Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD1-031

Kewanee 138kV

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 AD1-031 Kewanee 138kV project is a proposal to connect a 70 Energy (26.6 MW Capacity) solar PV facility to be located in Henry County, IL. The IC had proposed a service date for this project of 12/31/2019, but in correspondence has indicated 2020.

It is proposed in the AD1-031 Interconnection Request (Attachment N) that the customer is selecting the primary POI on the Kewanee 138kV bus. They are selecting a secondary POI as by tying into the Kewanee-Hennepin (Ameren)-Streator 138kV Line 6101.

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) AD1-031, a 70MW solar facility, proposes to interconnect with the ComEd transmission system by tying into the 138kV bus at the Kewanee TSS 74.

Presently, there is no 138kV bus position available at Kewanee TSS 74 to interconnect AD1-031 generator lead, and per ComEd investigation, it is not feasible to expand the existing TSS Kewanee TSS 74 to create a 138kV bus position for AD1-031 due to physical limitations.

See prior interconnection requests AA2-039 and AC1-033, for examples.

Attachment Facilities

The generator lead would interconnect to the 138kV bus-1 at TSS 74 Kewanee should a previous project withdraw and this bay becomes available. This interconnection would require one 138kV circuit breaker, a dead-end structure and revenue metering.

The cost for the attachment facilities is estimated at $4.0M.

Scope of Work	Cost Estimate
Installation of one 138kV circuit breaker, one dead-end structure and one set of revenue metering (see notes below on cost estimate)	$ 4.0M

ComEd would take 24-months to construct after ISA and ICSA are signed.

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 Interconnection Customer.

3) 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.

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

5) The Interconnection Customer is responsible for all engineering, procurement, testing and construction of all equipment on the Interconnection Customer’s side of the Point of Interconnection (POI).

Network Impacts for Primary POI

The Queue Project AD1-031 was evaluated as a 70.0 MW (Capacity 26.6 MW) injection at the Kewanee 138kV substation in the ComEd area. Project AD1-031 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-031 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 - MISO AMIL) The KEWANEE ;13-4KEWANEE N 138 kV line (from bus 271838 to bus 348923 ckt 1) loads from 95.31% to 101.0% (**DC power flow**) of its emergency rating (449 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_155-38-L15508_'. This project contributes approximately 25.54 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_155-38-L15508_'
 TRIP BRANCH FROM BUS 271331 TO BUS 271333 CKT 1          / DIXON;8R 138 DIXON; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 271331 CKT 1          / NELSO;RT 138 DIXON;8R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 272095 CKT 1          / NELSO;RT 138 NELSO; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 293710 CKT 1          / NELSO;RT 138 O29 138
 MOVE 100 PERCENT LOAD FROM BUS 271331 TO BUS 271330      / DIXON;8R 138 DIXON;7B 138
 DISCONNECT BUS 272095                    / NELSO; R 138
 END
```

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

Contribution to Previously Identified Overloads

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

1. (CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 196.88% to 209.32% (**DC power flow**) of its emergency rating (160 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 19.76 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
 DISCONNECT BUS 271836                    / KEWAN; 1 138
 DISCONNECT BUS 271837                    / KEWAN; 5 138
 DISCONNECT BUS 271838                    / KEWAN; 4 138
```

```
END
```

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

2. (CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 196.88% to 209.32% (**DC power flow**) of its emergency rating (160 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 19.76 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_074-38-L7413__'
 TRIP BRANCH FROM BUS 271836 TO BUS 271241 CKT 1            / KEWAN; 1 138 CRESC; R 138
 DISCONNECT BUS 271836                      / KEWAN; 1 138
 DISCONNECT BUS 271837                      / KEWAN; 5 138
 DISCONNECT BUS 271838                      / KEWAN; 4 138
 END
```

3. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 114.98% to 125.84% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 23.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
 DISCONNECT BUS 271836                      / KEWAN; 1 138
 DISCONNECT BUS 271837                      / KEWAN; 5 138
 DISCONNECT BUS 271838                      / KEWAN; 4 138
 END
```

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

4. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 114.98% to 125.84% (**DC power flow**) of its emergency rating (214 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 23.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_074-38-L7413__'
 TRIP BRANCH FROM BUS 271836 TO BUS 271241 CKT 1            / KEWAN; 1 138 CRESC; R 138
 DISCONNECT BUS 271836                      / KEWAN; 1 138
 DISCONNECT BUS 271837                      / KEWAN; 5 138
 DISCONNECT BUS 271838                      / KEWAN; 4 138
 END
```

5. (CE - MISO AMIL) The KEWANEE ;12-4EDWARDS3 138 kV line (from bus 271837 to bus 349637 ckt 1) loads from 108.02% to 115.31% (**DC power flow**) of its emergency rating (143 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_155-38-L15508_'. This project contributes approximately 10.4 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_155-38-L15508_'
 TRIP BRANCH FROM BUS 271331 TO BUS 271333 CKT 1            / DIXON;8R 138 DIXON; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 271331 CKT 1            / NELSO;RT 138 DIXON;8R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 272095 CKT 1            / NELSO;RT 138 NELSO; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 293710 CKT 1            / NELSO;RT 138 O29 138
 MOVE 100 PERCENT LOAD FROM BUS 271331 TO BUS 271330        / DIXON;8R 138 DIXON;7B 138
```

```
DISCONNECT BUS 272095                    / NELSO; R 138
END
```

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

6. (MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 101.71% to 112.57% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 23.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
 DISCONNECT BUS 271836                   / KEWAN; 1 138
 DISCONNECT BUS 271837                   / KEWAN; 5 138
 DISCONNECT BUS 271838                   / KEWAN; 4 138
 END
```

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

7. (MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 101.71% to 112.57% (**DC power flow**) of its emergency rating (214 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 23.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_074-38-L7413__'
 TRIP BRANCH FROM BUS 271836 TO BUS 271241 CKT 1          / KEWAN; 1 138 CRESC; R 138
 DISCONNECT BUS 271836                   / KEWAN; 1 138
 DISCONNECT BUS 271837                   / KEWAN; 5 138
 DISCONNECT BUS 271838                   / KEWAN; 4 138
 END
```

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. (CE - CE) The CRESCENT ; R-OGLESBY ; T 138 kV line (from bus 271241 to bus 272189 ckt 1) loads from 141.19% to 146.68% (**DC power flow**) of its emergency rating (174 MVA) for the single line contingency outage of 'COMED_P1-2_KEWANEE'. This project contributes approximately 9.47 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_KEWANEE'
 DISCONNECT BRANCH FROM BUS 271838 TO BUS 348923 CKT 1
 END
```

2. (CE - CE) The CRESCENT ; R-OGLESBY ; T 138 kV line (from bus 271241 to bus 272189 ckt 1) loads from 100.0% to 101.58% (**DC power flow**) of its normal rating (174 MVA) for non-contingency condition. This project contributes approximately 6.03 MW to the thermal violation.

3. (CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 171.5% to 183.9% (**DC power flow**) of its emergency rating (160 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 19.85 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

4. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 109.34% to 120.27% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 23.57 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

5. (CE - CE) The KEWANEE ;12-KEWANEE ;11 138 kV line (from bus 271837 to bus 271836 ckt 1) loads from 94.65% to 103.07% (**DC power flow**) of its emergency rating (246 MVA) for the single line contingency outage of 'COMED_P1-2_KEWANEE'. This project contributes approximately 20.85 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_KEWANEE'
 DISCONNECT BRANCH FROM BUS 271838 TO BUS 348923 CKT 1
 END
```

6. (CE - MISO AMIL) The KEWANEE ;12-4EDWARDS3 138 kV line (from bus 271837 to bus 349637 ckt 1) loads from 94.48% to 102.06% (**DC power flow**) of its emergency rating (143

MVA) for the single line contingency outage of 'COMED_P1-2_KEWANEE'. This project contributes approximately 10.78 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_KEWANEE'
 DISCONNECT BRANCH FROM BUS 271838 TO BUS 348923 CKT 1
 END
```

7. (CE - MISO AMIL) The KEWANEE ;13-4KEWANEE N 138 kV line (from bus 271838 to bus 348923 ckt 1) loads from 124.08% to 132.21% (**DC power flow**) of its normal rating (244 MVA) for non-contingency condition. This project contributes approximately 19.85 MW to the thermal violation.

8. (CE - CE) The KICKAPOO ; B-LASCO STA; B 138 kV line (from bus 271844 to bus 271908 ckt 1) loads from 106.3% to 107.14% (**DC power flow**) of its normal rating (351 MVA) for non-contingency condition. This project contributes approximately 6.38 MW to the thermal violation.

9. (CE - CE) The KEWANEE ;21-KEWANEE ;13 138 kV line (from bus 271845 to bus 271838 ckt 1) loads from 102.41% to 114.53% (**DC power flow**) of its normal rating (351 MVA) for non-contingency condition. This project contributes approximately 42.88 MW to the thermal violation.

10. (CE - CE) The KEWANEE ;21-KEWANEE ;13 138 kV line (from bus 271845 to bus 271838 ckt 1) loads from 99.39% to 110.48% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P1-2_138-L7411__R-R'. This project contributes approximately 50.21 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L7411__R-R'
 TRIP BRANCH FROM BUS 348962 TO BUS 271835 CKT 1          / KEEMIN; R 138 KEWAN; 2 138
 END
```

11. (CE - CE) The LASCO STA; B-MAZON ; B 138 kV line (from bus 271908 to bus 271986 ckt 1) loads from 123.95% to 124.87% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P1-3_TR81_LASCO_B-S'. This project contributes approximately 4.09 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR81_LASCO_B-S'
 TRIP BRANCH FROM BUS 270802 TO BUS 270803 CKT 1          / LASCO STA; B 345 LASCO STA; R 345
 TRIP BRANCH FROM BUS 270802 TO BUS 271908 CKT 1          / LASCO STA; B 345 LASCO STA; B 138
 END
```

12. (CE - CE) The NELSON ;RT-DIXON ;8R 138 kV line (from bus 272097 to bus 271331 ckt 1) loads from 103.16% to 104.58% (**DC power flow**) of its emergency rating (440 MVA) for the single line contingency outage of 'COMED_P1-3_TR82_NELSO_B-R'. This project contributes approximately 14.05 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR82_NELSO_B-R'
 TRIP BRANCH FROM BUS 275203 TO BUS 270828 CKT 1          / NELSO;2M 138 NELSO; B 345
 TRIP BRANCH FROM BUS 275203 TO BUS 272095 CKT 1          / NELSO;2M 138 NELSO; R 138
 TRIP BRANCH FROM BUS 275203 TO BUS 275303 CKT 1          / NELSO;2M 138 NELSO;2C 34.5
 END
```

13. (CE - CE) The NELSON ;RT-DIXON ;8R 138 kV line (from bus 272097 to bus 271331 ckt 1) loads from 103.32% to 104.21% (**DC power flow**) of its normal rating (343 MVA) for non-contingency condition. This project contributes approximately 6.81 MW to the thermal violation.

14. (CE - CE) The NORMANDY ; R-O09 OP1 138 138 kV line (from bus 272111 to bus 293510 ckt 1) loads from 89.11% to 100.04% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 23.57 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

15. (CE - CE) The OGLESBY ; T-MAZON ; R 138 kV line (from bus 272189 to bus 271987 ckt 1) loads from 101.97% to 103.28% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P1-2_138-L0112__B-S'. This project contributes approximately 6.48 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L0112__B-S'
 TRIP BRANCH FROM BUS 271844 TO BUS 271908 CKT 1              / KICKA; B 138 LASCO; B 138
 END
```

16. (CE - CE) The ROCK FALL; R-NELSON ; R 138 kV line (from bus 272367 to bus 272095 ckt 1) loads from 186.29% to 189.27% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P2-1_187-L15508__'. This project contributes approximately 15.02 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_187-L15508__'
 TRIP BRANCH FROM BUS 293710 TO BUS 272097 CKT 1              / O29 ; 138 NELSO;RT 138
 END
```

17. (CE - CE) The ROCK FALL; R-NELSON ; R 138 kV line (from bus 272367 to bus 272095 ckt 1) loads from 113.73% to 115.85% (**DC power flow**) of its normal rating (173 MVA) for non-contingency condition. This project contributes approximately 8.49 MW to the thermal violation.

18. (CE - CE) The O09 OP1 138-ROCK FALL; R 138 kV line (from bus 293510 to bus 272367 ckt 1) loads from 222.14% to 225.38% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of 'COMED_P2-1_187-L15508__'. This project contributes approximately 15.69 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_187-L15508__'
 TRIP BRANCH FROM BUS 293710 TO BUS 272097 CKT 1              / O29 ; 138 NELSO;RT 138
 END
```

19. (CE - CE) The O09 OP1 138-ROCK FALL; R 138 kV line (from bus 293510 to bus 272367 ckt 1) loads from 145.56% to 147.82% (**DC power flow**) of its normal rating (173 MVA) for non-contingency condition. This project contributes approximately 9.02 MW to the thermal violation.

20. (CE - CE) The O29-NELSON ;RT 138 kV line (from bus 293710 to bus 272097 ckt 1) loads from 184.76% to 187.4% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of 'COMED_P2-1_133-CB_23___'. This project contributes approximately 15.71 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_133-CB_23___'
 TRIP BRANCH FROM BUS 272367 TO BUS 293510 CKT 1              / R FAL; R 138 O9 138
 END
```

21. (CE - CE) The O29-NELSON ;RT 138 kV line (from bus 293710 to bus 272097 ckt 1) loads from 143.15% to 145.05% (**DC power flow**) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 9.1 MW to the thermal violation.

22. (MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 96.12% to 107.05% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 23.57 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

Light Load Analysis - 2021

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

System Reinforcements

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)

Multiple Facility Contingency

1. (CE - MISO AMIL) The KEWANEE ;13-4KEWANEE N 138 kV line (from bus 271838 to bus 348923 ckt 1) loads from 95.31% to 101.0% (**DC power flow**) of its emergency rating (449 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_155-38-L15508_'. This project contributes approximately 25.54 MW to the thermal violation.

COMED:

ComEd 138kV TSS 74 station bus section SLD & ALDR ratings are 498 MVA & 573 MVA respectively. No upgrade is required.

MISO AMIL:
The external (i.e. Non-PJM) Transmission Owner, MISO AMIL, will not evaluate this violation until the impact study phase.

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. (CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 196.88% to 209.32% (**DC power flow**) of its emergency rating (160 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 19.76 MW to the thermal violation.

COMED:
ComEd 138Kv L6101 SLD & ALDR ratings are 498 MVA & 573 MVA. No upgrade is required.

MISO AMIL:
The external (i.e. Non-PJM) Transmission Owner, MISO AMIL, will not evaluate this violation until the impact study phase.

2. (CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 196.88% to 209.32% (**DC power flow**) of its emergency rating (160 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 19.76 MW to the thermal violation.

Same as Contribution to Previously Identified #1

3. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 114.98% to 125.84% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 23.41 MW to the thermal violation.

COMED:
ComEd 138Kv L7411 SLD & ALDR ratings are 230 MVA & 265 MVA. The post contingency flow exceeds the ratings therefore an upgrade will be required. The upgrade will be the station conductor at TSS 74 Kewanee. A preliminary estimate for this upgrade is $500K with a preliminary construction timeline of 18-20 months. Upon completion of this upgrade the new ratings will be 190/246/256/294 MVA, SN/SE/SLD/ALDR.

MISO AMIL:
The external (i.e. Non-PJM) Transmission Owner, MISO AMIL, will not evaluate this violation until the impact study phase.

4. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 114.98% to 125.84% (**DC power flow**) of its emergency rating (214 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 23.41 MW to the thermal violation.

Same as Contribution to Previously Identified #3

5. (CE - MISO AMIL) The KEWANEE ;12-4EDWARDS3 138 kV line (from bus 271837 to bus 349637 ckt 1) loads from 108.02% to 115.31% (**DC power flow**) of its emergency rating (143 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_155-38-L15508_'. This project contributes approximately 10.4 MW to the thermal violation.

COMED:
ComEd 138Kv L7423 SLD & ALDR ratings are 256 MVA & 294 MVA. No upgrade is required.

MISO AMIL:
The external (i.e. Non-PJM) Transmission Owner, MISO AMIL, will not evaluate this violation until the impact study phase.

6. (MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 101.71% to 112.57% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 23.41 MW to the thermal violation.

COMED:
ComEd 138Kv L13304 SLD & ALDR ratings are 280 MVA & 322 MVA. No upgrade is required.

MISO AMIL:
The external (i.e. Non-PJM) Transmission Owner, MISO AMIL, will not evaluate this violation until the impact study phase.

7. (MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 101.71% to 112.57% (**DC power flow**) of its emergency rating (214 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 23.41 MW to the thermal violation.

Same as Contribution to Previously Identified #6

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

To be determined

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. (CE - CE) The CRESCENT ; R-OGLESBY ; T 138 kV line (from bus 271241 to bus 272189 ckt 1) loads from 141.19% to 146.68% (**DC power flow**) of its emergency rating (174 MVA) for the single line contingency outage of 'COMED_P1-2_KEWANEE'. This project contributes approximately 9.47 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_KEWANEE'
 DISCONNECT BRANCH FROM BUS 271838 TO BUS 348923 CKT 1
 END
```

2. (CE - CE) The CRESCENT ; R-OGLESBY ; T 138 kV line (from bus 271241 to bus 272189 ckt 1) loads from 100.0% to 101.58% (**DC power flow**) of its normal rating (174 MVA) for non-contingency condition. This project contributes approximately 6.03 MW to the thermal violation.

3. (CE - CE) The DIXON ;8R-DIXON ; R 138 kV line (from bus 271331 to bus 271333 ckt 1) loads from 103.49% to 104.97% (**DC power flow**) of its emergency rating (421 MVA) for the single line contingency outage of 'COMED_P1-3_TR82_NELSO_B-R'. This project contributes approximately 14.05 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR82_NELSO_B-R'
 TRIP BRANCH FROM BUS 275203 TO BUS 270828 CKT 1          / NELSO;2M 138 NELSO; B 345
 TRIP BRANCH FROM BUS 275203 TO BUS 272095 CKT 1          / NELSO;2M 138 NELSO; R 138
 TRIP BRANCH FROM BUS 275203 TO BUS 275303 CKT 1          / NELSO;2M 138 NELSO;2C 34.5
 END
```

4. (CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 171.5% to 183.9% (**DC power flow**) of its emergency rating (160 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 19.85 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
```

```
END
```

5. (CE - CE) The KEWANEE ;23-HENNEEPIN; T 138 kV line (from bus 271835 to bus 271655 ckt 1) loads from 136.68% to 149.55% (**DC power flow**) of its emergency rating (195 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 25.0 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

6. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 109.34% to 120.27% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 23.57 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

7. (CE - CE) The KEWANEE ;12-KEWANEE ;11 138 kV line (from bus 271837 to bus 271836 ckt 1) loads from 94.65% to 103.07% (**DC power flow**) of its emergency rating (246 MVA) for the single line contingency outage of 'COMED_P1-2_KEWANEE'. This project contributes approximately 20.85 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_KEWANEE'
 DISCONNECT BRANCH FROM BUS 271838 TO BUS 348923 CKT 1
 END
```

8. (CE - MISO AMIL) The KEWANEE ;12-4EDWARDS3 138 kV line (from bus 271837 to bus 349637 ckt 1) loads from 94.48% to 102.06% (**DC power flow**) of its emergency rating (143 MVA) for the single line contingency outage of 'COMED_P1-2_KEWANEE'. This project contributes approximately 10.78 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_KEWANEE'
 DISCONNECT BRANCH FROM BUS 271838 TO BUS 348923 CKT 1
 END
```

9. (CE - MISO AMIL) The KEWANEE ;13-4KEWANEE N 138 kV line (from bus 271838 to bus 348923 ckt 1) loads from 124.08% to 132.21% (**DC power flow**) of its normal rating (244 MVA) for non-contingency condition. This project contributes approximately 19.85 MW to the thermal violation.

10. (CE - CE) The KICKAPOO ; B-LASCO STA; B 138 kV line (from bus 271844 to bus 271908 ckt 1) loads from 106.3% to 107.14% (**DC power flow**) of its normal rating (351 MVA) for non-contingency condition. This project contributes approximately 6.38 MW to the thermal violation.

11. (CE - CE) The KEWANEE ;21-KEWANEE ;13 138 kV line (from bus 271845 to bus 271838 ckt 1) loads from 102.41% to 114.53% (**DC power flow**) of its normal rating (351 MVA) for non-contingency condition. This project contributes approximately 42.88 MW to the thermal violation.

12. (CE - CE) The KEWANEE ;21-KEWANEE ;13 138 kV line (from bus 271845 to bus 271838 ckt 1) loads from 99.39% to 110.48% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P1-2_138-L7411__R-R'. This project contributes approximately 50.21 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L7411__R-R'
 TRIP BRANCH FROM BUS 348962 TO BUS 271835 CKT 1          / KEEMIN; R 138 KEWAN; 2 138
 END
```

13. (CE - CE) The LASCO STA; B-MAZON ; B 138 kV line (from bus 271908 to bus 271986 ckt 1) loads from 123.95% to 124.87% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P1-3_TR81_LASCO_B-S'. This project contributes approximately 4.09 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR81_LASCO_B-S'
 TRIP BRANCH FROM BUS 270802 TO BUS 270803 CKT 1          / LASCO STA; B
345 LASCO STA; R 345
 TRIP BRANCH FROM BUS 270802 TO BUS 271908 CKT 1          / LASCO STA; B
345 LASCO STA; B 138
 END
```

14. (CE - CE) The NELSON ;RT-DIXON ;8R 138 kV line (from bus 272097 to bus 271331 ckt 1) loads from 103.16% to 104.58% (**DC power flow**) of its emergency rating (440 MVA) for the single line contingency outage of 'COMED_P1-3_TR82_NELSO_B-R'. This project contributes approximately 14.05 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR82_NELSO_B-R'
 TRIP BRANCH FROM BUS 275203 TO BUS 270828 CKT 1          / NELSO;2M 138 NELSO; B 345
 TRIP BRANCH FROM BUS 275203 TO BUS 272095 CKT 1          / NELSO;2M 138 NELSO; R 138
 TRIP BRANCH FROM BUS 275203 TO BUS 275303 CKT 1          / NELSO;2M 138 NELSO;2C 34.5
 END
```

15. (CE - CE) The NELSON ;RT-DIXON ;8R 138 kV line (from bus 272097 to bus 271331 ckt 1) loads from 103.32% to 104.21% (**DC power flow**) of its normal rating (343 MVA) for non-contingency condition. This project contributes approximately 6.81 MW to the thermal violation.

16. (CE - CE) The NORMANDY ; R-O09 OP1 138 138 kV line (from bus 272111 to bus 293510 ckt 1) loads from 89.11% to 100.04% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 23.57 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

17. (CE - CE) The OGLESBY ; T-MAZON ; R 138 kV line (from bus 272189 to bus 271987 ckt 1) loads from 101.97% to 103.28% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P1-2_138-L0112__B-S'. This project contributes approximately 6.48 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L0112__B-S'
 TRIP BRANCH FROM BUS 271844 TO BUS 271908 CKT 1              / KICKA; B 138 LASCO; B 138
 END
```

18. (CE - CE) The POWERTON ;-POWERTON ;RT 138 kV line (from bus 272269 to bus 272285 ckt 1) loads from 90.13% to 100.2% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 21.41 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

19. (CE - CE) The ROCK FALL; R-NELSON ; R 138 kV line (from bus 272367 to bus 272095 ckt 1) loads from 186.29% to 189.27% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P2-1_187-L15508__'. This project contributes approximately 15.02 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_187-L15508__'
 TRIP BRANCH FROM BUS 293710 TO BUS 272097 CKT 1              / O29 ; 138 NELSO;RT 138
 END
```

20. (CE - CE) The ROCK FALL; R-NELSON ; R 138 kV line (from bus 272367 to bus 272095 ckt 1) loads from 113.73% to 115.85% (**DC power flow**) of its normal rating (173 MVA) for non-contingency condition. This project contributes approximately 8.49 MW to the thermal violation.

21. (CE - CE) The O09 OP1 138-ROCK FALL; R 138 kV line (from bus 293510 to bus 272367 ckt 1) loads from 222.14% to 225.38% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of 'COMED_P2-1_187-L15508__'. This project contributes approximately 15.69 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_187-L15508__'
 TRIP BRANCH FROM BUS 293710 TO BUS 272097 CKT 1              / O29 ; 138 NELSO;RT 138
 END
```

22. (CE - CE) The O09 OP1 138-ROCK FALL; R 138 kV line (from bus 293510 to bus 272367 ckt 1) loads from 145.56% to 147.82% (**DC power flow**) of its normal rating (173 MVA) for non-contingency condition. This project contributes approximately 9.02 MW to the thermal violation.

23. (CE - CE) The O29-NELSON ;RT 138 kV line (from bus 293710 to bus 272097 ckt 1) loads from 184.76% to 187.4% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of 'COMED_P2-1_133-CB_23___'. This project contributes approximately 15.71 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_133-CB_23___'
 TRIP BRANCH FROM BUS 272367 TO BUS 293510 CKT 1              / R FAL; R 138 O9 138
 END
```

24. (CE - CE) The O29-NELSON ;RT 138 kV line (from bus 293710 to bus 272097 ckt 1) loads from 143.15% to 145.05% (**DC power flow**) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 9.1 MW to the thermal violation.

25. (MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 96.12% to 107.05% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 23.57 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

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 - MISO AMIL) The KEWANEE ;13-4KEWANEE N 138 kV line (from bus 271838 to bus 348923 ckt 1) loads from 95.31% to 101.0% (**DC power flow**) of its emergency rating (449 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_155-38-L15508_'. This project contributes approximately 25.54 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_155-38-L15508_'
 TRIP BRANCH FROM BUS 271331 TO BUS 271333 CKT 1          / DIXON;8R 138 DIXON; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 271331 CKT 1          / NELSO;RT 138 DIXON;8R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 272095 CKT 1          / NELSO;RT 138 NELSO; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 293710 CKT 1          / NELSO;RT 138 O29 138
 MOVE 100 PERCENT LOAD FROM BUS 271331 TO BUS 271330      / DIXON;8R 138 DIXON;7B 138
 DISCONNECT BUS 272095                                    / NELSO; R 138
 END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O1*	*9.7*
934052	*AD1-031 E O1*	*15.83*
934421	*AD1-066*	*2.51*
274832	*ANNAWAN ; 1U*	*35.87*
274877	*BISHOP HL;1U*	*1.44*
274878	*BISHOP HL;2U*	*1.44*
294401	*BSHIL;1U E*	*29.25*
294410	*BSHIL;2U E*	*29.25*
274849	*CRESCENT ;1U*	*13.8*
990901	*L-005 E*	*38.46*
293516	*O-009 E1*	*26.69*
293517	*O-009 E2*	*13.55*
293518	*O-009 E3*	*14.93*
293715	*O-029 E*	*28.58*
293716	*O-029 E*	*15.67*
293717	*O-029 E*	*14.4*
293771	*O-035 E*	*15.*
919621	*AA2-039 C*	*7.13*
919622	*AA2-039 E*	*47.72*
925581	*AC1-033 C*	*4.79*
925582	*AC1-033 E*	*32.08*
926841	*AC1-171 C*	*1.58*
926842	*AC1-171 E*	*10.58*
927201	*AC1-214 C*	*4.82*
927202	*AC1-214 E*	*12.8*

Appendix 2

(CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 196.88% to 209.32% (**DC power flow**) of its emergency rating (160 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 19.76 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
  DISCONNECT BUS 271836                    / KEWAN; 1 138
  DISCONNECT BUS 271837                    / KEWAN; 5 138
  DISCONNECT BUS 271838                    / KEWAN; 4 138
  END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O1*	*7.51*
934052	*AD1-031 E O1*	*12.25*
274832	*ANNAWAN ; 1U*	*6.31*
274877	*BISHOP HL;1U*	*1.11*
274878	*BISHOP HL;2U*	*1.11*
294401	*BSHIL;1U E*	*22.57*
294410	*BSHIL;2U E*	*22.57*
274848	*CAMPGROVE;RU*	*1.45*
990901	*L-005 E*	*29.5*
293061	*N-015 E*	*7.06*
293516	*O-009 E1*	*5.26*
293517	*O-009 E2*	*2.67*
293518	*O-009 E3*	*2.94*
293715	*O-029 E*	*5.5*
293716	*O-029 E*	*3.01*
293717	*O-029 E*	*2.77*
294392	*P-010 E*	*8.97*
917451	*Z2-081*	*0.73*
919621	*AA2-039 C*	*5.5*
919622	*AA2-039 E*	*36.82*
926821	*AC1-168 C*	*5.95*
926822	*AC1-168 E*	*39.89*
926841	*AC1-171 C*	*1.13*
926842	*AC1-171 E*	*7.58*

Appendix 3

(CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 114.98% to 125.84% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 23.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
  DISCONNECT BUS 271836                    / KEWAN; 1 138
  DISCONNECT BUS 271837                    / KEWAN; 5 138
  DISCONNECT BUS 271838                    / KEWAN; 4 138
  END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O1*	*8.9*
934052	*AD1-031 E O1*	*14.51*
934421	*AD1-066*	*0.76*
274877	*BISHOP HL;1U*	*1.31*
274878	*BISHOP HL;2U*	*1.31*
294401	*BSHIL;1U E*	*26.74*
294410	*BSHIL;2U E*	*26.74*
274848	*CAMPGROVE;RU*	*1.74*
274849	*CRESCENT ;1U*	*4.16*
990901	*L-005 E*	*35.42*
293771	*O-035 E*	*4.52*
919621	*AA2-039 C*	*6.52*
919622	*AA2-039 E*	*43.62*
926821	*AC1-168 C*	*0.91*
926822	*AC1-168 E*	*6.12*
926841	*AC1-171 C*	*1.53*
926842	*AC1-171 E*	*10.26*
927201	*AC1-214 C*	*1.45*
927202	*AC1-214 E*	*3.86*

Appendix 4

(CE - MISO AMIL) The KEWANEE ;12-4EDWARDS3 138 kV line (from bus 271837 to bus 349637 ckt 1) loads from 108.02% to 115.31% (**DC power flow**) of its emergency rating (143 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_155-38-L15508_'. This project contributes approximately 10.4 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_155-38-L15508_'
 TRIP BRANCH FROM BUS 271331 TO BUS 271333 CKT 1          / DIXON;8R 138 DIXON; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 271331 CKT 1          / NELSO;RT 138 DIXON;8R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 272095 CKT 1          / NELSO;RT 138 NELSO; R 138
 TRIP BRANCH FROM BUS 272097 TO BUS 293710 CKT 1          / NELSO;RT 138 O29 138
 MOVE 100 PERCENT LOAD FROM BUS 271331 TO BUS 271330      / DIXON;8R 138 DIXON;7B 138
 DISCONNECT BUS 272095                                    / NELSO; R 138
 END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O1*	*3.95*
934052	*AD1-031 E O1*	*6.45*
934421	*AD1-066*	*1.21*
274832	*ANNAWAN ; 1U*	*14.65*
274877	*BISHOP HL;1U*	*0.58*
274878	*BISHOP HL;2U*	*0.58*
294401	*BSHIL;1U E*	*11.91*
294410	*BSHIL;2U E*	*11.91*
274849	*CRESCENT ;1U*	*6.65*
990901	*L-005 E*	*15.58*
293516	*O-009 E1*	*10.93*
293517	*O-009 E2*	*5.55*
293518	*O-009 E3*	*6.12*
293715	*O-029 E*	*11.71*
293716	*O-029 E*	*6.42*
293717	*O-029 E*	*5.9*
293771	*O-035 E*	*7.23*
919621	*AA2-039 C*	*2.9*
919622	*AA2-039 E*	*19.42*
925581	*AC1-033 C*	*1.96*
925582	*AC1-033 E*	*13.09*
926821	*AC1-168 C*	*0.68*
926822	*AC1-168 E*	*4.59*
926841	*AC1-171 C*	*0.61*
926842	*AC1-171 E*	*4.09*
927201	*AC1-214 C*	*2.32*
927202	*AC1-214 E*	*6.17*

Appendix 5

(MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 101.71% to 112.57% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 23.41 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
  DISCONNECT BUS 271836                    / KEWAN; 1 138
  DISCONNECT BUS 271837                    / KEWAN; 5 138
  DISCONNECT BUS 271838                    / KEWAN; 4 138
  END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O1*	*8.9*
934052	*AD1-031 E O1*	*14.51*
934421	*AD1-066*	*0.76*
274877	*BISHOP HL;1U*	*1.31*
274878	*BISHOP HL;2U*	*1.31*
294401	*BSHIL;1U E*	*26.74*
294410	*BSHIL;2U E*	*26.74*
274848	*CAMPGROVE;RU*	*1.74*
274849	*CRESCENT ;1U*	*4.16*
990901	*L-005 E*	*35.42*
293771	*O-035 E*	*4.52*
919621	*AA2-039 C*	*6.52*
919622	*AA2-039 E*	*43.62*
926821	*AC1-168 C*	*0.91*
926822	*AC1-168 E*	*6.12*
926841	*AC1-171 C*	*1.53*
926842	*AC1-171 E*	*10.26*
927201	*AC1-214 C*	*1.45*
927202	*AC1-214 E*	*3.86*

Secondary Point of Interconnection (Option-2)

The Interconnection Customer (IC) AD1-031, a 70MW solar facility, proposes to interconnect with the ComEd transmission system by tying into the Kewanee-Hennepin (Ameren)-Streator 138kV Line 6101.

Attachment Facilities

The IC AD1-031 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 AD1-031, a new 138kV Interconnection Substation would need to be built close to the Kewanee-Hennepin (Ameren)-Streator 138kV Line 6101 immediately adjacent to the Kewanee TSS 74.

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 Kewanee-Hennepin (Ameren)-Streator 138kV Line 6101, 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. The IC will be responsible for the ComEd oversight costs (i.e. costs incurred by the Transmission Owner when engaging in oversight activities to satisfy itself that the IC is complying with the Transmission Owner's standards and specifications for the construction of facilities).

ComEd would design, engineer and construct the tie in of the Interconnection Substation to the Kewanee-Hennepin (Ameren)-Streator 138kV Line 6101.

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 TSS 74 Kewanee, TSS 61 Streator, and AMEREN's Hennepin Substation. The ComEd cost is given below:

Scope of Work	Cost Estimate
Relay/communications/SCADA upgrades at TSS 74 Kewanee substation	$ 750,000
Relay/communications/SCADA upgrades at TSS 61 Streator substation	$ 750,000
Relay/communications/SCADA upgrades at Hennepin Substation (Ameren to provide cost estimate later)	$0
Total Cost Estimate (see notes below on cost estimate)	$1,500,000

Notes on Cost Estimate:

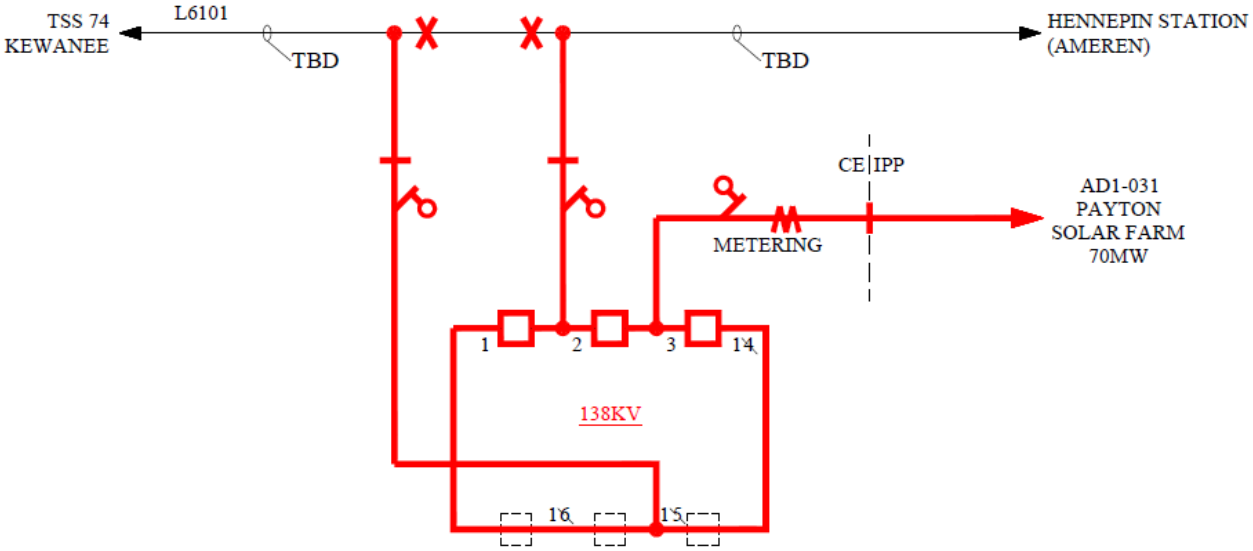
1) These estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided by the IC.

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).

AD1-031
SECONDARY POI OPTION



AD1-031
PAYTON SOLAR
FARM
70MW

Network Impacts for Secondary POI

The Queue Project AD1-031 was evaluated as a 70.0 MW (Capacity 26.6 MW) injection tapping Kewanee; 23 to Hennepin; T 138kV line in the ComEd area. Project AD1-031 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-031 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. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 115.25% to 122.27% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 15.18 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
 DISCONNECT BUS 271836                    / KEWAN; 1 138
 DISCONNECT BUS 271837                    / KEWAN; 5 138
 DISCONNECT BUS 271838                    / KEWAN; 4 138
 END
```

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

2. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 115.25% to 122.27% (**DC power flow**) of its emergency rating (214 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 15.18 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_074-38-L7413__'
 TRIP BRANCH FROM BUS 271836 TO BUS 271241 CKT 1          / KEWAN; 1 138 CRESC; R 138
 DISCONNECT BUS 271836                    / KEWAN; 1 138
 DISCONNECT BUS 271837                    / KEWAN; 5 138
```

```
 DISCONNECT BUS 271838                    / KEWAN; 4 138
 END
```

3. (CE - CE) The OGLESBY ; T-MAZON ; R 138 kV line (from bus 272189 to bus 271987 ckt 1) loads from 104.15% to 108.21% (**DC power flow**) of its load dump rating (223 MVA) for the bus fault outage of 'COMED_P2-2_001_LA-138B__1'. This project contributes approximately 9.05 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_001_LA-138B__1'
 DISCONNECT BUS 271908                    / LASCO STA; B 138
 END
```

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

4. (CE - CE) The OGLESBY ; T-MAZON ; R 138 kV line (from bus 272189 to bus 271987 ckt 1) loads from 104.15% to 108.21% (**DC power flow**) of its load dump rating (223 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_001-38-L0108__'. This project contributes approximately 9.05 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_001-38-L0108__'
 TRIP BRANCH FROM BUS 271908 TO BUS 271986 CKT 1      / LASCO; B 138 MAZON; B 138
 DISCONNECT BUS 271908                    / LASCO; B 138
 END
```

5. (CE - CE) The OGLESBY ; T-MAZON ; R 138 kV line (from bus 272189 to bus 271987 ckt 1) loads from 104.15% to 108.21% (**DC power flow**) of its load dump rating (223 MVA) for the line fault with failed breaker contingency outage of 'COMED_P4_001-38-TR81___'. This project contributes approximately 9.05 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_001-38-TR81___'
 TRIP BRANCH FROM BUS 270802 TO BUS 270803 CKT 1      / LASCO STA; B 345 LASCO STA; R 345
 TRIP BRANCH FROM BUS 270802 TO BUS 271908 CKT 1      / LASCO STA; B 345 LASCO STA; B 138
 DISCONNECT BUS 271908                    / LASCO STA; B 138
 TRIP BRANCH FROM BUS 270802 TO BUS 270803 CKT 1      / LASCO STA; B 345 LASCO STA; R 345
 END
```

6. (CE - CE) The AD1-031 TAP-HENNEEPIN; T 138 kV line (from bus 934050 to bus 271655 ckt 1) loads from 139.91% to 159.79% (**DC power flow**) of its load dump rating (207 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 41.04 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
 DISCONNECT BUS 271836                    / KEWAN; 1 138
 DISCONNECT BUS 271837                    / KEWAN; 5 138
 DISCONNECT BUS 271838                    / KEWAN; 4 138
 END
```

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

7. (CE - CE) The AD1-031 TAP-HENNEEPIN; T 138 kV line (from bus 934050 to bus 271655 ckt 1) loads from 139.91% to 159.79% (**DC power flow**) of its load dump rating (207 MVA) for

the line fault with failed breaker contingency outage of 'COMED_P4_074-38-L7413__'. This project contributes approximately 41.04 MW to the thermal violation.

```
CONTINGENCY 'COMED_P4_074-38-L7413__'
 TRIP BRANCH FROM BUS 271836 TO BUS 271241 CKT 1          / KEWAN; 1 138 CRESC; R 138
 DISCONNECT BUS 271836                        / KEWAN; 1 138
 DISCONNECT BUS 271837                        / KEWAN; 5 138
 DISCONNECT BUS 271838                        / KEWAN; 4 138
 END
```

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. (CE - CE) The WALTO; B-ELECT JCT; B 345 kV line (from bus 270932 to bus 270730 ckt 1) loads from 99.93% to 100.12% (**DC power flow**) of its emergency rating (1528 MVA) for the single line contingency outage of 'COMED_P1-2_345-L15501_B-R'. This project contributes approximately 6.06 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_345-L15501_B-R'
 TRIP BRANCH FROM BUS 270828 TO BUS 274768 CKT 1          / NELSO; B 345 LEECO;BP 345
 END
```

2. (CE - CE) The DIXON ;8R-DIXON ; R 138 kV line (from bus 271331 to bus 271333 ckt 1) loads from 103.65% to 104.81% (**DC power flow**) of its emergency rating (421 MVA) for the single line contingency outage of 'COMED_P1-3_TR82_NELSO_B-R'. This project contributes approximately 11.06 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR82_NELSO_B-R'
 TRIP BRANCH FROM BUS 275203 TO BUS 270828 CKT 1          / NELSO;2M 138 NELSO; B 345
 TRIP BRANCH FROM BUS 275203 TO BUS 272095 CKT 1          / NELSO;2M 138 NELSO; R 138
 TRIP BRANCH FROM BUS 275203 TO BUS 275303 CKT 1          / NELSO;2M 138 NELSO;2C 34.5
 END
```

3. (CE - MISO AMIL) The HENNEEPIN; T-4HENNEPIN S 138 kV line (from bus 271655 to bus 348918 ckt 1) loads from 170.89% to 192.09% (**DC power flow**) of its emergency rating (160 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 33.93 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

4. (CE - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 109.62% to 116.38% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 14.64 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
 END
```

5. (CE - CE) The KEWANEE ;12-KEWANEE ;11 138 kV line (from bus 271837 to bus 271836 ckt 1) loads from 95.0% to 99.17% (**DC power flow**) of its emergency rating (246 MVA) for the single line contingency outage of 'COMED_P1-2_KEWANEE'. This project contributes approximately 10.36 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_KEWANEE'
 DISCONNECT BRANCH FROM BUS 271838 TO BUS 348923 CKT 1
 END
```

6. (CE - MISO AMIL) The KEWANEE ;13-4KEWANEE N 138 kV line (from bus 271838 to bus 348923 ckt 1) loads from 124.14% to 125.62% (**DC power flow**) of its normal rating (244 MVA) for non-contingency condition. This project contributes approximately 8.03 MW to the thermal violation.

7. (CE - CE) The KICKAPOO ; B-LASCO STA; B 138 kV line (from bus 271844 to bus 271908 ckt 1) loads from 107.21% to 110.02% (**DC power flow**) of its normal rating (351 MVA) for non-contingency condition. This project contributes approximately 9.7 MW to the thermal violation.

8. (CE - CE) The KICKAPOO ; B-LASCO STA; B 138 kV line (from bus 271844 to bus 271908 ckt 1) loads from 94.52% to 97.07% (**DC power flow**) of its emergency rating (442 MVA) for the single line contingency outage of 'COMED_P1-2_138-L1206__R-S'. This project contributes approximately 11.23 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L1206__R-S'
 TRIP BRANCH FROM BUS 271187 TO BUS 271987 CKT 1          / CHANNAHON; R 138 MAZON ; R 138
 TRIP BRANCH FROM BUS 271337 TO BUS 272125 CKT 1          / DRESDEN ; R 138 ESS J339 ; R 138
```

```
TRIP BRANCH FROM BUS 271987 TO BUS 272189 CKT 1          / MAZON ; R 138 OGLESBY ; T 138
TRIP BRANCH FROM BUS 272319 TO BUS 271187 CKT 1          / ESS J375 ; R 138 CHANNAHON; R 138
TRIP BRANCH FROM BUS 272319 TO BUS 272125 CKT 1          / ESS J375 ; R 138 ESS J339 ; R 138
MOVE 50 PERCENT LOAD FROM BUS 271187 TO BUS 271566       / CHANNAHON; R 138 GOOSE LK ; B 138
MOVE 50 PERCENT LOAD FROM BUS 271187 TO BUS 271567       / CHANNAHON; R 138 GOOSE LK ; R 138
MOVE 100 PERCENT LOAD FROM BUS 272125 TO BUS 272124      / ESS J339 ; R 138 ESS J339 ; B 138
CLOSE LINE FROM BUS 271986 TO BUS 271987 CKT 1           / MAZON ; B 138 MAZON ; R 138
DISCONNECT BUS 274836                                    / EQUISTAR ; R 13.8
END
```

9. (CE - CE) The KEWANEE ;21-KEWANEE ;13 138 kV line (from bus 271845 to bus 271838 ckt 1) loads from 101.01% to 109.43% (**DC power flow**) of its emergency rating (449 MVA) for the single line contingency outage of 'COMED_P2-1_074-L6101___-B'. This project contributes approximately 49.18 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_074-L6101___-B'
 TRIP BRANCH FROM BUS 934050 TO BUS 271655 CKT 1          / AD1-031 TAP 138 HENNE; T 138
 END
```

10. (CE - CE) The KEWANEE ;21-KEWANEE ;13 138 kV line (from bus 271845 to bus 271838 ckt 1) loads from 102.61% to 108.79% (**DC power flow**) of its normal rating (351 MVA) for non-contingency condition. This project contributes approximately 22.02 MW to the thermal violation.

11. (CE - CE) The LASCO STA; B-MAZON ; B 138 kV line (from bus 271908 to bus 271986 ckt 1) loads from 124.1% to 125.49% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P1-3_TR81_LASCO_B-S'. This project contributes approximately 6.29 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR81_LASCO_B-S'
 TRIP BRANCH FROM BUS 270802 TO BUS 270803 CKT 1          / LASCO STA; B 345 LASCO STA; R 345
 TRIP BRANCH FROM BUS 270802 TO BUS 271908 CKT 1          / LASCO STA; B 345 LASCO STA; B 138
 END
```

12. (CE - CE) The NELSON ;RT-DIXON ;8R 138 kV line (from bus 272097 to bus 271331 ckt 1) loads from 103.31% to 104.42% (**DC power flow**) of its emergency rating (440 MVA) for the single line contingency outage of 'COMED_P1-3_TR82_NELSO_B-R'. This project contributes approximately 11.06 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-3_TR82_NELSO_B-R'
 TRIP BRANCH FROM BUS 275203 TO BUS 270828 CKT 1          / NELSO;2M 138 NELSO; B 345
 TRIP BRANCH FROM BUS 275203 TO BUS 275203 CKT 1          / NELSO;2M 138 NELSO; R 138
 TRIP BRANCH FROM BUS 275203 TO BUS 275303 CKT 1          / NELSO;2M 138 NELSO;2C 34.5
 END
```

13. (CE - CE) The NELSON ;RT-DIXON ;8R 138 kV line (from bus 272097 to bus 271331 ckt 1) loads from 103.49% to 104.19% (**DC power flow**) of its normal rating (343 MVA) for non-contingency condition. This project contributes approximately 5.36 MW to the thermal violation.

14. (CE - CE) The OGLESBY ; T-MAZON ; R 138 kV line (from bus 272189 to bus 271987 ckt 1) loads from 102.85% to 106.92% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P1-2_138-L0112__B-S'. This project contributes approximately 9.08 MW to the thermal violation.

```
CONTINGENCY 'COMED_P1-2_138-L0112__B-S'
 TRIP BRANCH FROM BUS 271844 TO BUS 271908 CKT 1              / KICKA; B 138 LASCO; B 138
 END
```

15. (CE - CE) The ROCK FALL; R-NELSON ; R 138 kV line (from bus 272367 to bus 272095 ckt 1) loads from 186.64% to 188.99% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'COMED_P2-1_187-L15508__'. This project contributes approximately 11.81 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_187-L15508__'
 TRIP BRANCH FROM BUS 293710 TO BUS 272097 CKT 1              / O29 ; 138 NELSO;RT 138
 END
```

16. (CE - CE) The ROCK FALL; R-NELSON ; R 138 kV line (from bus 272367 to bus 272095 ckt 1) loads from 113.91% to 115.58% (**DC power flow**) of its normal rating (173 MVA) for non-contingency condition. This project contributes approximately 6.68 MW to the thermal violation.

17. (CE - CE) The O09 OP1 138-ROCK FALL; R 138 kV line (from bus 293510 to bus 272367 ckt 1) loads from 222.46% to 225.01% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of 'COMED_P2-1_187-L15508__'. This project contributes approximately 12.34 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_187-L15508__'
 TRIP BRANCH FROM BUS 293710 TO BUS 272097 CKT 1              / O29 ; 138 NELSO;RT 138
 END
```

18. (CE - CE) The O09 OP1 138-ROCK FALL; R 138 kV line (from bus 293510 to bus 272367 ckt 1) loads from 145.69% to 147.46% (**DC power flow**) of its normal rating (173 MVA) for non-contingency condition. This project contributes approximately 7.1 MW to the thermal violation.

19. (CE - CE) The O29-NELSON ;RT 138 kV line (from bus 293710 to bus 272097 ckt 1) loads from 185.0% to 187.08% (**DC power flow**) of its emergency rating (264 MVA) for the single line contingency outage of 'COMED_P2-1_133-CB_23___'. This project contributes approximately 12.36 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-1_133-CB_23___'
 TRIP BRANCH FROM BUS 272367 TO BUS 293510 CKT 1              / R FAL; R 138 O9 138
 END
```

20. (CE - CE) The O29-NELSON ;RT 138 kV line (from bus 293710 to bus 272097 ckt 1) loads from 143.39% to 144.87% (**DC power flow**) of its normal rating (208 MVA) for non-contingency condition. This project contributes approximately 7.16 MW to the thermal violation.

21. (MISO AMIL - CE) The 4KEEMIN-NORMANDY ; R 138 kV line (from bus 348962 to bus 272111 ckt 1) loads from 96.4% to 103.16% (**DC power flow**) of its emergency rating (214 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 14.64 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
 OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
```

```
END
```

22. (CE - CE) The AD1-031 TAP-HENNEEPIN; T 138 kV line (from bus 934050 to bus 271655 ckt 1) loads from 137.12% to 158.56% (**DC power flow**) of its emergency rating (195 MVA) for the single line contingency outage of '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'. This project contributes approximately 41.72 MW to the thermal violation.

```
CONTINGENCY '271838 KEWANEE ;13 271845 KEWANEE ;21 1 138/138'
  OPEN BRANCH FROM BUS 271838 TO BUS 271845 CKT 1
  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 - MISO AMIL) The KEWANEE ;23-4KEEMIN 138 kV line (from bus 271835 to bus 348962 ckt 1) loads from 115.25% to 122.27% (**DC power flow**) of its emergency rating (214 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 15.18 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
 DISCONNECT BUS 271836                  / KEWAN; 1 138
 DISCONNECT BUS 271837                  / KEWAN; 5 138
 DISCONNECT BUS 271838                  / KEWAN; 4 138
 END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O2*	*5.77*
934052	*AD1-031 E O2*	*9.41*
934421	*AD1-066*	*0.76*
LTF	*AD1-094*	*3.24*
LTF	*BAYOU*	*< 0.01*
274877	*BISHOP HL;1U*	*1.31*
274878	*BISHOP HL;2U*	*1.31*
294401	*BSHIL;1U E*	*26.74*
294410	*BSHIL;2U E*	*26.74*
274848	*CAMPGROVE;RU*	*1.74*
LTF	*CBM-N*	*0.02*
LTF	*CBM-S1*	*0.28*
LTF	*CBM-S2*	*0.24*
LTF	*CBM-W2*	*3.*
LTF	*CIN*	*0.56*
LTF	*COTTONWOOD*	*0.05*
LTF	*CPLE*	*0.06*
274849	*CRESCENT ;1U*	*4.15*
LTF	*FARMERCITY*	*0.22*
LTF	*G-007A*	*0.23*
LTF	*IPL*	*0.34*
990901	*L-005 E*	*35.42*
LTF	*LGEE*	*0.08*
LTF	*MECS*	*0.23*
LTF	*NYISO*	*0.32*
293771	*O-035 E*	*4.52*
LTF	*O-066A*	*0.11*
LTF	*TATANKA*	*0.62*
LTF	*VFT*	*0.63*
LTF	*X1-078*	*0.18*
LTF	*Z1-043*	*24.78*
919621	*AA2-039 C*	*6.52*

919622	*AA2-039 E*	*43.62*
926821	*AC1-168 C*	*0.91*
926822	*AC1-168 E*	*6.11*
926841	*AC1-171 C*	*1.53*
926842	*AC1-171 E*	*10.26*
927201	*AC1-214 C*	*1.45*
927202	*AC1-214 E*	*3.85*

Appendix 2

(CE - CE) The OGLESBY ; T-MAZON ; R 138 kV line (from bus 272189 to bus 271987 ckt 1) loads from 104.15% to 108.21% (**DC power flow**) of its load dump rating (223 MVA) for the bus fault outage of 'COMED_P2-2_001_LA-138B__1'. This project contributes approximately 9.05 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_001_LA-138B__1'
 DISCONNECT BUS 271908                          / LASCO STA; B 138
 END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O2*	*3.44*
934052	*AD1-031 E O2*	*5.61*
934421	*AD1-066*	*1.35*
LTF	*AD1-094*	*5.7*
274832	*ANNAWAN ; 1U*	*7.91*
294401	*BSHIL;1U E*	*7.38*
294410	*BSHIL;2U E*	*7.38*
LTF	*CBM-N*	*< 0.01*
LTF	*CBM-S1*	*0.76*
LTF	*CBM-S2*	*0.36*
LTF	*CBM-W1*	*2.49*
LTF	*CBM-W2*	*8.42*
LTF	*CIN*	*0.45*
LTF	*CPLE*	*0.07*
274849	*CRESCENT ;1U*	*7.42*
LTF	*DEARBORN*	*0.09*
LTF	*G-007A*	*0.06*
274871	*GR RIDGE ;2U*	*1.35*
274847	*GR RIDGE ;BU*	*1.06*
LTF	*IPL*	*0.26*
990901	*L-005 E*	*10.01*
LTF	*LGEE*	*0.05*
LTF	*MEC*	*3.96*
293061	*N-015 E*	*21.6*
LTF	*NYISO*	*0.04*
293771	*O-035 E*	*8.07*
LTF	*O-066A*	*0.03*
294392	*P-010 E*	*27.43*
274851	*PROVIDENC;RU*	*0.4*
LTF	*VFT*	*0.15*
LTF	*X1-078*	*0.04*
LTF	*Z1-043*	*43.61*
916211	*Z1-072*	*0.27*
917451	*Z2-081*	*0.46*

919621	*AA2-039 C*	*1.8*
919622	*AA2-039 E*	*12.05*
925581	*AC1-033 C*	*1.21*
925582	*AC1-033 E*	*8.1*
926821	*AC1-168 C*	*1.73*
926822	*AC1-168 E*	*11.63*
926841	*AC1-171 C*	*0.52*
926842	*AC1-171 E*	*3.46*
927201	*AC1-214 C*	*2.59*
927202	*AC1-214 E*	*6.89*

Appendix 3

(CE - CE) The AD1-031 TAP-HENNEEPIN; T 138 kV line (from bus 934050 to bus 271655 ckt 1) loads from 139.91% to 159.79% (**DC power flow**) of its load dump rating (207 MVA) for the bus fault outage of 'COMED_P2-2_074_KE-138___1'. This project contributes approximately 41.04 MW to the thermal violation.

```
CONTINGENCY 'COMED_P2-2_074_KE-138___1'
 DISCONNECT BUS 271836                  / KEWAN; 1 138
 DISCONNECT BUS 271837                  / KEWAN; 5 138
 DISCONNECT BUS 271838                  / KEWAN; 4 138
 END
```

Bus Number	*Bus Name*	*Full Contribution*
934051	*AD1-031 C O2*	*15.6*
934052	*AD1-031 E O2*	*25.45*
274832	*ANNAWAN ; 1U*	*8.28*
274877	*BISHOP HL;1U*	*1.4*
274878	*BISHOP HL;2U*	*1.4*
LTF	*BLUEG*	*0.01*
294401	*BSHIL;1U E*	*28.55*
294410	*BSHIL;2U E*	*28.55*
274848	*CAMPGROVE;RU*	*1.84*
LTF	*CARR*	*0.01*
LTF	*CBM-S1*	*0.24*
LTF	*CBM-S2*	*0.07*
LTF	*CBM-W1*	*2.95*
LTF	*CBM-W2*	*2.41*
LTF	*CIN*	*0.03*
LTF	*CLIFTY*	*0.16*
LTF	*CPLE*	*0.01*
LTF	*DEARBORN*	*0.07*
LTF	*EDWARDS*	*0.28*
LTF	*G-007*	*0.03*
LTF	*IPL*	*0.01*
990901	*L-005 E*	*37.58*
LTF	*MEC*	*2.39*
293516	*O-009 E1*	*6.9*
293517	*O-009 E2*	*3.5*
293518	*O-009 E3*	*3.86*
293715	*O-029 E*	*7.21*
293716	*O-029 E*	*3.95*
293717	*O-029 E*	*3.63*
LTF	*O-066*	*0.09*
LTF	*RENSSELAER*	*< 0.01*
LTF	*ROSETON*	*0.06*

LTF	*TRIMBLE*	*< 0.01*
LTF	*WEC*	*0.19*
919621	*AA2-039 C*	*6.96*
919622	*AA2-039 E*	*46.57*
926841	*AC1-171 C*	*1.54*
926842	*AC1-171 E*	*10.32*