	*AC2-147 C*	*1.04*
933342	*AC2-147 E*	*1.7*
933351	*AC2-148 C*	*1.03*
933352	*AC2-148 E*	*1.68*
933361	*AC2-149 C*	*1.11*
933362	*AC2-149 E*	*1.81*
933371	*AC2-150 C*	*1.03*
933372	*AC2-150 E*	*1.68*
933381	*AC2-151 C*	*1.16*
933382	*AC2-151 E*	*1.89*
933401	*AC2-153 C*	*0.56*
933402	*AC2-153 E*	*0.91*
933411	*AC2-154 C*	*3.15*
933412	*AC2-154 E*	*5.14*
933431	*AC2-156 C*	*1.14*
933432	*AC2-156 E*	*1.86*
933511	*AC2-166 C*	*2.78*
933512	*AC2-166 E*	*3.08*
933911	*AD1-013 C O1*	*2.19*
933912	*AD1-013 E O1*	*3.5*
933931	*AD1-016 C*	*1.11*
933932	*AD1-016 E*	*1.81*
934001	*AD1-024 C*	*3.08*
934002	*AD1-024 E*	*5.02*
934101	*AD1-039 1*	*9.27*
934111	*AD1-039 2*	*9.64*

934401	*AD1-064 C O1*	*3.87*
934402	*AD1-064 E O1*	*18.11*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.66*
934651	*AD1-096 C*	*1.06*
934652	*AD1-096 E*	*1.74*
934701	*AD1-098 C O1*	*8.2*
934702	*AD1-098 E O1*	*5.99*
934721	*AD1-100 C*	*27.51*
934722	*AD1-100 E*	*128.82*
934871	*AD1-116 C*	*1.14*
934872	*AD1-116 E*	*1.86*
934881	*AD1-117 C*	*6.41*
934882	*AD1-117 E*	*4.27*
934941	*AD1-126 C*	*6.97*
934942	*AD1-126 E*	*4.65*
934971	*AD1-129 C*	*1.08*
934972	*AD1-129 E*	*0.72*
935001	*AD1-133 C O1*	*24.99*
935002	*AD1-133 E O1*	*16.66*
274890	*CAYUG;1U E*	*16.38*
274891	*CAYUG;2U E*	*16.38*
274859	*EASYR;U1 E*	*13.11*
274860	*EASYR;U2 E*	*13.11*
290051	*GSG-6; E*	*12.46*
940531	*J351*	*446.03*
951131	*J643*	*27.14*
981291	*J740 C*	*5.78*
981292	*J740 E*	*23.11*
275149	*KEMPTON ;1E*	*23.22*
290108	*LEEDK;1U E*	*28.96*
274850	*MENDOTA H;RU*	*7.17*
293061	*N-015 E*	*18.27*
293516	*O-009 E1*	*9.14*
293517	*O-009 E2*	*4.64*
293518	*O-009 E3*	*5.11*
293715	*O-029 E*	*11.6*
293716	*O-029 E*	*6.36*
293717	*O-029 E*	*5.84*
293644	*O22 E1*	*12.48*
293645	*O22 E2*	*24.23*
290021	*O50 E*	*23.22*
294392	*P-010 E*	*23.2*
294763	*P-046 E*	*11.2*
274888	*PILOT HIL;1E*	*23.22*

274830	*PWR VTREC;1U*	*7.29*
274831	*PWR VTREC;2U*	*7.29*
274722	*S-055 E*	*13.49*
884780	*S58 FTIR*	*63.8*
884781	*S58 NFTIR*	*191.39*
274789	*SE CHICAG;6U*	*1.52*
274790	*SE CHICAG;7U*	*1.52*
274791	*SE CHICAG;8U*	*1.52*
295111	*SUBLETTE E*	*3.24*
299993	*U3-031C*	*6.54*
903433	*W3-046*	*28.59*
274874	*WALNR;2U*	*2.84*
294502	*WALNR;2U E*	*11.38*
295109	*WESTBROOK E*	*6.67*
274687	*WILL CNTY;4U*	*82.35*
910542	*X3-005 E*	*1.04*
914641	*Y2-103*	*53.96*
915011	*Y3-013 1*	*4.5*
915021	*Y3-013 2*	*4.5*
915031	*Y3-013 3*	*4.5*
916502	*Z1-106 E1*	*1.51*
916504	*Z1-106 E2*	*1.51*
916512	*Z1-107 E*	*3.16*
916522	*Z1-108 E*	*2.98*
916651	*Z1-127 1*	*2.28*
916652	*Z1-127 2*	*1.05*
918051	*AA1-018 C*	*2.92*
918052	*AA1-018 E*	*19.54*
918972	*AA1-116 E*	*3.32*
918982	*AA1-117 E*	*3.32*
919221	*AA1-146*	*20.95*
919581	*AA2-030*	*20.95*
919591	*AA2-035*	*156.6*
920112	*AA2-107 E*	*2.93*
920272	*AA2-123 E*	*2.92*
930481	*AB1-089*	*78.55*
930491	*AB1-090*	*78.55*
930501	*AB1-091*	*92.45*
930761	*AB1-122 1*	*85.28*
930771	*AB1-122 2*	*88.68*
931221	*AB1-172*	*0.98*
924471	*AB2-096*	*50.62*
925161	*AB2-173*	*3.74*
925301	*AB2-191 C*	*1.51*
925302	*AB2-191 E*	*1.34*

925881	*AC1-067*	*207.71*
926311	*AC1-109 1*	*2.28*
926321	*AC1-109 2*	*2.28*
926331	*AC1-110 1*	*2.27*
926341	*AC1-110 2*	*2.27*
926351	*AC1-111 1*	*0.91*
926361	*AC1-111 2*	*0.91*
926371	*AC1-111 3*	*0.91*
926381	*AC1-111 4*	*0.91*
926391	*AC1-111 5*	*0.91*
926401	*AC1-111 6*	*0.91*
927511	*AC1-113 1*	*1.42*
927522	*AC1-113 2*	*1.42*
926431	*AC1-114*	*2.84*
927451	*AC1-142A 1*	*5.06*
927461	*AC1-142A 2*	*5.06*
926701	*AC1-153 C1*	*92.69*
926711	*AC1-153 C2*	*96.39*
926702	*AC1-153 E1*	*3.71*
926712	*AC1-153 E2*	*3.86*
926821	*AC1-168 C*	*1.38*
926822	*AC1-168 E*	*9.24*
927531	*AC1-185 1*	*0.82*
927541	*AC1-185 2*	*0.82*
927551	*AC1-185 3*	*0.82*
927561	*AC1-185 4*	*0.82*
927571	*AC1-185 5*	*0.82*
927581	*AC1-185 6*	*0.82*
927591	*AC1-185 7*	*0.82*
927601	*AC1-185 8*	*0.82*
927091	*AC1-204 1*	*87.03*
927101	*AC1-204 2*	*87.01*

Appendix 2

(CE - CE) The WILTON ; B-WILTON ;3M 345 kV line (from bus 270926 to bus 275232 ckt 1) loads from 142.18% to 142.36% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.61 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.03*
932012	*AC2-007 E*	*1.92*
932881	*AC2-115 1*	*2.92*
932891	*AC2-115 2*	*2.92*
932921	*AC2-116*	*1.02*
932931	*AC2-117*	*6.53*
933341	*AC2-147 C*	*1.07*
933342	*AC2-147 E*	*1.75*
933361	*AC2-149 C*	*1.14*
933362	*AC2-149 E*	*1.86*
933381	*AC2-151 C*	*1.21*
933382	*AC2-151 E*	*1.97*
933391	*AC2-152 C*	*0.57*
933392	*AC2-152 E*	*0.94*
933401	*AC2-153 C*	*0.57*
933402	*AC2-153 E*	*0.93*
933411	*AC2-154 C*	*3.21*
933412	*AC2-154 E*	*5.24*
933431	*AC2-156 C*	*1.17*
933432	*AC2-156 E*	*1.91*
933511	*AC2-166 C*	*2.86*
933512	*AC2-166 E*	*3.16*
933911	*AD1-013 C O1*	*2.26*
933912	*AD1-013 E O1*	*3.61*
933931	*AD1-016 C*	*1.14*
933932	*AD1-016 E*	*1.86*
934001	*AD1-024 C*	*3.14*
934002	*AD1-024 E*	*5.13*
934101	*AD1-039 1*	*9.68*
934111	*AD1-039 2*	*9.86*
934401	*AD1-064 C O1*	*3.97*
934402	*AD1-064 E O1*	*18.61*

934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.68*
934651	*AD1-096 C*	*1.1*
934652	*AD1-096 E*	*1.79*
934701	*AD1-098 C O1*	*8.44*
934702	*AD1-098 E O1*	*6.16*
934721	*AD1-100 C*	*35.27*
934722	*AD1-100 E*	*165.14*
934871	*AD1-116 C*	*1.18*
934872	*AD1-116 E*	*1.92*
934881	*AD1-117 C*	*6.6*
934882	*AD1-117 E*	*4.4*
934941	*AD1-126 C*	*7.17*
934942	*AD1-126 E*	*4.78*
934971	*AD1-129 C*	*1.11*
934972	*AD1-129 E*	*0.74*
935001	*AD1-133 C O1*	*27.74*
935002	*AD1-133 E O1*	*18.49*
274890	*CAYUG;1U E*	*20.69*
274891	*CAYUG;2U E*	*20.69*
290051	*GSG-6; E*	*12.83*
275149	*KEMPTON ;1E*	*23.69*
290108	*LEEDK;1U E*	*29.79*
274770	*LINCOLN ;1U*	*4.36*
274771	*LINCOLN ;2U*	*4.36*
274772	*LINCOLN ;3U*	*4.36*
274773	*LINCOLN ;4U*	*4.36*
274774	*LINCOLN ;5U*	*4.36*
274775	*LINCOLN ;6U*	*4.36*
274776	*LINCOLN ;7U*	*4.36*
274777	*LINCOLN ;8U*	*4.36*
274850	*MENDOTA H;RU*	*7.38*
293061	*N-015 E*	*19.24*
293644	*O22 E1*	*12.63*
293645	*O22 E2*	*24.52*
290021	*O50 E*	*23.89*
294392	*P-010 E*	*24.44*
294763	*P-046 E*	*11.52*
274888	*PILOT HIL;1E*	*23.69*
274830	*PWR VTREC;1U*	*7.49*
274831	*PWR VTREC;2U*	*7.49*
296308	*R-030 C1*	*5.02*
296271	*R-030 C2*	*5.02*
296125	*R-030 C3*	*5.08*
296309	*R-030 E1*	*20.06*

296272	*R-030 E2*	*20.06*
296128	*R-030 E3*	*20.31*
274722	*S-055 E*	*13.81*
884780	*S58 FTIR*	*63.32*
884781	*S58 NFTIR*	*189.95*
295111	*SUBLETTE E*	*3.34*
299993	*U3-031C*	*11.55*
903433	*W3-046*	*29.56*
295109	*WESTBROOK E*	*6.87*
274687	*WILL CNTY;4U*	*82.27*
910542	*X3-005 E*	*0.91*
914641	*Y2-103*	*55.22*
915011	*Y3-013 1*	*4.6*
915021	*Y3-013 2*	*4.6*
915031	*Y3-013 3*	*4.6*
916502	*Z1-106 E1*	*1.55*
916504	*Z1-106 E2*	*1.55*
916512	*Z1-107 E*	*3.18*
916522	*Z1-108 E*	*3.05*
916651	*Z1-127 1*	*2.14*
916652	*Z1-127 2*	*1.05*
917501	*Z2-087 C*	*3.92*
917502	*Z2-087 E*	*26.24*
918051	*AA1-018 C*	*3.03*
918052	*AA1-018 E*	*20.25*
918972	*AA1-116 E*	*3.38*
918982	*AA1-117 E*	*3.38*
919591	*AA2-035*	*161.05*
920112	*AA2-107 E*	*3.01*
920272	*AA2-123 E*	*3.*
930481	*AB1-089*	*80.75*
930491	*AB1-090*	*80.75*
930501	*AB1-091*	*91.4*
930761	*AB1-122 1*	*89.1*
930771	*AB1-122 2*	*90.74*
931221	*AB1-172*	*0.99*
924041	*AB2-047 C O1*	*4.84*
924042	*AB2-047 E O1*	*32.38*
924471	*AB2-096*	*52.*
925301	*AB2-191 C*	*1.55*
925302	*AB2-191 E*	*1.38*
925881	*AC1-067*	*168.19*
926311	*AC1-109 1*	*2.35*
926321	*AC1-109 2*	*2.35*
926331	*AC1-110 1*	*2.33*

926341	*AC1-110 2*	*2.33*
926351	*AC1-111 1*	*0.94*
926361	*AC1-111 2*	*0.94*
926371	*AC1-111 3*	*0.94*
926381	*AC1-111 4*	*0.94*
926391	*AC1-111 5*	*0.94*
926401	*AC1-111 6*	*0.94*
927511	*AC1-113 1*	*1.46*
927522	*AC1-113 2*	*1.46*
926431	*AC1-114*	*2.92*
927451	*AC1-142A 1*	*5.15*
927461	*AC1-142A 2*	*5.15*
926701	*AC1-153 C1*	*96.84*
926711	*AC1-153 C2*	*98.63*
926702	*AC1-153 E1*	*3.87*
926712	*AC1-153 E2*	*3.94*
927531	*AC1-185 1*	*0.02*
927541	*AC1-185 2*	*0.02*
927551	*AC1-185 3*	*0.02*
927561	*AC1-185 4*	*0.02*
927571	*AC1-185 5*	*0.02*
927581	*AC1-185 6*	*0.02*
927591	*AC1-185 7*	*0.02*
927601	*AC1-185 8*	*0.02*
927091	*AC1-204 1*	*89.41*
927101	*AC1-204 2*	*89.41*

Appendix 3

(CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 145.2% to 145.39% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.92 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.05*
932012	*AC2-007 E*	*1.96*
932881	*AC2-115 1*	*2.98*
932891	*AC2-115 2*	*2.98*
932921	*AC2-116*	*1.04*
932931	*AC2-117*	*6.67*
933341	*AC2-147 C*	*1.09*
933342	*AC2-147 E*	*1.79*
933361	*AC2-149 C*	*1.17*
933362	*AC2-149 E*	*1.9*
933381	*AC2-151 C*	*1.23*
933382	*AC2-151 E*	*2.01*
933391	*AC2-152 C*	*0.59*
933392	*AC2-152 E*	*0.96*
933401	*AC2-153 C*	*0.58*
933402	*AC2-153 E*	*0.95*
933411	*AC2-154 C*	*3.28*
933412	*AC2-154 E*	*5.35*
933431	*AC2-156 C*	*1.2*
933432	*AC2-156 E*	*1.95*
933511	*AC2-166 C*	*2.92*
933512	*AC2-166 E*	*3.23*
933911	*AD1-013 C O1*	*2.31*
933912	*AD1-013 E O1*	*3.68*
933931	*AD1-016 C*	*1.16*
933932	*AD1-016 E*	*1.9*
934001	*AD1-024 C*	*3.21*
934002	*AD1-024 E*	*5.23*
934101	*AD1-039 1*	*9.89*
934111	*AD1-039 2*	*10.07*
934401	*AD1-064 C O1*	*4.06*
934402	*AD1-064 E O1*	*19.*

934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.69*
934651	*AD1-096 C*	*1.12*
934652	*AD1-096 E*	*1.82*
934701	*AD1-098 C O1*	*8.62*
934702	*AD1-098 E O1*	*6.3*
934721	*AD1-100 C*	*35.97*
934722	*AD1-100 E*	*168.38*
934871	*AD1-116 C*	*1.21*
934872	*AD1-116 E*	*1.97*
934881	*AD1-117 C*	*6.74*
934882	*AD1-117 E*	*4.49*
934941	*AD1-126 C*	*7.33*
934942	*AD1-126 E*	*4.88*
934971	*AD1-129 C*	*1.13*
934972	*AD1-129 E*	*0.75*
935001	*AD1-133 C O1*	*28.31*
935002	*AD1-133 E O1*	*18.88*
274890	*CAYUG;1U E*	*21.1*
274891	*CAYUG;2U E*	*21.1*
290051	*GSG-6; E*	*13.1*
275149	*KEMPTON ;1E*	*24.18*
290108	*LEEDK;1U E*	*30.43*
274770	*LINCOLN ;1U*	*4.48*
274771	*LINCOLN ;2U*	*4.48*
274772	*LINCOLN ;3U*	*4.48*
274773	*LINCOLN ;4U*	*4.48*
274774	*LINCOLN ;5U*	*4.48*
274775	*LINCOLN ;6U*	*4.48*
274776	*LINCOLN ;7U*	*4.48*
274777	*LINCOLN ;8U*	*4.48*
274850	*MENDOTA H;RU*	*7.54*
293061	*N-015 E*	*19.65*
293644	*O22 E1*	*12.9*
293645	*O22 E2*	*25.03*
290021	*O50 E*	*24.4*
294392	*P-010 E*	*24.95*
294763	*P-046 E*	*11.76*
274888	*PILOT HIL;1E*	*24.18*
274830	*PWR VTREC;1U*	*7.65*
274831	*PWR VTREC;2U*	*7.65*
296308	*R-030 C1*	*5.12*
296271	*R-030 C2*	*5.12*
296125	*R-030 C3*	*5.18*
296309	*R-030 E1*	*20.47*

296272	*R-030 E2*	*20.47*
296128	*R-030 E3*	*20.72*
274722	*S-055 E*	*14.1*
884780	*S58 FTIR*	*64.66*
884781	*S58 NFTIR*	*193.98*
295111	*SUBLETTE E*	*3.41*
299993	*U3-031C*	*11.85*
903433	*W3-046*	*30.19*
295109	*WESTBROOK E*	*7.01*
274687	*WILL CNTY;4U*	*84.02*
910542	*X3-005 E*	*0.92*
914641	*Y2-103*	*56.4*
915011	*Y3-013 1*	*4.7*
915021	*Y3-013 2*	*4.7*
915031	*Y3-013 3*	*4.7*
916502	*Z1-106 E1*	*1.58*
916504	*Z1-106 E2*	*1.58*
916512	*Z1-107 E*	*3.25*
916522	*Z1-108 E*	*3.12*
916651	*Z1-127 1*	*2.19*
916652	*Z1-127 2*	*1.07*
917501	*Z2-087 C*	*4.*
917502	*Z2-087 E*	*26.77*
918051	*AA1-018 C*	*3.09*
918052	*AA1-018 E*	*20.69*
918972	*AA1-116 E*	*3.45*
918982	*AA1-117 E*	*3.45*
919591	*AA2-035*	*164.48*
920112	*AA2-107 E*	*3.08*
920272	*AA2-123 E*	*3.06*
930481	*AB1-089*	*82.47*
930491	*AB1-090*	*82.47*
930501	*AB1-091*	*93.33*
930761	*AB1-122 1*	*90.98*
930771	*AB1-122 2*	*92.67*
931221	*AB1-172*	*1.01*
924041	*AB2-047 C O1*	*4.94*
924042	*AB2-047 E O1*	*33.03*
924471	*AB2-096*	*53.1*
925301	*AB2-191 C*	*1.59*
925302	*AB2-191 E*	*1.41*
925881	*AC1-067*	*171.92*
926311	*AC1-109 1*	*2.4*
926321	*AC1-109 2*	*2.4*
926331	*AC1-110 1*	*2.38*

926341	*AC1-110 2*	*2.38*
926351	*AC1-111 1*	*0.96*
926361	*AC1-111 2*	*0.96*
926371	*AC1-111 3*	*0.96*
926381	*AC1-111 4*	*0.96*
926391	*AC1-111 5*	*0.96*
926401	*AC1-111 6*	*0.96*
927511	*AC1-113 1*	*1.49*
927522	*AC1-113 2*	*1.49*
926431	*AC1-114*	*2.98*
927451	*AC1-142A 1*	*5.26*
927461	*AC1-142A 2*	*5.26*
926701	*AC1-153 C1*	*98.89*
926711	*AC1-153 C2*	*100.73*
926702	*AC1-153 E1*	*3.96*
926712	*AC1-153 E2*	*4.03*
927531	*AC1-185 1*	*0.02*
927541	*AC1-185 2*	*0.02*
927551	*AC1-185 3*	*0.02*
927561	*AC1-185 4*	*0.02*
927571	*AC1-185 5*	*0.02*
927581	*AC1-185 6*	*0.02*
927591	*AC1-185 7*	*0.02*
927601	*AC1-185 8*	*0.02*
927091	*AC1-204 1*	*91.32*
927101	*AC1-204 2*	*91.31*

Appendix 4

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275232 to bus 270644 ckt 1) loads from 142.18% to 142.36% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT5-6__'. This project contributes approximately 14.61 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT5-6__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270644 CKT 1          / WILTO;4M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275233 TO BUS 270927 CKT 1          / WILTO;4M 345 WILTO; R 345
 TRIP BRANCH FROM BUS 275233 TO BUS 275333 CKT 1          / WILTO;4M 345 WILTO;4C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.03*
932012	*AC2-007 E*	*1.92*
932881	*AC2-115 1*	*2.92*
932891	*AC2-115 2*	*2.92*
932921	*AC2-116*	*1.02*
932931	*AC2-117*	*6.53*
933341	*AC2-147 C*	*1.07*
933342	*AC2-147 E*	*1.75*
933361	*AC2-149 C*	*1.14*
933362	*AC2-149 E*	*1.86*
933381	*AC2-151 C*	*1.21*
933382	*AC2-151 E*	*1.97*
933391	*AC2-152 C*	*0.57*
933392	*AC2-152 E*	*0.94*
933401	*AC2-153 C*	*0.57*
933402	*AC2-153 E*	*0.93*
933411	*AC2-154 C*	*3.21*
933412	*AC2-154 E*	*5.24*
933431	*AC2-156 C*	*1.17*
933432	*AC2-156 E*	*1.91*
933511	*AC2-166 C*	*2.86*
933512	*AC2-166 E*	*3.16*
933911	*AD1-013 C O1*	*2.26*
933912	*AD1-013 E O1*	*3.61*
933931	*AD1-016 C*	*1.14*
933932	*AD1-016 E*	*1.86*
934001	*AD1-024 C*	*3.14*
934002	*AD1-024 E*	*5.13*
934101	*AD1-039 1*	*9.68*
934111	*AD1-039 2*	*9.86*
934401	*AD1-064 C O1*	*3.97*
934402	*AD1-064 E O1*	*18.61*

934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.68*
934651	*AD1-096 C*	*1.1*
934652	*AD1-096 E*	*1.79*
934701	*AD1-098 C O1*	*8.44*
934702	*AD1-098 E O1*	*6.16*
934721	*AD1-100 C*	*35.27*
934722	*AD1-100 E*	*165.14*
934871	*AD1-116 C*	*1.18*
934872	*AD1-116 E*	*1.92*
934881	*AD1-117 C*	*6.6*
934882	*AD1-117 E*	*4.4*
934941	*AD1-126 C*	*7.17*
934942	*AD1-126 E*	*4.78*
934971	*AD1-129 C*	*1.11*
934972	*AD1-129 E*	*0.74*
935001	*AD1-133 C O1*	*27.74*
935002	*AD1-133 E O1*	*18.49*
274890	*CAYUG;1U E*	*20.69*
274891	*CAYUG;2U E*	*20.69*
290051	*GSG-6; E*	*12.83*
275149	*KEMPTON ;1E*	*23.69*
290108	*LEEDK;1U E*	*29.79*
274770	*LINCOLN ;1U*	*4.36*
274771	*LINCOLN ;2U*	*4.36*
274772	*LINCOLN ;3U*	*4.36*
274773	*LINCOLN ;4U*	*4.36*
274774	*LINCOLN ;5U*	*4.36*
274775	*LINCOLN ;6U*	*4.36*
274776	*LINCOLN ;7U*	*4.36*
274777	*LINCOLN ;8U*	*4.36*
274850	*MENDOTA H;RU*	*7.38*
293061	*N-015 E*	*19.24*
293644	*O22 E1*	*12.63*
293645	*O22 E2*	*24.52*
290021	*O50 E*	*23.89*
294392	*P-010 E*	*24.44*
294763	*P-046 E*	*11.52*
274888	*PILOT HIL;1E*	*23.69*
274830	*PWR VTREC;1U*	*7.49*
274831	*PWR VTREC;2U*	*7.49*
296308	*R-030 C1*	*5.02*
296271	*R-030 C2*	*5.02*
296125	*R-030 C3*	*5.08*
296309	*R-030 E1*	*20.06*

296272	*R-030 E2*	*20.06*
296128	*R-030 E3*	*20.31*
274722	*S-055 E*	*13.81*
884780	*S58 FTIR*	*63.32*
884781	*S58 NFTIR*	*189.95*
295111	*SUBLETTE E*	*3.34*
299993	*U3-031C*	*11.55*
903433	*W3-046*	*29.56*
295109	*WESTBROOK E*	*6.87*
274687	*WILL CNTY;4U*	*82.27*
910542	*X3-005 E*	*0.91*
914641	*Y2-103*	*55.22*
915011	*Y3-013 1*	*4.6*
915021	*Y3-013 2*	*4.6*
915031	*Y3-013 3*	*4.6*
916502	*Z1-106 E1*	*1.55*
916504	*Z1-106 E2*	*1.55*
916512	*Z1-107 E*	*3.18*
916522	*Z1-108 E*	*3.05*
916651	*Z1-127 1*	*2.14*
916652	*Z1-127 2*	*1.05*
917501	*Z2-087 C*	*3.92*
917502	*Z2-087 E*	*26.24*
918051	*AA1-018 C*	*3.03*
918052	*AA1-018 E*	*20.25*
918972	*AA1-116 E*	*3.38*
918982	*AA1-117 E*	*3.38*
919591	*AA2-035*	*161.05*
920112	*AA2-107 E*	*3.01*
920272	*AA2-123 E*	*3.*
930481	*AB1-089*	*80.75*
930491	*AB1-090*	*80.75*
930501	*AB1-091*	*91.4*
930761	*AB1-122 1*	*89.1*
930771	*AB1-122 2*	*90.74*
931221	*AB1-172*	*0.99*
924041	*AB2-047 C O1*	*4.84*
924042	*AB2-047 E O1*	*32.38*
924471	*AB2-096*	*52.*
925301	*AB2-191 C*	*1.55*
925302	*AB2-191 E*	*1.38*
925881	*AC1-067*	*168.19*
926311	*AC1-109 1*	*2.35*
926321	*AC1-109 2*	*2.35*
926331	*AC1-110 1*	*2.33*

926341	*AC1-110 2*	*2.33*
926351	*AC1-111 1*	*0.94*
926361	*AC1-111 2*	*0.94*
926371	*AC1-111 3*	*0.94*
926381	*AC1-111 4*	*0.94*
926391	*AC1-111 5*	*0.94*
926401	*AC1-111 6*	*0.94*
927511	*AC1-113 1*	*1.46*
927522	*AC1-113 2*	*1.46*
926431	*AC1-114*	*2.92*
927451	*AC1-142A 1*	*5.15*
927461	*AC1-142A 2*	*5.15*
926701	*AC1-153 C1*	*96.84*
926711	*AC1-153 C2*	*98.63*
926702	*AC1-153 E1*	*3.87*
926712	*AC1-153 E2*	*3.94*
927531	*AC1-185 1*	*0.02*
927541	*AC1-185 2*	*0.02*
927551	*AC1-185 3*	*0.02*
927561	*AC1-185 4*	*0.02*
927571	*AC1-185 5*	*0.02*
927581	*AC1-185 6*	*0.02*
927591	*AC1-185 7*	*0.02*
927601	*AC1-185 8*	*0.02*
927091	*AC1-204 1*	*89.41*
927101	*AC1-204 2*	*89.41*

Appendix 5

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 145.2% to 145.39% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.92 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.05*
932012	*AC2-007 E*	*1.96*
932881	*AC2-115 1*	*2.98*
932891	*AC2-115 2*	*2.98*
932921	*AC2-116*	*1.04*
932931	*AC2-117*	*6.67*
933341	*AC2-147 C*	*1.09*
933342	*AC2-147 E*	*1.79*
933361	*AC2-149 C*	*1.17*
933362	*AC2-149 E*	*1.9*
933381	*AC2-151 C*	*1.23*
933382	*AC2-151 E*	*2.01*
933391	*AC2-152 C*	*0.59*
933392	*AC2-152 E*	*0.96*
933401	*AC2-153 C*	*0.58*
933402	*AC2-153 E*	*0.95*
933411	*AC2-154 C*	*3.28*
933412	*AC2-154 E*	*5.35*
933431	*AC2-156 C*	*1.2*
933432	*AC2-156 E*	*1.95*
933511	*AC2-166 C*	*2.92*
933512	*AC2-166 E*	*3.23*
933911	*AD1-013 C O1*	*2.31*
933912	*AD1-013 E O1*	*3.68*
933931	*AD1-016 C*	*1.16*
933932	*AD1-016 E*	*1.9*
934001	*AD1-024 C*	*3.21*
934002	*AD1-024 E*	*5.23*
934101	*AD1-039 1*	*9.89*
934111	*AD1-039 2*	*10.07*
934401	*AD1-064 C O1*	*4.06*
934402	*AD1-064 E O1*	*19.*

934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.69*
934651	*AD1-096 C*	*1.12*
934652	*AD1-096 E*	*1.82*
934701	*AD1-098 C O1*	*8.62*
934702	*AD1-098 E O1*	*6.3*
934721	*AD1-100 C*	*35.97*
934722	*AD1-100 E*	*168.38*
934871	*AD1-116 C*	*1.21*
934872	*AD1-116 E*	*1.97*
934881	*AD1-117 C*	*6.74*
934882	*AD1-117 E*	*4.49*
934941	*AD1-126 C*	*7.33*
934942	*AD1-126 E*	*4.88*
934971	*AD1-129 C*	*1.13*
934972	*AD1-129 E*	*0.75*
935001	*AD1-133 C O1*	*28.31*
935002	*AD1-133 E O1*	*18.88*
274890	*CAYUG;1U E*	*21.1*
274891	*CAYUG;2U E*	*21.1*
290051	*GSG-6; E*	*13.1*
275149	*KEMPTON ;1E*	*24.18*
290108	*LEEDK;1U E*	*30.43*
274770	*LINCOLN ;1U*	*4.48*
274771	*LINCOLN ;2U*	*4.48*
274772	*LINCOLN ;3U*	*4.48*
274773	*LINCOLN ;4U*	*4.48*
274774	*LINCOLN ;5U*	*4.48*
274775	*LINCOLN ;6U*	*4.48*
274776	*LINCOLN ;7U*	*4.48*
274777	*LINCOLN ;8U*	*4.48*
274850	*MENDOTA H;RU*	*7.54*
293061	*N-015 E*	*19.65*
293644	*O22 E1*	*12.9*
293645	*O22 E2*	*25.03*
290021	*O50 E*	*24.4*
294392	*P-010 E*	*24.95*
294763	*P-046 E*	*11.76*
274888	*PILOT HIL;1E*	*24.18*
274830	*PWR VTREC;1U*	*7.65*
274831	*PWR VTREC;2U*	*7.65*
296308	*R-030 C1*	*5.12*
296271	*R-030 C2*	*5.12*
296125	*R-030 C3*	*5.18*
296309	*R-030 E1*	*20.47*

296272	*R-030 E2*	*20.47*
296128	*R-030 E3*	*20.72*
274722	*S-055 E*	*14.1*
884780	*S58 FTIR*	*64.66*
884781	*S58 NFTIR*	*193.98*
295111	*SUBLETTE E*	*3.41*
299993	*U3-031C*	*11.85*
903433	*W3-046*	*30.19*
295109	*WESTBROOK E*	*7.01*
274687	*WILL CNTY;4U*	*84.02*
910542	*X3-005 E*	*0.92*
914641	*Y2-103*	*56.4*
915011	*Y3-013 1*	*4.7*
915021	*Y3-013 2*	*4.7*
915031	*Y3-013 3*	*4.7*
916502	*Z1-106 E1*	*1.58*
916504	*Z1-106 E2*	*1.58*
916512	*Z1-107 E*	*3.25*
916522	*Z1-108 E*	*3.12*
916651	*Z1-127 1*	*2.19*
916652	*Z1-127 2*	*1.07*
917501	*Z2-087 C*	*4.*
917502	*Z2-087 E*	*26.77*
918051	*AA1-018 C*	*3.09*
918052	*AA1-018 E*	*20.69*
918972	*AA1-116 E*	*3.45*
918982	*AA1-117 E*	*3.45*
919591	*AA2-035*	*164.48*
920112	*AA2-107 E*	*3.08*
920272	*AA2-123 E*	*3.06*
930481	*AB1-089*	*82.47*
930491	*AB1-090*	*82.47*
930501	*AB1-091*	*93.33*
930761	*AB1-122 1*	*90.98*
930771	*AB1-122 2*	*92.67*
931221	*AB1-172*	*1.01*
924041	*AB2-047 C O1*	*4.94*
924042	*AB2-047 E O1*	*33.03*
924471	*AB2-096*	*53.1*
925301	*AB2-191 C*	*1.59*
925302	*AB2-191 E*	*1.41*
925881	*AC1-067*	*171.92*
926311	*AC1-109 1*	*2.4*
926321	*AC1-109 2*	*2.4*
926331	*AC1-110 1*	*2.38*

926341	*AC1-110 2*	*2.38*
926351	*AC1-111 1*	*0.96*
926361	*AC1-111 2*	*0.96*
926371	*AC1-111 3*	*0.96*
926381	*AC1-111 4*	*0.96*
926391	*AC1-111 5*	*0.96*
926401	*AC1-111 6*	*0.96*
927511	*AC1-113 1*	*1.49*
927522	*AC1-113 2*	*1.49*
926431	*AC1-114*	*2.98*
927451	*AC1-142A 1*	*5.26*
927461	*AC1-142A 2*	*5.26*
926701	*AC1-153 C1*	*98.89*
926711	*AC1-153 C2*	*100.73*
926702	*AC1-153 E1*	*3.96*
926712	*AC1-153 E2*	*4.03*
927531	*AC1-185 1*	*0.02*
927541	*AC1-185 2*	*0.02*
927551	*AC1-185 3*	*0.02*
927561	*AC1-185 4*	*0.02*
927571	*AC1-185 5*	*0.02*
927581	*AC1-185 6*	*0.02*
927591	*AC1-185 7*	*0.02*
927601	*AC1-185 8*	*0.02*
927091	*AC1-204 1*	*91.32*
927101	*AC1-204 2*	*91.31*

Secondary Point of Interconnection (Option-2)

The Interconnection Customer (IC) AD1-098, a 100MW solar facility, proposes to interconnect with the ComEd transmission system by connecting to the 138kV bus at the McGirr Road TSS 169. The existing McGirr Road TSS 169 is not designed to accommodate a line termination. For that reason, this TSS have to be converted to a ring bus to create a line termination for the generator lead.

Attachment Facilities

The IC AD1-098 generator lead will interconnect to the 138kV bus at the newly built McGirr Road TSS 169. This interconnection would require one 138kV line MOD, a dead-end structure and revenue metering as shown in the one line diagram.

The cost for the attachment facilities is estimated at $1M.

Scope of Work	Cost Estimate
Installation of one 138kV line MOD, one dead-end structure and one set of revenue metering (see notes below on cost estimate)	$1,000,000

Direct Connection Network Upgrades

In order to accommodate interconnection of AD1-098 under this option, the existing McGirr Road 138kV substation would need to be reconfigured into a ring bus configuration to create a line termination for the generator lead.

The scope of work includes the installation of two 138kV circuit breakers to convert the existing arrangement into a ring-bus configuration and re-terminating the existing lines L10714, L16901 and L16914 as shown in the one line diagram below.

The IC is responsible for constructing all of the facilities on the IC side of the point of interconnection outside of the substation. It would be the IC's responsibility to obtain any additional required real-estate for expansion of the McGirr Road 138kV substation.

ComEd would design, engineer and construct the McGirr Road 138kV substation.

The preliminary cost estimate for Direct Connection Network Upgrade is given in the following table.

Scope of Work	Cost Estimate
Installation of two 138kV circuit breakers and bus reconfiguration as described above	$ 10,000,000
Total Cost Estimate (see notes below on cost estimate)	$ 10,000,000

ComEd would take approximately 24-months to construct the substation and transmission line work after the ISA / ICSA are signed.

Non-Direct Connection Network Upgrades

The re-termination of existing lines L10714, L16901 and L16914 to new bus position in a rin-bus configuration would require relay/communications/SCADA upgrades at Dixon, Mendota Hill, Shady Oaks and Steward substations. The ComEd cost is given below:

Scope of Work	Cost Estimate
Relay/communications/SCADA upgrades at Dixon, Mendota Hill, Shady Oaks and Steward substations	$ 1,500,000

Notes on Cost Estimate:

1) These estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided by the IC.

2) There were no site visits performed for these estimates. There may be costs related to specific site related issues that are not identified in these estimates. The site reviews will be performed during the Facilities Study or during detailed engineering.

3) These estimates are not a guarantee of the maximum amount payable by the IC and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, IC will be responsible for paying all actual costs of ComEd's work.

4) The IC is responsible for all engineering, procurement, testing and construction of all equipment on the IC's side of the Point of Interconnection (POI).

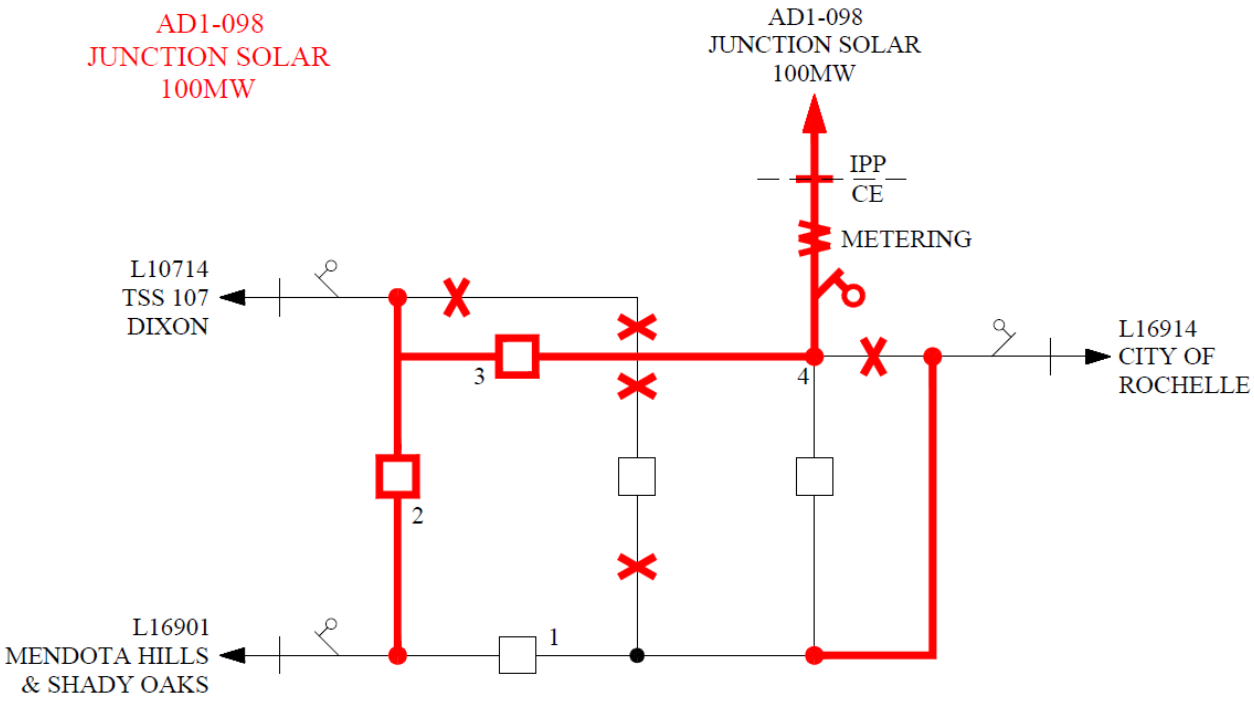

Figure 2. Single Line Diagram for Option 2

Network Impacts for Secondary POI

The Queue Project AD1-098 was evaluated as a 100.0 MW (Capacity 57.8 MW) injection at the McGirr Road 138kV in the ComEd area. Project AD1-098 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-098 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

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. (CE - CE) The BLUE ISL ;RT-BLUE ISL ; R 345 kV line (from bus 270667 to bus 270665 ckt 1) loads from 99.96% to 100.14% (**DC power flow**) of its load dump rating (1479 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 6.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT4-5__'
 TRIP BRANCH FROM BUS 275168 TO BUS 270607 CKT 1          / COLLI;2M 345 COLLI; 765
 TRIP BRANCH FROM BUS 275168 TO BUS 270697 CKT 1          / COLLI;2M 345 COLLI; R 345
 TRIP BRANCH FROM BUS 275168 TO BUS 275268 CKT 1          / COLLI;2M 345 COLLI;2C 33
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 END
```

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

2. (CE - CE) The WATERMAN ; B-SANDWICH ; R 138 kV line (from bus 272728 to bus 272445 ckt 1) loads from 96.62% to 105.94% (**DC power flow**) of its load dump rating (433 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_083-38-BT3-4__'. This project contributes approximately 40.64 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_083-38-BT3-4__'
 TRIP BRANCH FROM BUS 271390 TO BUS 271586 CKT 1          / ELECT; B 138 W541 ; B 138
 TRIP BRANCH FROM BUS 271560 TO BUS 271558 CKT 1          / GLIDD;BT 138 GLIDD; B 138
 TRIP BRANCH FROM BUS 271560 TO BUS 272728 CKT 1          / GLIDD;BT 138 WATER; B 138
 TRIP BRANCH FROM BUS 271586 TO BUS 272114 CKT 1          / W541 ; B 138 N AUR; B 138
 TRIP BRANCH FROM BUS 272114 TO BUS 272522 CKT 1          / N AUR; B 138 SUGAR; B 138
 TRIP BRANCH FROM BUS 272522 TO BUS 271560 CKT 1          / SUGAR; B 138 GLIDD;BT 138
 MOVE 100 PERCENT LOAD FROM BUS 271586 TO BUS 271587        / W541 ; B 138 W541 ; R 138
 MOVE 100 PERCENT LOAD FROM BUS 272522 TO BUS 272523        / SUGAR; B 138 SUGAR; R 138
 CLOSE LINE FROM BUS 272114 TO BUS 272115 CKT 1           / N AUR; B 138 N AUR; R 138
 TRIP BRANCH FROM BUS 271558 TO BUS 272730 CKT 1          / GLIDD; B 138 WATER;3B 138
```

```
MOVE 100 PERCENT LOAD FROM BUS 272761 TO BUS 272759          / W DEK;7R 138 W DEK;4R 138
DISCONNECT BUS 271581                                        / B200 ; R 138
DISCONNECT BUS 272757                                        / W DEK;7T 138
END
```

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

3. (CE - CE) The WATERMAN ; B-SANDWICH ; R 138 kV line (from bus 272728 to bus 272445 ckt 1) loads from 96.25% to 105.38% (**DC power flow**) of its load dump rating (321 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_111-38-TR82___'. This project contributes approximately 29.28 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_111-38-TR82___'
 TRIP BRANCH FROM BUS 271390 TO BUS 271586 CKT 1             / ELECT; B 138 W541 ; B 138
 TRIP BRANCH FROM BUS 271390 TO BUS 272724 CKT 1             / ELECT; B 138 WARRE;BT 138
 TRIP BRANCH FROM BUS 271390 TO BUS 275239 CKT 1             / ELECT; B 138 ELECT;2M 138
 MOVE 100 PERCENT LOAD FROM BUS 271586 TO BUS 271587           / W541 ; B 138 W541 ; R 138
 MOVE 100 PERCENT LOAD FROM BUS 272522 TO BUS 272523           / SUGAR; B 138 SUGAR; R 138
 CLOSE LINE FROM BUS 272114 TO BUS 272115 CKT 1              / N AUR; B 138 N AUR; R 138
 DISCONNECT BUS 271560                                       / GLIDD;BT 138
 DISCONNECT BUS 272522                                       / SUGAR; B 138
 DISCONNECT BUS 275239                                       / ELECT;2M 138
 REMOVE SWSHUNT FROM BUS 271390
 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)

1. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.11% to 158.28% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 14.29 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1             / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 270607 TO BUS 270630 CKT 1             / COLLI; 765 PLANO; 765
 END
```

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

2. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.08% to 158.24% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 14.31 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT4-5__'
 TRIP BRANCH FROM BUS 275168 TO BUS 270607 CKT 1             / COLLI;2M 345 COLLI; 765
 TRIP BRANCH FROM BUS 275168 TO BUS 270697 CKT 1             / COLLI;2M 345 COLLI; R 345
 TRIP BRANCH FROM BUS 275168 TO BUS 275268 CKT 1             / COLLI;2M 345 COLLI;2C 33
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1             / WILTO; 765 05DUMONT 765
 END
```

3. (CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 143.57% to 143.83% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.34 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

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

4. (CE - CE) The WATERMAN ; B-GLIDDEN ;BT 138 kV line (from bus 272728 to bus 271560 ckt 1) loads from 133.61% to 146.11% (**DC power flow**) of its load dump rating (275 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_146-38-BT_____'. This project contributes approximately 34.64 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_146-38-BT_____'
 TRIP BRANCH FROM BUS 271116 TO BUS 272250 CKT 1          / BRIST; B 138 PLANO; B 138
 TRIP BRANCH FROM BUS 272024 TO BUS 271182 CKT 1          / MONTG; B 138 W507 ; B 138
 TRIP BRANCH FROM BUS 272026 TO BUS 271116 CKT 1          / MONTG;BT 138 BRIST; B 138
 TRIP BRANCH FROM BUS 272026 TO BUS 272024 CKT 1          / MONTG;BT 138 MONTG; B 138
 TRIP BRANCH FROM BUS 272202 TO BUS 272026 CKT 1          / OSWEG; B 138 MONTG;BT 138
 TRIP BRANCH FROM BUS 272794 TO BUS 272202 CKT 1          / WOLFS; B 138 OSWEG; B 138
 MOVE 100 PERCENT LOAD FROM BUS 271116 TO BUS 271117        / BRIST; B 138 BRIST; R 138
 MOVE 100 PERCENT LOAD FROM BUS 272202 TO BUS 272203        / OSWEG; B 138 OSWEG; R 138
 CLOSE LINE FROM BUS 271182 TO BUS 271183 CKT 1           / W507 ; B 138 W507 ; R 138
 CLOSE LINE FROM BUS 272024 TO BUS 272025 CKT 1           / MONTG; B 138 MONTG; R 138
 TRIP BRANCH FROM BUS 272728 TO BUS 272445 CKT 1          / WATER; B 138 SANDW; R 138
 END
```

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

5. (CE - CE) The W DEKALB ;3T-WATERMAN ;3B 138 kV line (from bus 272756 to bus 272730 ckt 1) loads from 130.56% to 142.54% (**DC power flow**) of its load dump rating (452 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_006-45-BT3-4__'. This project contributes approximately 54.08 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_006-45-BT3-4__'
 TRIP BRANCH FROM BUS 274768 TO BUS 270678 CKT 1          / LEECO;BP 345 BYRON; B 345
 REMOVE UNIT 1 FROM BUS 274656                    / BYRON;1U 25
 END
```

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

6. (CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 143.56% to 143.82% (**DC power flow**) of its load dump rating (1379 MVA) for the

line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.34 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

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

Steady-State Voltage Requirements
(Results of the steady-state voltage studies should be inserted here)

To be determined

Short Circuit
(Summary of impacted circuit breakers)

No issues identified

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

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. (MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.05% to 158.22% (**DC power flow**) of its normal rating (1409 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 14.3 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1          / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

2. (CE - CE) The DIXON ; R-DIXON ; B 138 kV line (from bus 271333 to bus 271332 ckt 1) loads from 110.86% to 126.95% (**DC power flow**) of its emergency rating (332 MVA) for the single line contingency outage of 'COMED_P1-2_138-L11323_R-R-A'. This project contributes approximately 53.38 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L11323_R-R-A'
 TRIP BRANCH FROM BUS 271680 TO BUS 272756 CKT 1          / HAUME; B 138 W DEK;3T 138
 TRIP BRANCH FROM BUS 272730 TO BUS 271558 CKT 1          / WATER;3B 138 GLIDD; B 138
 TRIP BRANCH FROM BUS 272730 TO BUS 272728 CKT 1          / WATER;3B 138 WATER; B 138
 TRIP BRANCH FROM BUS 272756 TO BUS 272730 CKT 1          / W DEK;3T 138 WATER;3B 138
 TRIP BRANCH FROM BUS 272756 TO BUS 934940 CKT 1          / W DEK;3T 138 AD1-126 TAP 138
 END
```

3. (CE - CE) The GLIDDEN ;BT-SUGAR GRV; B 138 kV line (from bus 271560 to bus 272522 ckt 1) loads from 106.75% to 116.84% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of 'COMED_P1-2_138-L11301_R-R'. This project contributes approximately 26.61 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L11301_R-R'
 TRIP BRANCH FROM BUS 272728 TO BUS 272445 CKT 1          / WATER; B 138 SANDW; R 138
 END
```

4. (CE - CE) The GLIDDEN ;BT-SUGAR GRV; B 138 kV line (from bus 271560 to bus 272522 ckt 1) loads from 95.11% to 103.88% (**DC power flow**) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 18.21 MW to the thermal violation.

5. (CE - CE) The HAUMESSER; B-W DEKALB ;3T 138 kV line (from bus 271680 to bus 272756 ckt 1) loads from 113.65% to 135.76% (**DC power flow**) of its emergency rating (452 MVA) for the single line contingency outage of 'COMED_P1-2_138-L10714_R-R'. This project contributes approximately 99.94 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L10714_R-R'
 TRIP BRANCH FROM BUS 271333 TO BUS 272002 CKT 1          / DIXON; R 138 MCGIR; 138
 END
```

6. (CE - CE) The HAUMESSER; B-W DEKALB ;3T 138 kV line (from bus 271680 to bus 272756 ckt 1) loads from 107.26% to 119.6% (**DC power flow**) of its normal rating (438 MVA) for non-contingency condition. This project contributes approximately 53.85 MW to the thermal violation.

7. (CE - CE) The MCGIRR RD;-DIXON ; R 138 kV line (from bus 272002 to bus 271333 ckt 1) loads from 114.41% to 136.67% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P2-1_094-L11323__'. This project contributes approximately 99.94 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_094-L11323__'
 TRIP BRANCH FROM BUS 271680 TO BUS 272756 CKT 1          / HAUME; B 138 W DEK;3T 138
 END
```

8. (CE - CE) The ESS H445 ;3B-AD1-013 TAP 138 kV line (from bus 272362 to bus 933910 ckt 1) loads from 97.34% to 117.82% (**DC power flow**) of its emergency rating (197 MVA) for

the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 40.25 MW to the thermal violation.

CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1 / H440 ;RT 138 STEWA; B 138
 END

9. (CE - CE) The ESS H440 ; R-ESS H440N ;R 138 kV line (from bus 272363 to bus 272364 ckt 1) loads from 89.09% to 106.91% (**DC power flow**) of its emergency rating (226 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 40.26 MW to the thermal violation.

CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1 / H440 ;RT 138 STEWA; B 138
 END

10. (CE - CE) The ESS H440N ;R-ESS H445 ;3B 138 kV line (from bus 272364 to bus 272362 ckt 1) loads from 89.02% to 106.85% (**DC power flow**) of its emergency rating (226 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 40.25 MW to the thermal violation.

CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1 / H440 ;RT 138 STEWA; B 138
 END

11. (CE - CE) The ESS H440 ;RT-ESS H440 ; R 138 kV line (from bus 272365 to bus 272363 ckt 1) loads from 112.45% to 132.92% (**DC power flow**) of its emergency rating (197 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 40.26 MW to the thermal violation.

CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1 / H440 ;RT 138 STEWA; B 138
 END

12. (CE - CE) The SUGAR GRV; B-N AURORA ; B 138 kV line (from bus 272522 to bus 272114 ckt 1) loads from 87.55% to 97.64% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of 'COMED_P1-2_138-L11301_R-R'. This project contributes approximately 26.61 MW to the thermal violation.

CONTINGENCY 'COMED_P1-2_138-L11301_R-R'
 TRIP BRANCH FROM BUS 272728 TO BUS 272445 CKT 1 / WATER; B 138 SANDW; R 138
 END

13. (CE - CE) The WATERMAN ; B-GLIDDEN ;BT 138 kV line (from bus 272728 to bus 271560 ckt 1) loads from 139.17% to 152.19% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of 'COMED_P1-2_138-L11301_R-R'. This project contributes approximately 34.64 MW to the thermal violation.

CONTINGENCY 'COMED_P1-2_138-L11301_R-R'
 TRIP BRANCH FROM BUS 272728 TO BUS 272445 CKT 1 / WATER; B 138 SANDW; R 138
 END

14. (CE - CE) The WATERMAN ; B-SANDWICH ; R 138 kV line (from bus 272728 to bus 272445 ckt 1) loads from 94.83% to 103.99% (**DC power flow**) of its emergency rating (321 MVA) for the single line contingency outage of 'COMED_P1-2_138-L11106_B-R'. This project contributes approximately 29.35 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L11106_B-R'
 TRIP BRANCH FROM BUS 271390 TO BUS 271586 CKT 1            / ELECT; B 138 W541 ; B 138
 TRIP BRANCH FROM BUS 271560 TO BUS 271558 CKT 1            / GLIDD;BT 138 GLIDD; B 138
 TRIP BRANCH FROM BUS 271560 TO BUS 272728 CKT 1            / GLIDD;BT 138 WATER; B 138
 TRIP BRANCH FROM BUS 271586 TO BUS 272114 CKT 1            / W541 ; B 138 N AUR; B 138
 TRIP BRANCH FROM BUS 272114 TO BUS 272522 CKT 1            / N AUR; B 138 SUGAR; B 138
 TRIP BRANCH FROM BUS 272522 TO BUS 271560 CKT 1            / SUGAR; B 138 GLIDD;BT 138
 MOVE 100 PERCENT LOAD FROM BUS 271586 TO BUS 271587          / W541 ; B 138 W541 ; R 138
 MOVE 100 PERCENT LOAD FROM BUS 272522 TO BUS 272523          / SUGAR; B 138 SUGAR; R 138
 CLOSE LINE FROM BUS 272114 TO BUS 272115 CKT 1             / N AUR; B 138 N AUR; R 138
 END
```

15. (CE - CE) The WATERMAN ;3B-GLIDDEN ; B 138 kV line (from bus 272730 to bus 271558 ckt 1) loads from 102.27% to 112.24% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P2-1_113-L11323__'. This project contributes approximately 45.09 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_113-L11323__'
 TRIP BRANCH FROM BUS 272730 TO BUS 272728 CKT 1            / WATER;3B 138 WATER; B 138
 END
```

16. (CE - CE) The WATERMAN ;3B-WATERMAN ; B 138 kV line (from bus 272730 to bus 272728 ckt 1) loads from 105.11% to 121.35% (**DC power flow**) of its emergency rating (504 MVA) for the single line contingency outage of 'COMED_P1-2_138-L10714_R-R'. This project contributes approximately 81.68 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L10714_R-R'
 TRIP BRANCH FROM BUS 271333 TO BUS 272002 CKT 1            / DIXON; R 138 MCGIR; 138
 END
```

17. (CE - CE) The WATERMAN ;3B-WATERMAN ; B 138 kV line (from bus 272730 to bus 272728 ckt 1) loads from 93.59% to 102.75% (**DC power flow**) of its normal rating (487 MVA) for non-contingency condition. This project contributes approximately 44.57 MW to the thermal violation.

18. (CE - CE) The W DEKALB ;3T-WATERMAN ;3B 138 kV line (from bus 272756 to bus 272730 ckt 1) loads from 129.64% to 141.66% (**DC power flow**) of its emergency rating (452 MVA) for the single line contingency outage of 'COMED_P1-2_345-L15502_B-R'. This project contributes approximately 54.28 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L15502_B-R'
 TRIP BRANCH FROM BUS 270828 TO BUS 270932 CKT 1            / NELSO; B 345 WALTO; B 345
 END
```

19. (CE - CE) The W DEKALB ;3T-WATERMAN ;3B 138 kV line (from bus 272756 to bus 272730 ckt 1) loads from 120.23% to 132.15% (**DC power flow**) of its normal rating (452 MVA) for non-contingency condition. This project contributes approximately 53.85 MW to the thermal violation.

20. (CE - AEP) The UNIV PK N;RP-05OLIVE 345 kV line (from bus 274804 to bus 243229 ckt 1) loads from 130.67% to 130.86% (**DC power flow**) of its normal rating (971 MVA) for the single line contingency outage of 'COMED_P1-2_695_B2'. This project contributes approximately 9.84 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_695_B2'
 OPEN BRANCH FROM BUS 243206 TO BUS 270644 CKT 1              / 243206 05DUMONT 765 270644 WILTO; 765 1
 END
```

21. (CE - CE) The AD1-013 TAP-STEWARD ; B 138 kV line (from bus 933910 to bus 272516 ckt 1) loads from 108.37% to 128.83% (**DC power flow**) of its emergency rating (197 MVA) for the single line contingency outage of 'COMED_P2-1_186-L16914__'. This project contributes approximately 40.25 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_186-L16914__'
 TRIP BRANCH FROM BUS 272365 TO BUS 272516 CKT 1              / H440 ;RT 138 STEWA; B 138
 END
```

Light Load Analysis - 2021

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

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

(CE - CE) The BLUE ISL ;RT-BLUE ISL ; R 345 kV line (from bus 270667 to bus 270665 ckt 1) loads from 99.96% to 100.14% (**DC power flow**) of its load dump rating (1479 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT4-5__'. This project contributes approximately 6.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT4-5__'
 TRIP BRANCH FROM BUS 275168 TO BUS 270607 CKT 1          / COLLI;2M 345 COLLI; 765
 TRIP BRANCH FROM BUS 275168 TO BUS 270697 CKT 1          / COLLI;2M 345 COLLI; R 345
 TRIP BRANCH FROM BUS 275168 TO BUS 275268 CKT 1          / COLLI;2M 345 COLLI;2C 33
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*0.46*
932012	*AC2-007 E*	*0.85*
932881	*AC2-115 1*	*1.29*
932891	*AC2-115 2*	*1.29*
932921	*AC2-116*	*0.45*
932931	*AC2-117*	*3.28*
933341	*AC2-147 C*	*0.47*
933342	*AC2-147 E*	*0.77*
933351	*AC2-148 C*	*0.47*
933352	*AC2-148 E*	*0.77*
933361	*AC2-149 C*	*0.5*
933362	*AC2-149 E*	*0.81*
933371	*AC2-150 C*	*0.47*
933372	*AC2-150 E*	*0.77*
933391	*AC2-152 C*	*0.32*
933392	*AC2-152 E*	*0.52*
933401	*AC2-153 C*	*0.25*
933402	*AC2-153 E*	*0.41*
933431	*AC2-156 C*	*0.51*
933432	*AC2-156 E*	*0.83*
933511	*AC2-166 C*	*1.25*
933512	*AC2-166 E*	*1.38*
933911	*AD1-013 C O2*	*0.99*
933912	*AD1-013 E O2*	*1.58*
933931	*AD1-016 C*	*0.5*
933932	*AD1-016 E*	*0.82*
934051	*AD1-031 C O2*	*1.52*
934052	*AD1-031 E O2*	*2.47*
934101	*AD1-039 1*	*4.57*
934111	*AD1-039 2*	*4.15*
934401	*AD1-064 C O2*	*1.72*

934402	*AD1-064 E O2*	*8.05*
934421	*AD1-066*	*0.57*
934431	*AD1-067 C*	*0.07*
934432	*AD1-067 E*	*0.3*
LTF	*AD1-092*	*6.43*
LTF	*AD1-093*	*11.07*
LTF	*AD1-094*	*1.91*
934651	*AD1-096 C*	*0.48*
934652	*AD1-096 E*	*0.79*
934701	*AD1-098 C O2*	*3.71*
934702	*AD1-098 E O2*	*2.71*
934721	*AD1-100 C O2*	*27.24*
934722	*AD1-100 E O2*	*127.52*
934871	*AD1-116 C*	*0.73*
934872	*AD1-116 E*	*1.19*
934881	*AD1-117 C*	*2.92*
934882	*AD1-117 E*	*1.95*
934941	*AD1-126 C*	*3.13*
934942	*AD1-126 E*	*2.09*
934971	*AD1-129 C*	*0.49*
934972	*AD1-129 E*	*0.33*
935001	*AD1-133 C O2*	*22.85*
935002	*AD1-133 E O2*	*15.24*
935141	*AD1-148*	*2.69*
274832	*ANNAWAN ; 1U*	*5.89*
LTF	*BLUEG*	*0.76*
294401	*BSHIL;1U E*	*4.62*
294410	*BSHIL;2U E*	*4.62*
LTF	*CARR*	*0.34*
LTF	*CATAWBA*	*0.06*
274890	*CAYUG;1U E*	*11.9*
274891	*CAYUG;2U E*	*11.9*
LTF	*CBM-S1*	*1.64*
LTF	*CBM-W1*	*27.36*
LTF	*CBM-W2*	*28.57*
LTF	*CELEVELAND*	*0.16*
LTF	*CIN*	*0.14*
LTF	*CLIFTY*	*5.17*
274849	*CRESCENT ;1U*	*3.11*
LTF	*DEARBORN*	*1.45*
274859	*EASYR;U1 E*	*5.99*
274860	*EASYR;U2 E*	*5.99*
LTF	*G-007*	*0.89*
290051	*GSG-6; E*	*5.62*
LTF	*HAMLET*	*0.29*

990901	*L-005 E*	*6.9*
290108	*LEEDK;1U E*	*13.*
274770	*LINCOLN ;1U*	*2.36*
274771	*LINCOLN ;2U*	*2.36*
274772	*LINCOLN ;3U*	*2.36*
274773	*LINCOLN ;4U*	*2.36*
274774	*LINCOLN ;5U*	*2.36*
274775	*LINCOLN ;6U*	*2.36*
274776	*LINCOLN ;7U*	*2.36*
274777	*LINCOLN ;8U*	*2.36*
LTF	*MEC*	*21.65*
274850	*MENDOTA H;RU*	*3.23*
293516	*O-009 E1*	*4.95*
293517	*O-009 E2*	*2.51*
293518	*O-009 E3*	*2.77*
293715	*O-029 E*	*5.29*
293716	*O-029 E*	*2.9*
293717	*O-029 E*	*2.67*
293771	*O-035 E*	*3.39*
LTF	*O-066*	*2.98*
290021	*O50 E*	*10.59*
294763	*P-046 E*	*5.1*
274830	*PWR VTREC;1U*	*3.32*
274831	*PWR VTREC;2U*	*3.32*
296308	*R-030 C1*	*2.76*
296271	*R-030 C2*	*2.76*
296125	*R-030 C3*	*2.79*
296309	*R-030 E1*	*11.03*
296272	*R-030 E2*	*11.03*
296128	*R-030 E3*	*11.16*
LTF	*RENSSELAER*	*0.27*
LTF	*ROSETON*	*1.93*
LTF	*ROWAN*	*0.17*
274722	*S-055 E*	*6.1*
884780	*S58 FTIR*	*45.82*
884781	*S58 NFTIR*	*137.45*
295111	*SUBLETTE E*	*1.46*
LTF	*TRIMBLE*	*0.16*
274853	*TWINGROVE;U1*	*11.3*
274854	*TWINGROVE;U2*	*11.3*
299993	*U3-031C*	*6.24*
903433	*W3-046*	*13.68*
905082	*W4-005 E*	*19.06*
274874	*WALNR;2U*	*1.3*
294502	*WALNR;2U E*	*5.19*

LTF	*WEC*	*4.34*
295109	*WESTBROOK E*	*3.01*
909052	*X2-022 E*	*0.55*
914641	*Y2-103*	*24.42*
915011	*Y3-013 1*	*2.03*
915021	*Y3-013 2*	*2.03*
915031	*Y3-013 3*	*2.03*
LTF	*Z1-043*	*14.64*
916502	*Z1-106 E1*	*0.68*
916504	*Z1-106 E2*	*0.68*
916522	*Z1-108 E*	*1.35*
917501	*Z2-087 C*	*2.15*
917502	*Z2-087 E*	*14.42*
918051	*AA1-018 C*	*1.87*
918052	*AA1-018 E*	*12.52*
919221	*AA1-146*	*9.6*
919581	*AA2-030*	*9.6*
919591	*AA2-035*	*78.42*
919621	*AA2-039 C*	*1.13*
919622	*AA2-039 E*	*7.54*
920112	*AA2-107 E*	*1.31*
920272	*AA2-123 E*	*1.33*
930481	*AB1-089*	*35.76*
930491	*AB1-090*	*35.76*
930761	*AB1-122 1*	*42.03*
930771	*AB1-122 2*	*38.23*
LTF	*AB2-013*	*9.22*
924041	*AB2-047 C O1*	*2.66*
924042	*AB2-047 E O1*	*17.77*
924261	*AB2-070 C O1*	*1.48*
924262	*AB2-070 E O1*	*9.88*
924471	*AB2-096*	*23.03*
925161	*AB2-173*	*1.71*
925301	*AB2-191 C*	*0.68*
925302	*AB2-191 E*	*0.6*
925581	*AC1-033 C*	*0.76*
925582	*AC1-033 E*	*5.07*
925771	*AC1-053 C*	*1.46*
925772	*AC1-053 E*	*9.77*
926311	*AC1-109 1*	*1.06*
926321	*AC1-109 2*	*1.06*
926331	*AC1-110 1*	*1.*
926341	*AC1-110 2*	*1.*
926351	*AC1-111 1*	*0.41*
926361	*AC1-111 2*	*0.41*

926371	*AC1-111 3*	*0.41*
926381	*AC1-111 4*	*0.41*
926391	*AC1-111 5*	*0.41*
926401	*AC1-111 6*	*0.41*
927511	*AC1-113 1*	*0.65*
927522	*AC1-113 2*	*0.65*
926431	*AC1-114*	*1.29*
927451	*AC1-142A 1*	*2.35*
927461	*AC1-142A 2*	*2.35*
926701	*AC1-153 C1*	*45.68*
926711	*AC1-153 C2*	*41.55*
926702	*AC1-153 E1*	*1.83*
926712	*AC1-153 E2*	*1.66*
926821	*AC1-168 C*	*0.57*
926822	*AC1-168 E*	*3.8*
926841	*AC1-171 C*	*0.58*
926842	*AC1-171 E*	*3.89*
927531	*AC1-185 1*	*0.37*
927541	*AC1-185 2*	*0.37*
927551	*AC1-185 3*	*0.37*
927561	*AC1-185 4*	*0.37*
927571	*AC1-185 5*	*0.37*
927581	*AC1-185 6*	*0.37*
927591	*AC1-185 7*	*0.37*
927601	*AC1-185 8*	*0.37*
927091	*AC1-204 1*	*41.74*
927101	*AC1-204 2*	*41.93*
927201	*AC1-214 C*	*1.09*
927202	*AC1-214 E*	*2.89*

Appendix 2

(CE - CE) The WATERMAN ; B-SANDWICH ; R 138 kV line (from bus 272728 to bus 272445 ckt 1) loads from 96.62% to 105.94% (**DC power flow**) of its load dump rating (433 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_083-38-BT3-4__'. This project contributes approximately 40.64 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_083-38-BT3-4__'
 TRIP BRANCH FROM BUS 271390 TO BUS 271586 CKT 1          / ELECT; B 138 W541 ; B 138
 TRIP BRANCH FROM BUS 271560 TO BUS 271558 CKT 1          / GLIDD;BT 138 GLIDD; B 138
 TRIP BRANCH FROM BUS 271560 TO BUS 272728 CKT 1          / GLIDD;BT 138 WATER; B 138
 TRIP BRANCH FROM BUS 271586 TO BUS 272114 CKT 1          / W541 ; B 138 N AUR; B 138
 TRIP BRANCH FROM BUS 272114 TO BUS 272522 CKT 1          / N AUR; B 138 SUGAR; B 138
 TRIP BRANCH FROM BUS 272522 TO BUS 271560 CKT 1          / SUGAR; B 138 GLIDD;BT 138
 MOVE 100 PERCENT LOAD FROM BUS 271586 TO BUS 271587        / W541 ; B 138 W541 ; R 138
 MOVE 100 PERCENT LOAD FROM BUS 272522 TO BUS 272523        / SUGAR; B 138 SUGAR; R 138
 CLOSE LINE FROM BUS 272114 TO BUS 272115 CKT 1           / N AUR; B 138 N AUR; R 138
 TRIP BRANCH FROM BUS 271558 TO BUS 272730 CKT 1          / GLIDD; B 138 WATER;3B 138
 MOVE 100 PERCENT LOAD FROM BUS 272761 TO BUS 272759        / W DEK;7R 138 W DEK;4R 138
 DISCONNECT BUS 271581                    / B200 ; R 138
 DISCONNECT BUS 272757                    / W DEK;7T 138
 END
```

Bus Number	*Bus Name*	*Full Contribution*
933401	*AC2-153 C*	*2.29*
933402	*AC2-153 E*	*3.73*
933511	*AC2-166 C*	*11.45*
933512	*AC2-166 E*	*12.65*
933911	*AD1-013 C O2*	*6.42*
933912	*AD1-013 E O2*	*10.25*
934401	*AD1-064 C O2*	*14.49*
934402	*AD1-064 E O2*	*67.83*
934431	*AD1-067 C*	*0.45*
934432	*AD1-067 E*	*1.88*
934701	*AD1-098 C O2*	*23.49*
934702	*AD1-098 E O2*	*17.15*
934941	*AD1-126 C*	*26.34*
934942	*AD1-126 E*	*17.56*
LTF	*BLUEG*	*0.09*
LTF	*CANNELTON*	*< 0.01*
LTF	*CARR*	*0.03*
LTF	*CBM-S1*	*0.34*
LTF	*CBM-S2*	*0.05*
LTF	*CBM-W1*	*5.86*
LTF	*CBM-W2*	*4.27*
LTF	*CLIFTY*	*0.55*
LTF	*DEARBORN*	*0.14*
272364	*ESS H440N ;R*	*1.79*
LTF	*G-007*	*0.08*

LTF	*GIBSON*	*< 0.01*
274855	*GSG-6 ;RU*	*1.75*
290051	*GSG-6; E*	*35.6*
274872	*LEE DEKAL;1U*	*3.21*
290108	*LEEDK;1U E*	*105.15*
LTF	*MEC*	*5.42*
274850	*MENDOTA H;RU*	*20.48*
LTF	*O-066*	*0.26*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.18*
295110	*SUBLETTE C*	*0.26*
295111	*SUBLETTE E*	*9.27*
LTF	*TRIMBLE*	*0.02*
LTF	*WEC*	*0.27*
295108	*WESTBROOK C*	*0.57*
295109	*WESTBROOK E*	*19.06*
916221	*Z1-073*	*0.48*
920112	*AA2-107 E*	*12.05*
925301	*AB2-191 C*	*4.31*
925302	*AB2-191 E*	*3.82*

Appendix 3

(MISO NIPS - AEP) The 17STILLWELL-05DUMONT 345 kV line (from bus 255113 to bus 243219 ckt 1) loads from 158.11% to 158.28% (**DC power flow**) of its emergency rating (1409 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_023-65-BT2-3__'. This project contributes approximately 14.29 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_023-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 243206 CKT 1          / WILTO; 765 05DUMONT 765
 TRIP BRANCH FROM BUS 270607 TO BUS 270630 CKT 1          / COLLI; 765 PLANO; 765
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.01*
932012	*AC2-007 E*	*1.87*
932881	*AC2-115 1*	*2.85*
932891	*AC2-115 2*	*2.85*
932921	*AC2-116*	*1.*
932931	*AC2-117*	*6.24*
933341	*AC2-147 C*	*1.04*
933342	*AC2-147 E*	*1.7*
933351	*AC2-148 C*	*1.03*
933352	*AC2-148 E*	*1.68*
933361	*AC2-149 C*	*1.12*
933362	*AC2-149 E*	*1.82*
933371	*AC2-150 C*	*1.03*
933372	*AC2-150 E*	*1.68*
933381	*AC2-151 C*	*1.17*
933382	*AC2-151 E*	*1.91*
933401	*AC2-153 C*	*0.56*
933402	*AC2-153 E*	*0.91*
933411	*AC2-154 C*	*3.23*
933412	*AC2-154 E*	*5.27*
933431	*AC2-156 C*	*1.15*
933432	*AC2-156 E*	*1.87*
933511	*AC2-166 C*	*2.8*
933512	*AC2-166 E*	*3.09*
933911	*AD1-013 C O2*	*2.2*
933912	*AD1-013 E O2*	*3.52*
933931	*AD1-016 C*	*1.11*
933932	*AD1-016 E*	*1.82*
934001	*AD1-024 C*	*3.14*
934002	*AD1-024 E*	*5.12*
934101	*AD1-039 1*	*9.24*
934111	*AD1-039 2*	*9.67*
934401	*AD1-064 C O2*	*3.86*

934402	*AD1-064 E O2*	*18.05*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.66*
LTF	*AD1-092*	*13.31*
LTF	*AD1-093*	*23.05*
LTF	*AD1-094*	*4.46*
934651	*AD1-096 C*	*1.07*
934652	*AD1-096 E*	*1.74*
934701	*AD1-098 C O2*	*8.26*
934702	*AD1-098 E O2*	*6.03*
934721	*AD1-100 C O2*	*28.17*
934722	*AD1-100 E O2*	*131.87*
934871	*AD1-116 C*	*1.14*
934872	*AD1-116 E*	*1.86*
934881	*AD1-117 C*	*6.43*
934882	*AD1-117 E*	*4.28*
934941	*AD1-126 C*	*7.01*
934942	*AD1-126 E*	*4.67*
934971	*AD1-129 C*	*1.08*
934972	*AD1-129 E*	*0.72*
935001	*AD1-133 C O2*	*26.14*
935002	*AD1-133 E O2*	*17.43*
LTF	*BLUEG*	*1.99*
LTF	*CANNELTON*	*0.02*
LTF	*CARR*	*0.89*
LTF	*CATAWBA*	*0.29*
274890	*CAYUG;1U E*	*13.92*
274891	*CAYUG;2U E*	*13.92*
LTF	*CBM-S1*	*2.38*
LTF	*CBM-W1*	*77.59*
LTF	*CBM-W2*	*53.81*
LTF	*CELEVELAND*	*0.79*
LTF	*CIN*	*0.69*
LTF	*CLIFTY*	*13.48*
LTF	*DEARBORN*	*3.12*
274859	*EASYR;U1 E*	*13.15*
274860	*EASYR;U2 E*	*13.15*
LTF	*G-007*	*2.39*
290051	*GSG-6; E*	*12.52*
LTF	*HAMLET*	*1.13*
940531	*J351*	*446.34*
951131	*J643*	*27.27*
981291	*J740 C*	*5.81*
981292	*J740 E*	*23.23*
275149	*KEMPTON ;1E*	*23.81*

290108	*LEEDK;1U E*	*29.11*
LTF	*MEC*	*45.47*
274850	*MENDOTA H;RU*	*7.2*
293061	*N-015 E*	*18.58*
293516	*O-009 E1*	*10.87*
293517	*O-009 E2*	*5.52*
293518	*O-009 E3*	*6.08*
293715	*O-029 E*	*11.62*
293716	*O-029 E*	*6.37*
293717	*O-029 E*	*5.86*
LTF	*O-066*	*8.03*
293644	*O22 E1*	*12.51*
293645	*O22 E2*	*24.27*
290021	*O50 E*	*23.25*
294392	*P-010 E*	*23.6*
294763	*P-046 E*	*11.24*
274888	*PILOT HIL;1E*	*23.81*
274830	*PWR VTREC;1U*	*7.32*
274831	*PWR VTREC;2U*	*7.32*
LTF	*RENSSELAER*	*0.7*
LTF	*ROSETON*	*5.08*
LTF	*ROWAN*	*0.69*
274722	*S-055 E*	*13.54*
884780	*S58 FTIR*	*62.83*
884781	*S58 NFTIR*	*188.5*
274789	*SE CHICAG;6U*	*1.53*
274790	*SE CHICAG;7U*	*1.53*
274791	*SE CHICAG;8U*	*1.53*
295111	*SUBLETTE E*	*3.26*
LTF	*TRIMBLE*	*0.42*
299993	*U3-031C*	*6.4*
903433	*W3-046*	*28.58*
274874	*WALNR;2U*	*2.85*
294502	*WALNR;2U E*	*11.41*
LTF	*WEC*	*9.61*
295109	*WESTBROOK E*	*6.7*
274687	*WILL CNTY;4U*	*82.69*
910542	*X3-005 E*	*1.05*
914641	*Y2-103*	*54.18*
915011	*Y3-013 1*	*4.51*
915021	*Y3-013 2*	*4.51*
915031	*Y3-013 3*	*4.51*
LTF	*Z1-043*	*34.12*
916502	*Z1-106 E1*	*1.52*
916504	*Z1-106 E2*	*1.52*

916512	*Z1-107 E*	*3.18*
916522	*Z1-108 E*	*2.99*
916651	*Z1-127 1*	*2.31*
916652	*Z1-127 2*	*1.07*
918051	*AA1-018 C*	*2.93*
918052	*AA1-018 E*	*19.58*
918972	*AA1-116 E*	*3.4*
918982	*AA1-117 E*	*3.4*
919221	*AA1-146*	*21.01*
919581	*AA2-030*	*21.01*
919591	*AA2-035*	*155.8*
920112	*AA2-107 E*	*2.95*
920272	*AA2-123 E*	*2.93*
930481	*AB1-089*	*78.85*
930491	*AB1-090*	*78.85*
930501	*AB1-091*	*94.52*
930761	*AB1-122 1*	*84.98*
930771	*AB1-122 2*	*88.96*
931221	*AB1-172*	*0.99*
LTF	*AB2-013*	*19.2*
924471	*AB2-096*	*50.83*
925161	*AB2-173*	*3.75*
925301	*AB2-191 C*	*1.51*
925302	*AB2-191 E*	*1.34*
925881	*AC1-067*	*209.15*
926311	*AC1-109 1*	*2.29*
926321	*AC1-109 2*	*2.29*
926331	*AC1-110 1*	*2.28*
926341	*AC1-110 2*	*2.28*
926351	*AC1-111 1*	*0.92*
926361	*AC1-111 2*	*0.92*
926371	*AC1-111 3*	*0.92*
926381	*AC1-111 4*	*0.92*
926391	*AC1-111 5*	*0.92*
926401	*AC1-111 6*	*0.92*
927511	*AC1-113 1*	*1.43*
927522	*AC1-113 2*	*1.43*
926431	*AC1-114*	*2.85*
927451	*AC1-142A 1*	*5.07*
927461	*AC1-142A 2*	*5.07*
926701	*AC1-153 C1*	*92.37*
926711	*AC1-153 C2*	*96.7*
926702	*AC1-153 E1*	*3.7*
926712	*AC1-153 E2*	*3.87*
926821	*AC1-168 C*	*1.38*

926822	*AC1-168 E*	*9.28*
927531	*AC1-185 1*	*0.82*
927541	*AC1-185 2*	*0.82*
927551	*AC1-185 3*	*0.82*
927561	*AC1-185 4*	*0.82*
927571	*AC1-185 5*	*0.82*
927581	*AC1-185 6*	*0.82*
927591	*AC1-185 7*	*0.82*
927601	*AC1-185 8*	*0.82*
927091	*AC1-204 1*	*87.14*
927101	*AC1-204 2*	*87.11*

Appendix 4

(CE - CE) The WILTON ; R-WILTON ;4M 345 kV line (from bus 270927 to bus 275233 ckt 1) loads from 143.57% to 143.83% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.34 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.01*
932012	*AC2-007 E*	*1.88*
932881	*AC2-115 1*	*2.87*
932891	*AC2-115 2*	*2.87*
932921	*AC2-116*	*1.*
933361	*AC2-149 C*	*1.11*
933362	*AC2-149 E*	*1.82*
933381	*AC2-151 C*	*1.15*
933382	*AC2-151 E*	*1.88*
933391	*AC2-152 C*	*0.65*
933392	*AC2-152 E*	*1.06*
933401	*AC2-153 C*	*0.56*
933402	*AC2-153 E*	*0.91*
933411	*AC2-154 C*	*2.83*
933412	*AC2-154 E*	*4.62*
933431	*AC2-156 C*	*1.14*
933432	*AC2-156 E*	*1.86*
933511	*AC2-166 C*	*2.79*
933512	*AC2-166 E*	*3.08*
933911	*AD1-013 C O2*	*2.21*
933912	*AD1-013 E O2*	*3.53*
933931	*AD1-016 C*	*1.12*
933932	*AD1-016 E*	*1.82*
934001	*AD1-024 C*	*2.86*
934002	*AD1-024 E*	*4.67*
934101	*AD1-039 1*	*9.72*
934111	*AD1-039 2*	*9.7*
934401	*AD1-064 C O2*	*3.85*
934402	*AD1-064 E O2*	*18.03*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.66*
LTF	*AD1-092*	*14.04*

LTF	*AD1-093*	*24.18*
LTF	*AD1-094*	*4.62*
934701	*AD1-098 C O2*	*8.29*
934702	*AD1-098 E O2*	*6.05*
934721	*AD1-100 C O2*	*54.31*
934722	*AD1-100 E O2*	*254.26*
934871	*AD1-116 C*	*1.17*
934872	*AD1-116 E*	*1.91*
934941	*AD1-126 C*	*7.*
934942	*AD1-126 E*	*4.67*
934971	*AD1-129 C*	*1.09*
934972	*AD1-129 E*	*0.72*
935001	*AD1-133 C O2*	*45.96*
935002	*AD1-133 E O2*	*30.64*
LTF	*BLUEG*	*2.32*
LTF	*CANNELTON*	*0.05*
LTF	*CARR*	*0.9*
LTF	*CATAWBA*	*0.29*
274890	*CAYUG;1U E*	*24.26*
274891	*CAYUG;2U E*	*24.26*
LTF	*CBM-S1*	*2.6*
LTF	*CBM-W1*	*74.17*
LTF	*CBM-W2*	*59.01*
LTF	*CELEVELAND*	*0.79*
LTF	*CIN*	*0.27*
LTF	*CLIFTY*	*14.77*
LTF	*DEARBORN*	*2.74*
LTF	*ELMERSMITH*	*0.04*
LTF	*G-007*	*2.43*
290051	*GSG-6; E*	*12.56*
LTF	*HAMLET*	*1.14*
275149	*KEMPTON ;1E*	*20.88*
290108	*LEEDK;1U E*	*29.1*
274770	*LINCOLN ;1U*	*4.68*
274771	*LINCOLN ;2U*	*4.68*
274772	*LINCOLN ;3U*	*4.68*
274773	*LINCOLN ;4U*	*4.68*
274774	*LINCOLN ;5U*	*4.68*
274775	*LINCOLN ;6U*	*4.68*
274776	*LINCOLN ;7U*	*4.68*
274777	*LINCOLN ;8U*	*4.68*
LTF	*MEC*	*47.35*
274850	*MENDOTA H;RU*	*7.22*
293061	*N-015 E*	*17.77*
LTF	*O-066*	*8.18*

293644	*O22 E1*	*12.5*
293645	*O22 E2*	*24.27*
290021	*O50 E*	*23.68*
294392	*P-010 E*	*22.57*
274888	*PILOT HIL;1E*	*20.88*
274830	*PWR VTREC;1U*	*7.34*
274831	*PWR VTREC;2U*	*7.34*
296308	*R-030 C1*	*5.69*
296271	*R-030 C2*	*5.69*
296125	*R-030 C3*	*5.75*
296309	*R-030 E1*	*22.74*
296272	*R-030 E2*	*22.74*
296128	*R-030 E3*	*23.02*
LTF	*RENSSELAER*	*0.71*
LTF	*ROSETON*	*5.14*
LTF	*ROWAN*	*0.7*
274722	*S-055 E*	*13.53*
884780	*S58 FTIR*	*61.26*
884781	*S58 NFTIR*	*183.79*
295111	*SUBLETTE E*	*3.27*
LTF	*TRIMBLE*	*0.48*
274853	*TWINGROVE;U1*	*23.44*
274854	*TWINGROVE;U2*	*23.44*
299993	*U3-031C*	*12.4*
903433	*W3-046*	*12.74*
LTF	*WEC*	*9.63*
295109	*WESTBROOK E*	*6.72*
274687	*WILL CNTY;4U*	*80.62*
910542	*X3-005 E*	*0.89*
914641	*Y2-103*	*54.12*
915011	*Y3-013 1*	*4.51*
915021	*Y3-013 2*	*4.51*
915031	*Y3-013 3*	*4.51*
LTF	*Z1-043*	*35.33*
916502	*Z1-106 E1*	*1.51*
916504	*Z1-106 E2*	*1.51*
916512	*Z1-107 E*	*3.07*
916522	*Z1-108 E*	*2.99*
916651	*Z1-127 1*	*2.01*
916652	*Z1-127 2*	*0.99*
917501	*Z2-087 C*	*4.44*
917502	*Z2-087 E*	*29.74*
918051	*AA1-018 C*	*3.*
918052	*AA1-018 E*	*20.08*
918972	*AA1-116 E*	*2.98*

918982	*AA1-117 E*	*2.98*
919591	*AA2-035*	*159.68*
920112	*AA2-107 E*	*2.94*
920272	*AA2-123 E*	*2.94*
930481	*AB1-089*	*79.21*
930491	*AB1-090*	*79.21*
930501	*AB1-091*	*81.66*
930761	*AB1-122 1*	*89.47*
930771	*AB1-122 2*	*89.21*
931221	*AB1-172*	*0.95*
LTF	*AB2-013*	*20.15*
924041	*AB2-047 C O1*	*5.48*
924042	*AB2-047 E O1*	*36.68*
924471	*AB2-096*	*50.97*
925301	*AB2-191 C*	*1.52*
925302	*AB2-191 E*	*1.35*
925881	*AC1-067*	*161.98*
926311	*AC1-109 1*	*2.29*
926321	*AC1-109 2*	*2.29*
926331	*AC1-110 1*	*2.27*
926341	*AC1-110 2*	*2.27*
926351	*AC1-111 1*	*0.91*
926361	*AC1-111 2*	*0.91*
926371	*AC1-111 3*	*0.91*
926381	*AC1-111 4*	*0.91*
926391	*AC1-111 5*	*0.91*
926401	*AC1-111 6*	*0.91*
927511	*AC1-113 1*	*1.43*
927522	*AC1-113 2*	*1.43*
926431	*AC1-114*	*2.87*
927451	*AC1-142A 1*	*5.06*
927461	*AC1-142A 2*	*5.06*
926701	*AC1-153 C1*	*97.25*
926711	*AC1-153 C2*	*96.97*
926702	*AC1-153 E1*	*3.89*
926712	*AC1-153 E2*	*3.88*
927091	*AC1-204 1*	*88.53*
927101	*AC1-204 2*	*88.54*

Appendix 5

(CE - CE) The WATERMAN ; B-GLIDDEN ;BT 138 kV line (from bus 272728 to bus 271560 ckt 1) loads from 133.61% to 146.11% (**DC power flow**) of its load dump rating (275 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_146-38-BT_____'. This project contributes approximately 34.64 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_146-38-BT_____'
 TRIP BRANCH FROM BUS 271116 TO BUS 272250 CKT 1          / BRIST; B 138 PLANO; B 138
 TRIP BRANCH FROM BUS 272024 TO BUS 271182 CKT 1          / MONTG; B 138 W507 ; B 138
 TRIP BRANCH FROM BUS 272026 TO BUS 271116 CKT 1          / MONTG;BT 138 BRIST; B 138
 TRIP BRANCH FROM BUS 272026 TO BUS 272024 CKT 1          / MONTG;BT 138 MONTG; B 138
 TRIP BRANCH FROM BUS 272202 TO BUS 272026 CKT 1          / OSWEG; B 138 MONTG;BT 138
 TRIP BRANCH FROM BUS 272794 TO BUS 272202 CKT 1          / WOLFS; B 138 OSWEG; B 138
 MOVE 100 PERCENT LOAD FROM BUS 271116 TO BUS 271117        / BRIST; B 138 BRIST; R 138
 MOVE 100 PERCENT LOAD FROM BUS 272202 TO BUS 272203        / OSWEG; B 138 OSWEG; R 138
 CLOSE LINE FROM BUS 271182 TO BUS 271183 CKT 1           / W507 ; B 138 W507 ; R 138
 CLOSE LINE FROM BUS 272024 TO BUS 272025 CKT 1           / MONTG; B 138 MONTG; R 138
 TRIP BRANCH FROM BUS 272728 TO BUS 272445 CKT 1          / WATER; B 138 SANDW; R 138
 END
```

Bus Number	*Bus Name*	*Full Contribution*
933401	*AC2-153 C*	*1.95*
933402	*AC2-153 E*	*3.19*
933511	*AC2-166 C*	*9.8*
933512	*AC2-166 E*	*10.83*
933911	*AD1-013 C O2*	*5.47*
933912	*AD1-013 E O2*	*8.74*
934401	*AD1-064 C O2*	*12.36*
934402	*AD1-064 E O2*	*57.86*
934431	*AD1-067 C*	*0.38*
934432	*AD1-067 E*	*1.6*
934701	*AD1-098 C O2*	*20.02*
934702	*AD1-098 E O2*	*14.62*
934941	*AD1-126 C*	*22.47*
934942	*AD1-126 E*	*14.98*
LTF	*BLUEG*	*0.06*
LTF	*CARR*	*0.02*
LTF	*CBM-S1*	*0.27*
LTF	*CBM-S2*	*0.05*
LTF	*CBM-W1*	*4.3*
LTF	*CBM-W2*	*3.34*
LTF	*CLIFTY*	*0.4*
LTF	*CPLE*	*< 0.01*
LTF	*DEARBORN*	*0.1*
272364	*ESS H440N ;R*	*1.52*
LTF	*G-007*	*0.06*
LTF	*GIBSON*	*< 0.01*
274855	*GSG-6 ;RU*	*1.49*

290051	*GSG-6; E*	*30.34*
274872	*LEE DEKAL;1U*	*2.74*
290108	*LEEDK;1U E*	*89.69*
LTF	*MEC*	*4.23*
274850	*MENDOTA H;RU*	*17.46*
LTF	*O-066*	*0.19*
LTF	*RENSSELAER*	*0.02*
LTF	*ROSETON*	*0.13*
295110	*SUBLETTE C*	*0.22*
295111	*SUBLETTE E*	*7.9*
LTF	*TRIMBLE*	*0.01*
LTF	*WEC*	*0.13*
295108	*WESTBROOK C*	*0.48*
295109	*WESTBROOK E*	*16.24*
916221	*Z1-073*	*0.41*
920112	*AA2-107 E*	*10.31*
925301	*AB2-191 C*	*3.67*
925302	*AB2-191 E*	*3.26*

Appendix 6

(CE - CE) The W DEKALB ;3T-WATERMAN ;3B 138 kV line (from bus 272756 to bus 272730 ckt 1) loads from 130.56% to 142.54% (**DC power flow**) of its load dump rating (452 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_006-45-BT3-4__'. This project contributes approximately 54.08 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_006-45-BT3-4__'
 TRIP BRANCH FROM BUS 274768 TO BUS 270678 CKT 1          / LEECO;BP 345 BYRON; B 345
 REMOVE UNIT 1 FROM BUS 274656                    / BYRON;1U 25
 END
```

Bus Number	*Bus Name*	*Full Contribution*
933351	*AC2-148 C*	*0.89*
933352	*AC2-148 E*	*1.45*
933371	*AC2-150 C*	*0.89*
933372	*AC2-150 E*	*1.45*
933911	*AD1-013 C O2*	*8.54*
933912	*AD1-013 E O2*	*13.65*
934401	*AD1-064 C O2*	*19.27*
934402	*AD1-064 E O2*	*90.22*
934431	*AD1-067 C*	*0.59*
934432	*AD1-067 E*	*2.5*
934701	*AD1-098 C O2*	*31.26*
934702	*AD1-098 E O2*	*22.82*
934941	*AD1-126 C*	*35.04*
934942	*AD1-126 E*	*23.36*
LTF	*BLUEG*	*0.05*
LTF	*CARR*	*0.03*
LTF	*CBM-S1*	*0.56*
LTF	*CBM-S2*	*0.17*
LTF	*CBM-W1*	*4.83*
LTF	*CBM-W2*	*6.38*
LTF	*CLIFTY*	*0.45*
LTF	*CPLE*	*0.02*
LTF	*DEARBORN*	*0.15*
272364	*ESS H440N ;R*	*2.38*
LTF	*G-007*	*0.06*
274855	*GSG-6 ;RU*	*2.32*
290051	*GSG-6; E*	*47.38*
274872	*LEE DEKAL;1U*	*4.27*
290108	*LEEDK;1U E*	*139.87*
LTF	*MEC*	*7.31*
274850	*MENDOTA H;RU*	*27.26*
LTF	*O-066*	*0.22*
LTF	*RENSSELAER*	*0.02*

LTF	*ROSETON*	*0.15*
295110	*SUBLETTE C*	*0.34*
295111	*SUBLETTE E*	*12.33*
LTF	*TRIMBLE*	*0.01*
905471	*W4-084*	*0.09*
295108	*WESTBROOK C*	*0.75*
295109	*WESTBROOK E*	*25.36*
916221	*Z1-073*	*0.64*
920112	*AA2-107 E*	*3.97*
925301	*AB2-191 C*	*5.73*
925302	*AB2-191 E*	*5.08*

Appendix 7

(CE - CE) The WILTON ; 765/345 kV transformer (from bus 275233 to bus 270644 ckt 1) loads from 143.56% to 143.82% (**DC power flow**) of its load dump rating (1379 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_112-65-BT2-3__'. This project contributes approximately 14.34 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_112-65-BT2-3__'
 TRIP BRANCH FROM BUS 270644 TO BUS 270607 CKT 1          / WILTO; 765 COLLI; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270644 CKT 1          / WILTO;3M 345 WILTO; 765
 TRIP BRANCH FROM BUS 275232 TO BUS 270926 CKT 1          / WILTO;3M 345 WILTO; B 345
 TRIP BRANCH FROM BUS 275232 TO BUS 275332 CKT 1          / WILTO;3M 345 WILTO;3C 33
 END
```

Bus Number	*Bus Name*	*Full Contribution*
932011	*AC2-007 C*	*1.01*
932012	*AC2-007 E*	*1.88*
932881	*AC2-115 1*	*2.87*
932891	*AC2-115 2*	*2.87*
932921	*AC2-116*	*1.*
933361	*AC2-149 C*	*1.11*
933362	*AC2-149 E*	*1.82*
933381	*AC2-151 C*	*1.15*
933382	*AC2-151 E*	*1.88*
933391	*AC2-152 C*	*0.65*
933392	*AC2-152 E*	*1.06*
933401	*AC2-153 C*	*0.56*
933402	*AC2-153 E*	*0.91*
933411	*AC2-154 C*	*2.83*
933412	*AC2-154 E*	*4.62*
933431	*AC2-156 C*	*1.14*
933432	*AC2-156 E*	*1.86*
933511	*AC2-166 C*	*2.79*
933512	*AC2-166 E*	*3.08*
933911	*AD1-013 C O2*	*2.21*
933912	*AD1-013 E O2*	*3.53*
933931	*AD1-016 C*	*1.12*
933932	*AD1-016 E*	*1.82*
934001	*AD1-024 C*	*2.86*
934002	*AD1-024 E*	*4.67*
934101	*AD1-039 1*	*9.72*
934111	*AD1-039 2*	*9.7*
934401	*AD1-064 C O2*	*3.85*
934402	*AD1-064 E O2*	*18.03*
934431	*AD1-067 C*	*0.16*
934432	*AD1-067 E*	*0.66*
LTF	*AD1-092*	*14.04*

LTF	*AD1-093*	*24.18*
LTF	*AD1-094*	*4.62*
934701	*AD1-098 C O2*	*8.29*
934702	*AD1-098 E O2*	*6.05*
934721	*AD1-100 C O2*	*54.31*
934722	*AD1-100 E O2*	*254.26*
934871	*AD1-116 C*	*1.17*
934872	*AD1-116 E*	*1.91*
934941	*AD1-126 C*	*7.*
934942	*AD1-126 E*	*4.67*
934971	*AD1-129 C*	*1.09*
934972	*AD1-129 E*	*0.72*
935001	*AD1-133 C O2*	*45.96*
935002	*AD1-133 E O2*	*30.64*
LTF	*BLUEG*	*2.32*
LTF	*CANNELTON*	*0.05*
LTF	*CARR*	*0.9*
LTF	*CATAWBA*	*0.29*
274890	*CAYUG;1U E*	*24.26*
274891	*CAYUG;2U E*	*24.26*
LTF	*CBM-S1*	*2.6*
LTF	*CBM-W1*	*74.17*
LTF	*CBM-W2*	*59.01*
LTF	*CELEVELAND*	*0.79*
LTF	*CIN*	*0.27*
LTF	*CLIFTY*	*14.77*
LTF	*DEARBORN*	*2.74*
LTF	*ELMERSMITH*	*0.04*
LTF	*G-007*	*2.43*
290051	*GSG-6; E*	*12.56*
LTF	*HAMLET*	*1.14*
275149	*KEMPTON ;1E*	*20.88*
290108	*LEEDK;1U E*	*29.1*
274770	*LINCOLN ;1U*	*4.68*
274771	*LINCOLN ;2U*	*4.68*
274772	*LINCOLN ;3U*	*4.68*
274773	*LINCOLN ;4U*	*4.68*
274774	*LINCOLN ;5U*	*4.68*
274775	*LINCOLN ;6U*	*4.68*
274776	*LINCOLN ;7U*	*4.68*
274777	*LINCOLN ;8U*	*4.68*
LTF	*MEC*	*47.35*
274850	*MENDOTA H;RU*	*7.22*
293061	*N-015 E*	*17.77*
LTF	*O-066*	*8.18*

293644	*O22 E1*	*12.5*
293645	*O22 E2*	*24.27*
290021	*O50 E*	*23.68*
294392	*P-010 E*	*22.57*
274888	*PILOT HIL;1E*	*20.88*
274830	*PWR VTREC;1U*	*7.34*
274831	*PWR VTREC;2U*	*7.34*
296308	*R-030 C1*	*5.69*
296271	*R-030 C2*	*5.69*
296125	*R-030 C3*	*5.75*
296309	*R-030 E1*	*22.74*
296272	*R-030 E2*	*22.74*
296128	*R-030 E3*	*23.02*
LTF	*RENSSELAER*	*0.71*
LTF	*ROSETON*	*5.14*
LTF	*ROWAN*	*0.7*
274722	*S-055 E*	*13.53*
884780	*S58 FTIR*	*61.26*
884781	*S58 NFTIR*	*183.79*
295111	*SUBLETTE E*	*3.27*
LTF	*TRIMBLE*	*0.48*
274853	*TWINGROVE;U1*	*23.44*
274854	*TWINGROVE;U2*	*23.44*
299993	*U3-031C*	*12.4*
903433	*W3-046*	*12.74*
LTF	*WEC*	*9.63*
295109	*WESTBROOK E*	*6.72*
274687	*WILL CNTY;4U*	*80.62*
910542	*X3-005 E*	*0.89*
914641	*Y2-103*	*54.12*
915011	*Y3-013 1*	*4.51*
915021	*Y3-013 2*	*4.51*
915031	*Y3-013 3*	*4.51*
LTF	*Z1-043*	*35.33*
916502	*Z1-106 E1*	*1.51*
916504	*Z1-106 E2*	*1.51*
916512	*Z1-107 E*	*3.07*
916522	*Z1-108 E*	*2.99*
916651	*Z1-127 1*	*2.01*
916652	*Z1-127 2*	*0.99*
917501	*Z2-087 C*	*4.44*
917502	*Z2-087 E*	*29.74*
918051	*AA1-018 C*	*3.*
918052	*AA1-018 E*	*20.08*
918972	*AA1-116 E*	*2.98*

918982	*AA1-117 E*	*2.98*
919591	*AA2-035*	*159.68*
920112	*AA2-107 E*	*2.94*
920272	*AA2-123 E*	*2.94*
930481	*AB1-089*	*79.21*
930491	*AB1-090*	*79.21*
930501	*AB1-091*	*81.66*
930761	*AB1-122 1*	*89.47*
930771	*AB1-122 2*	*89.21*
931221	*AB1-172*	*0.95*
LTF	*AB2-013*	*20.15*
924041	*AB2-047 C O1*	*5.48*
924042	*AB2-047 E O1*	*36.68*
924471	*AB2-096*	*50.97*
925301	*AB2-191 C*	*1.52*
925302	*AB2-191 E*	*1.35*
925881	*AC1-067*	*161.98*
926311	*AC1-109 1*	*2.29*
926321	*AC1-109 2*	*2.29*
926331	*AC1-110 1*	*2.27*
926341	*AC1-110 2*	*2.27*
926351	*AC1-111 1*	*0.91*
926361	*AC1-111 2*	*0.91*
926371	*AC1-111 3*	*0.91*
926381	*AC1-111 4*	*0.91*
926391	*AC1-111 5*	*0.91*
926401	*AC1-111 6*	*0.91*
927511	*AC1-113 1*	*1.43*
927522	*AC1-113 2*	*1.43*
926431	*AC1-114*	*2.87*
927451	*AC1-142A 1*	*5.06*
927461	*AC1-142A 2*	*5.06*
926701	*AC1-153 C1*	*97.25*
926711	*AC1-153 C2*	*96.97*
926702	*AC1-153 E1*	*3.89*
926712	*AC1-153 E2*	*3.88*
927091	*AC1-204 1*	*88.53*
927101	*AC1-204 2*	*88.54*