

Queue Project J515
System Impact Study Report

PJM Summer Peak Powerflow Analysis Input Assumptions:

- Model used – PJM AA2 Queue SIS 2019 Summer Peak case. All Active PJM queue projects modeled through the AA2 Queue along with all previously studied MISO DPP projects (studied through 2015). The MISO 2016 February Central generators being studied were added to the model.
- Contingencies used – All PJM category B (single) and C contingencies (tower, bus fault, fault with stuck breaker)
- Monitored areas – All PJM areas
- Analysis type – PJM Generation Deliverability Test
- MISO ERIS Projects were modeled as PJM Energy-Only projects.
- MISO NRIS Projects were modeled as PJM Capacity projects.
- Generators were scaled to their respective capacity portions for base case (N-0) and all contingencies.
- Generators were scaled to their respective summer energy-only capabilities for category C contingencies only.
- MISO generation sunk to MISO
- PJM generation sunk to PJM

Network Impacts

The Queue Project J515 was evaluated as a 400.0 MW (Capacity 0.0 MW) injection into the Cayuga 345 kV substation in the Duke Indiana area. Project J515 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project J515 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2019

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. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 141.32% to 145.92% (AC power flow) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '6485_C2_05DEQUIN 345-C1'. This project contributes approximately 60.0 MW to the thermal violation.

CONTINGENCY '6485_C2_05DEQUIN 345-C1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2	/ 243217
05DEQUIN 345 243878 05MEADOW 345 2	
OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1	/ 243217
05DEQUIN 345 249525 08WESTWD 345 1	
OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1	/ 249525
08WESTWD 345 249874 08WESTWD 138 1	
END	

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

2. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 141.32% to 145.92% (AC power flow) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '4704_C2_05DEQUIN 345-B1'. This project contributes approximately 60.0 MW to the thermal violation.

CONTINGENCY '4704_C2_05DEQUIN 345-B1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1	/ 243217
05DEQUIN 345 243878 05MEADOW 345 1	
OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1	/ 243217
05DEQUIN 345 249525 08WESTWD 345 1	
OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1	/ 249525
08WESTWD 345 249874 08WESTWD 138 1	
END	

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

3. (AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 136.15% to 139.08% (DC power flow) of its emergency rating (1918 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 56.17 MW to the thermal violation.

CONTINGENCY '8648_C2_05JEFRSO 765-B1'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1	/ 243208 05JEFRSO
765 243209 05ROCKPT 765 1	
OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 1	/ 243208 05JEFRSO
765 242865 05JEFRSO 345 1	
OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1	/ 242865
05JEFRSO 345 248000 06CLIFTY 345 Z1	
END	

Please refer to Appendix 3 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)

None

Short Circuit

(Summary of impacted circuit breakers)

None

Affected System Analysis & Mitigation

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. (AEP - MISO AMIL) The 05BREED-7CASEY 345 kV line (from bus 243213 to bus 346809 ckt 1) loads from 131.84% to 134.85% (DC power flow) of its normal rating (1332 MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 40.15 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1
END

2. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 183.61% to 189.82% (AC power flow) of its normal rating (971 MVA) for the single line contingency outage of '6490_B2_TOR16000'. This project contributes approximately 60.28 MW to the thermal violation.

CONTINGENCY '6490_B2_TOR16000'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217
05DEQUIN 345 243878 05MEADOW 345 2
END

3. (AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 183.61% to 189.82% (AC power flow) of its normal rating (971 MVA) for the single line contingency outage of '6472_B2_TOR15258'. This project contributes approximately 60.28 MW to the thermal violation.

CONTINGENCY '6472_B2_TOR15258'
OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217
05DEQUIN 345 243878 05MEADOW 345 1
END

4. (AEP - AEP) The 05EUGENE-05DEQUIN 345 kV line (from bus 243221 to bus 243217 ckt 1) loads from 124.48% to 131.11% (AC power flow) of its normal rating (971 MVA) for the single line contingency outage of '667_B2_TOR1697'. This project contributes approximately 64.38 MW to the thermal violation.

CONTINGENCY '667_B2_TOR1697'
OPEN BRANCH FROM BUS 243213 TO BUS 243217 CKT 1 / 243213 05BREED
345 243217 05DEQUIN 345 1
END

5. (AEP - AEP) The 05MEADOW-05OLIVE 345 kV line (from bus 243878 to bus 243229 ckt 1) loads from 118.24% to 121.76% (AC power flow) of its normal rating (971 MVA) for the single line contingency outage of '8695_B2'. This project contributes approximately 34.17 MW to the thermal violation.

CONTINGENCY '8695_B2'
OPEN BRANCH FROM BUS 243878 TO BUS 255205 CKT 1 / 243878
05MEADOW 345 255205 17REYNOLDS 345 1
END

6. (AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 179.19% to 183.13% (DC power flow) of its normal rating (1409

MVA) for the single line contingency outage of '363_B2_TOR1682'. This project contributes approximately 55.56 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1
END

7. (CE - CE) The Z2-087 TAP-PONTIAC ; R 345 kV line (from bus 917500 to bus 270853 ckt 1) loads from 102.42% to 103.79% (AC power flow) of its emergency rating (1528 MVA) for the single line contingency outage of 'SPS-2102&2106_A'. This project contributes approximately 20.98 MW to the thermal violation.

CONTINGENCY 'SPS-2102&2106_A'

TRIP BRANCH FROM BUS 270668 TO BUS 905080 CKT 1 / BLUEM; B 345
W4-005 TAP 345
TRIP BRANCH FROM BUS 270796 TO BUS 347962 CKT 1 / KINCA; B 345
7PAWNEE 345
TRIP BRANCH FROM BUS 270804 TO BUS 270796 CKT 1 / LATHA; T 345
KINCA; B 345
TRIP BRANCH FROM BUS 270804 TO BUS 348856 CKT 1 / LATHA; T 345
7LATHAM 345
END

Light Load Analysis - 2019

1. (AEP-AEP) The 05BENTON– T-094 345kV line (from bus 243212 to bus 247502 ckt 1) loads from 116.33% to 117.54% of its emergency rating 1409MVA for the single line contingency outage of '7023_B2_TOR8101690'. This project contributes approximately 16.669 MW to the overload.

CONTINGENCY '7023_B2_TOR8101690'

OPEN BRANCH FROM BUS 243215 TO BUS 247502 CKT 2 / 243215
05COOK 345 247502 T-094 345 2
END

2. (AEP-AEP) The 05BENTON – T-094 345kV line (from bus 243212 to bus 247502 ckt 1) loads from 115.81% to 116.93% of its emergency rating 1409MVA for the single line contingency outage of 'LN 190'. This project contributes approximately 16.6272 MW to the overload.

CONTINGENCY 'LN 190'
 OPEN BRANCH FROM BUS 243215 TO BUS 247502 CKT 2
 OPEN BRANCH FROM BUS 247502 TO BUS 256019 CKT 1
 OPEN BRANCH FROM BUS 247502 TO BUS 256019 CKT 2
 OPEN BRANCH FROM BUS 314642 TO BUS 314643 CKT 1 /* 3NAGS
 HD 115.00 - 3O INLET 115.00
 OPEN BUS 314643 /* ISLAND
 END

3. (AEP – MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 108.23% to 111.38% (AC power flow) of its emergency rating (1409 MVA) for the line fault with single contingency outage of '363_B2_TOR1682'. This project contributes approximately 44.368 MW to the thermal violation.

CONTINGENCY '363_B2_TOR1682'
 OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208
 05JEFRSO 765 243209 05ROCKPT 765 1
 END

4. (AEP – AEP) The 05DEQUIN - 05MEADOW345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 98.74% to 103.68% (AC power flow) of its emergency rating (971 MVA) for the line fault with single contingency outage of '6490_B2_TOR16000'. This project contributes approximately 47.9264 MW to the thermal violation.

CONTINGENCY '6490_B2_TOR16000'
 OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217
 05DEQUIN 345 243878 05MEADOW 345 2
 END

5. (AEP – AEP) The 05DEQUIN - 05MEADOW345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 98.74% to 103.68% (AC power flow) of its emergency rating (971 MVA) for the line fault with single contingency outage of '6472_B2_TOR15258'. This project contributes approximately 47.9264 MW to the thermal violation.

CONTINGENCY '6472_B2_TOR15258'
 OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217
 05DEQUIN 345 243878 05MEADOW 345 1
 END

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)

No violations identified for J515.

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. To relieve the Dequine – Meadowlake #1 345 kV line overload: There is a planned 2020 Baseline upgrade B2668 to reconductor the line. New ratings to be 1409/1959 MVA SN/SE. J515 can wait until B2668 is placed into service or J515 can pay an advancement cost to place B2668 into service earlier, if feasible per AEP. If J515 intends to come into service prior to the baseline upgrade, an interim study will need to be requested and completed.
2. To relieve the Dequine – Meadowlake #2 345 kV line overload: There are planned baseline upgrades to reconductor this line. 2020 baseline upgrade B2668 and 2021 baseline upgrade B2776 (reconductor line, replace Dequine riser and wavetrapp, adjust Meadowlake relay trip limit) to achieve ratings of 1825/2062 MVA SN/SE. J515 can

wait until B2668 and B2776 are placed into service or J515 can pay an advancement cost to place these baseline upgrades into service earlier, if feasible per AEP. If J515 intends to come into service prior to the baseline upgrades, an interim study will need to be requested and completed.

3. To relieve the Meadowlake - Reynolds 345 kV line overload: There is a planned 2017 baseline upgrade B2449 to rebuild the line. The new AEP-end ratings to be 2114/2938 MVA SN/SE. There is planned MISO/NIPSCO work at Reynolds associated with the Reynolds MVP project which is expected to be complete by summer 2018. The MISO-end ratings to be 3585/3585 MVA SN/SE. The AEP and NIPSCO planned work are expected to be complete by summer 2019, which is the Planning case used to evaluate J515. J515 has no cost responsibility here.

Light Load 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. To relieve the Benton – T-094 345 kV line overload:
Reinforcement: Reconductor or rebuild depending on the existing structures the portions of 345 kV lines between the Benton Harbor and Segreto 345 kV substations. PJM Network Upgrade N5106.
Estimated Cost: \$19,000,000
Time: 24 to 36 months

			19
Queue	MW contribution	% of Cost	Cost (\$19 M)
J041	3.9334	19.09	3.627
J515	16.669	80.91	15.373

2. To relieve the Meadowlake - Reynolds 345 kV line overload:
Please refer to the Summer Peak Load Flow Analysis Reinforcements section.
3. To relieve the Dequine – Meadowlake 345 kV line overload:
Please refer to the Summer Peak Load Flow Analysis Reinforcements section.

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To be provided by Transmission Owner as applicable:

Direct Connection Network Upgrades

(New facilities that once placed into service will have parallel flows (e.g. three-breaker ring bus))

TO Attachment Facilities

(New facilities to connect the generation or customer owned merchant transmission facilities to the system that will be owned by the TO once placed into service, will serve only the Interconnection Customer, and will not have parallel flows (e.g. disconnect switch, backbone structure))

Required Relaying and Communications

(List of impacted substations and estimates for relaying setting changes, replacements)

Metering

(Revenue metering if to be owned and maintained by the TO - If TO does not wish to own metering please state this for customers information)

Facilities Study Estimate

(If a Facilities Study is required, provide the estimated duration and cost estimate to perform Facilities Study)

Additional Interconnection Customer Responsibilities:

1. 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.
2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.
3. 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.

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 gauge 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

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 1) loads from 141.32% to 145.92% (AC power flow) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '6485_C2_05DEQUIN 345-C1'. This project contributes approximately 60.0 MW to the thermal violation.

CONTINGENCY '6485_C2_05DEQUIN 345-C1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 2 / 243217
05DEQUIN 345 243878 05MEADOW 345 2
OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217
05DEQUIN 345 249525 08WESTWD 345 1
OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1 / 249525
08WESTWD 345 249874 08WESTWD 138 1
END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	1.21
247900	05FR-11G E	42.02
243862	05FR-12G C	1.19
247901	05FR-12G E	41.32
243864	05FR-21G C	1.27
247902	05FR-21G E	44.16
243866	05FR-22G C	1.21
247903	05FR-22G E	42.29
243870	05FR-3G C	2.46
247904	05FR-3G E	85.65
243873	05FR-4G C	1.9
247905	05FR-4G E	64.4
927331	J196 C	0.99
927332	J196 E	3.94
997641	J401	1.
997772	J453 E	1.08
900404	X3-028 C	182.96
900405	X3-028 E	243.94
998111	AB1-002 C	2.64
998112	AB1-002 E	14.96
998120	AB1-003	60.

Appendix 2

(AEP - AEP) The 05DEQUIN-05MEADOW 345 kV line (from bus 243217 to bus 243878 ckt 2) loads from 141.32% to 145.92% (AC power flow) of its emergency rating (1304 MVA) for the line fault with failed breaker contingency outage of '4704_C2_05DEQUIN 345-B1'. This project contributes approximately 60.0 MW to the thermal violation.

CONTINGENCY '4704_C2_05DEQUIN 345-B1'

OPEN BRANCH FROM BUS 243217 TO BUS 243878 CKT 1 / 243217
05DEQUIN 345 243878 05MEADOW 345 1

OPEN BRANCH FROM BUS 243217 TO BUS 249525 CKT 1 / 243217
05DEQUIN 345 249525 08WESTWD 345 1

OPEN BRANCH FROM BUS 249525 TO BUS 249874 CKT 1 / 249525
08WESTWD 345 249874 08WESTWD 138 1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	1.21
247900	05FR-11G E	42.02
243862	05FR-12G C	1.19
247901	05FR-12G E	41.32
243864	05FR-21G C	1.27
247902	05FR-21G E	44.16
243866	05FR-22G C	1.21
247903	05FR-22G E	42.29
243870	05FR-3G C	2.46
247904	05FR-3G E	85.65
243873	05FR-4G C	1.9
247905	05FR-4G E	64.4
927331	J196 C	0.99
927332	J196 E	3.94
997641	J401	1.
997772	J453 E	1.08
900404	X3-028 C	182.96
900405	X3-028 E	243.94
998111	AB1-002 C	2.64
998112	AB1-002 E	14.96
998120	AB1-003	60.

Appendix 3

(AEP - MISO NIPS) The 05MEADOW-17REYNOLDS 345 kV line (from bus 243878 to bus 255205 ckt 1) loads from 136.15% to 139.08% (**DC power flow**) of its emergency rating (1918 MVA) for the line fault with failed breaker contingency outage of '8648_C2_05JEFRSO 765-B1'. This project contributes approximately 56.17 MW to the thermal violation.

CONTINGENCY '8648_C2_05JEFRSO 765-B1'

OPEN BRANCH FROM BUS 243208 TO BUS 243209 CKT 1 / 243208 05JEFRSO
765 243209 05ROCKPT 765 1

OPEN BRANCH FROM BUS 243208 TO BUS 242865 CKT 1 / 243208 05JEFRSO
765 242865 05JEFRSO 345 1

OPEN BRANCH FROM BUS 242865 TO BUS 248000 CKT Z1 / 242865
05JEFRSO 345 248000 06CLIFTY 345 Z1

END

<i>Bus Number</i>	<i>Bus Name</i>	<i>Full Contribution</i>
243859	05FR-11G C	1.11
247900	05FR-11G E	38.45
243862	05FR-12G C	1.09
247901	05FR-12G E	37.81
243864	05FR-21G C	1.16
247902	05FR-21G E	40.41
243866	05FR-22G C	1.11
247903	05FR-22G E	38.69
243870	05FR-3G C	2.25
247904	05FR-3G E	78.37
243873	05FR-4G C	1.74
247905	05FR-4G E	58.92
246909	05MDL-1G C	2.71
247906	05MDL-1G E	94.32
246910	05MDL-2G C	1.36
247907	05MDL-2G E	46.77
246976	05MDL-3G C	1.36
247912	05MDL-3G E	48.9
246979	05MDL-4G C	2.71
247913	05MDL-4G E	46.66
243442	05RKG1	25.19
243443	05RKG2	24.81
927331	J196 C	0.94
927332	J196 E	3.74
997772	J453 E	1.04
900404	X3-028 C	249.29
900405	X3-028 E	332.38

<i>915151</i>	<i>Y3-038</i>	<i>5.98</i>
<i>LTF</i>	<i>Z1-007</i>	<i>5.1</i>
<i>LTF</i>	<i>Z1-029</i>	<i>3.13</i>
<i>LTF</i>	<i>AA1-001</i>	<i>5.15</i>
<i>998111</i>	<i>AB1-002 C</i>	<i>2.76</i>
<i>998112</i>	<i>AB1-002 E</i>	<i>15.65</i>
<i>998120</i>	<i>AB1-003</i>	<i>56.17</i>