#Z1-021 – Richland II 138kV
Generation Interconnection

General

The Interconnection Customer is proposing a 36MW Capacity uprate to the existing Richland natural gas facility generating units 4, 5, and 6 currently interconnected to the ATSI transmission system and located in Defiance County, OH. This will bring the total output at these generating units to 390MW Capacity. ATSI is a FirstEnergy (FE) company. The proposed in-service date for this project is April 30, 2014.

This Generation Interconnection Feasibility Study provides analysis results to aid the Interconnection Customer in assessing the practicality and cost of incorporating the facility into the PJM system.

Revenue Metering and SCADA Requirements

For PJM: The Interconnection Customer will install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for Interconnection Customer's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 24.1 to 24.2.

For ATSI: The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:
www.firstenergycorp.com/feconnect
www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Network Impacts

The Z1-021 project was studied as a 36.0 MW (36.0MW Capacity) injection into the ATSI area at Richland 138 kV substation. Project Z1-021 was evaluated for compliance with reliability criteria for summer peak conditions in 2017.

Potential network impacts were as follows:

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

Item 1a. (FE - FE) The 02RDGVL+-02NAPMUN 138 kV line (from bus 239061 to bus 238979 ckt 1) loads from 97.77% to 101.94% (**DC power flow**) of its emergency rating (194 MVA) for the single line contingency outage of 'B_LINE2_WR_001'. This project contributes approximately 8.1 MW to the thermal violation.

CONTINGENCY 'B_LINE2_WR_001' /* SEG 02RICHLN TO 02NAOMI 138 CK 1

DISCONNECT BRANCH FROM BUS 239070 TO BUS 238521 CKT 1 /* 02RICHLD 138.00 02NAOMI 138.00
END

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

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

No violations were found.

Short Circuit

(Summary of impacted circuit breakers)

Not required.

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)

Item 2a. (AEP - AEP) The 05GRBLOP-05ROB PK 138 kV line (from bus 243014 to bus 243366 ckt 1) loads from 102.41% to 108.29% (**DC power flow**) of its emergency rating (223 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 13.09 MW to the thermal violation.

CONTINGENCY 'C5-TWL-WR013' /* RICHL-RIDGV JCT NO.1 & NO.2 138
DISCONNECT BUS 238521 /* 02NAOMI 138.00
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

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

Item 2b. (FE - FE) The 02NAOMI-02MIDW K 138 kV line (from bus 238521 to bus 238960 ckt 1) loads from 104.16% to 108.46% (**DC power flow**) of its emergency rating (191 MVA) for the single line contingency outage of 'B_LINE2_WR_003'. This project contributes approximately 8.2 MW to the thermal violation.

CONTINGENCY 'B_LINE2_WR_003' /* SEG 02NAOMI TO 02WAUSEO 138 CK 1

DISCONNECT BRANCH FROM BUS 238521 TO BUS 239165 CKT 1 /* 02NAOMI 138.00 02WAUSEO 138.00
END

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

Item 2c. (AEP - AEP) The 05E.LPSC 138/69 kV transformer (from bus 242993 to bus 245792 ckt 1) loads from 106.3% to 109.03% (**DC power flow**) of its emergency rating (69 MVA) for the single line contingency outage of 'B_LINE1_WR_029'. This project contributes approximately 1.88 MW to the thermal violation.

CONTINGENCY 'B_LINE1_WR_029' /* LINE STRYKE-NAPMUN-RICHLN 138 CK 1
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

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

Item 2d. (AEP - AEP) The 05E.LPSC 138/69 kV transformer (from bus 242993 to bus 245792 ckt 1) loads from 106.3% to 109.03% (**DC power flow**) of its emergency rating (69 MVA) for the single line contingency outage of 'B_LINE2_WR_037'. This project contributes approximately 1.88 MW to the thermal violation.

CONTINGENCY 'B_LINE2_WR_037' /* SEG 02RICHLJ TO 02RDGVL 138 CK 1
DISCONNECT BRANCH FROM BUS 239269 TO BUS 239060 CKT 1 /* 02RICHLJ 138.00 02RDGVL 138.00
END

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

Item 2e. (FE - FE) The 02RDGVL+-02NAPMUN 138 kV line (from bus 239061 to bus 238979 ckt 1) loads from 103.27% to 108.42% (**DC power flow**) of its emergency rating (194 MVA) for the tower line contingency outage of '7099'. This project contributes approximately 10.0 MW to the thermal violation.

CONTINGENCY '7099'
OPEN BRANCH FROM BUS 239070 TO BUS 243029 CKT 1 / 239070 02RICHLD 138 243029 05LCKWRD 138 1
OPEN BRANCH FROM BUS 239269 TO BUS 242993 CKT 1 / 239269 02RICHLJ 138 242993 05E.LPSC 138 1

OPEN BRANCH FROM BUS 242971 TO BUS 243029 CKT 1 / 242971 05BRYAN 138 243029 05LCKWRD 138 1
OPEN BRANCH FROM BUS 243029 TO BUS 243086 CKT 1 / 243029 05LCKWRD 138 243086 05S HICK 138 1
OPEN BRANCH FROM BUS 242971 TO BUS 245865 CKT 1 / 242971 05BRYAN 138 245865 BRYAN 69.0 1
END

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

Item 2f. (FE - FE) The 02RDGVL+-02NAPMUN 138 kV line (from bus 239061 to bus 238979 ckt 1) loads from 103.27% to 108.42% (**DC power flow**) of its emergency rating (194 MVA) for the tower line contingency outage of '7100'. This project contributes approximately 10.0 MW to the thermal violation.

CONTINGENCY '7100'
OPEN BRANCH FROM BUS 239070 TO BUS 243029 CKT 1 / 239070 02RICHLD 138 243029 05LCKWRD 138 1
OPEN BRANCH FROM BUS 239269 TO BUS 242993 CKT 1 / 239269 02RICHLJ 138 242993 05E.LPSC 138 1
END

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

Item 2g. (FE - FE) The 02RDGVL+-02NAPMUN 138 kV line (from bus 239061 to bus 238979 ckt 1) loads from 104.64% to 109.08% (**DC power flow**) of its emergency rating (194 MVA) for the line fault with failed breaker contingency outage of 'C2-BRK-WR063'. This project contributes approximately 8.62 MW to the thermal violation.

CONTINGENCY 'C2-BRK-WR063' /* WAUSEON 13416 BREAKER
DISCONNECT BUS 239165 /* 02WAUSEO 138.00
DISCONNECT BUS 238521 /* 02NAOMI 138.00
END

Please refer to Appendix 8 for a table containing the generators having contribution to this flowgate.

Item 2h. (AEP - AEP) The 05S HICK-05GRBLOP 138 kV line (from bus 243086 to bus 243014 ckt 1) loads from 106.72% to 112.59% (**DC power flow**) of its emergency rating (223 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 13.09 MW to the thermal violation.

CONTINGENCY 'C5-TWL-WR013' /* RICHL-RIDGV JCT NO.1 & NO.2 138
DISCONNECT BUS 238521 /* 02NAOMI 138.00
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

Please refer to Appendix 9 for a table containing the generators having contribution to this flowgate.

Item 2i. (FE - FE) The 02NAOMI-02WAUSEO 138 kV line (from bus 238521 to bus 239165 ckt 1) loads from 111.51% to 115.37% (**DC power flow**) of its emergency rating (190 MVA) for the single line contingency outage of 'B_LINE2_WR_002'. This project contributes approximately 7.33 MW to the thermal violation.

CONTINGENCY 'B_LINE2_WR_002' /* SEG 02MIDWAY TO 02NAOMI 138 CK 1
DISCONNECT BRANCH FROM BUS 238960 TO BUS 238521 CKT 1 /* 02MIDW K 138.00 02NAOMI 138.00
END

Please refer to Appendix 10 for a table containing the generators having contribution to this flowgate.

Item 2j. (FE - AEP) The 02RICHLD-05LCKWRD 138 kV line (from bus 239070 to bus 243029 ckt 1) loads from 110.47% to 115.8% (**DC power flow**) of its emergency rating (223 MVA) for the single line contingency outage of 'B_LINE1_WR_001'. This project contributes approximately 11.88 MW to the thermal violation.

CONTINGENCY 'B_LINE1_WR_001' /* 3-TERMINAL MIDWAY-RICHLAND-WAUSEON 138 CK 1
DISCONNECT BRANCH FROM BUS 238960 TO BUS 238521 CKT 1 /* 02MIDW K 138.00 02NAOMI 138.00
DISCONNECT BRANCH FROM BUS 239070 TO BUS 238521 CKT 1 /* 02RICHLD 138.00 02NAOMI 138.00
DISCONNECT BRANCH FROM BUS 238521 TO BUS 239165 CKT 1 /* 02NAOMI 138.00 02WAUSEO 138.00
END

Please refer to Appendix 11 for a table containing the generators having contribution to this flowgate.

Item 2k. (FE - AEP) The 02RICHLJ-05E.LPSC 138 kV line (from bus 239269 to bus 242993 ckt 1) loads from 112.37% to 117.52% (**DC power flow**) of its emergency rating (266 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 13.71 MW to the thermal violation.

CONTINGENCY 'C5-TWL-WR013' /* RICHL-RIDGV JCT NO.1 & NO.2 138
DISCONNECT BUS 238521 /* 02NAOMI 138.00
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

Please refer to Appendix 12 for a table containing the generators having contribution to this flowgate.

Item 2l. (AEP - AEP) The 05CAMPSS-05E LIMA 138 kV line (from bus 243083 to bus 242989 ckt 1) loads from 114.32% to 119.12% (**DC power flow**) of its emergency rating (223 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 10.71 MW to the thermal violation.

CONTINGENCY 'C5-TWL-WR013' /* RICHL-RIDGV JCT NO.1 & NO.2 138
DISCONNECT BUS 238521 /* 02NAOMI 138.00
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

Please refer to Appendix 13 for a table containing the generators having contribution to this flowgate.

Item 2m. (AEP - AEP) The 05RILEYC-05CAMPSS 138 kV line (from bus 243080 to bus 243083 ckt 1) loads from 116.52% to 121.32% (**DC power flow**) of its emergency rating (223 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 10.71 MW to the thermal violation.

CONTINGENCY 'C5-TWL-WR013' /* RICHL-RIDGV JCT NO.1 & NO.2 138
DISCONNECT BUS 238521 /* 02NAOMI 138.00
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

Please refer to Appendix 14 for a table containing the generators having contribution to this flowgate.

Item 2n. (AEP - AEP) The 05YELLWC-05RILEYC 138 kV line (from bus 247000 to bus 243080 ckt 1) loads from 119.84% to 124.64% (**DC power flow**) of its emergency rating (223 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 10.71 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-WR013'                          /* RICHL-RIDGV JCT NO.1 &
NO.2 138
  DISCONNECT BUS 238521                             /* 02NAOMI 138.00
  DISCONNECT BUS 239061                             /* 02RDGVL+ 138.00
  DISCONNECT BUS 239060                             /* 02RDGVL 138.00
  END
```

Please refer to Appendix 15 for a table containing the generators having contribution to this flowgate.

Item 2o. (FE - FE) The 02RDGVL+-02STRYKE 138 kV line (from bus 239061 to bus 239127 ckt 1) loads from 130.64% to 135.19% (**DC power flow**) of its emergency rating (194 MVA) for the tower line contingency outage of 'C5-TWL-WR012'. This project contributes approximately 8.83 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-WR012'                          /* MIDWAY-
NAPMUNI/MIDWAY-RICHL-WAUS 138
  DISCONNECT BUS 238521                             /* 02NAOMI 138.00
  DISCONNECT BRANCH FROM BUS 238962 TO BUS 238979 CKT 1          /*
02MIDWAY 138.00 02NAPMUN 138.00
  END
```

Please refer to Appendix 16 for a table containing the generators having contribution to this flowgate.

Item 2p. (AEP - AEP) The 05S HICK 138/69 kV transformer (from bus 243086 to bus 243179 ckt 1) loads from 130.71% to 135.46% (**DC power flow**) of its emergency rating (107 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 5.09 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-WR013'                          /* RICHL-RIDGV JCT NO.1 &
NO.2 138
  DISCONNECT BUS 238521                             /* 02NAOMI 138.00
  DISCONNECT BUS 239061                             /* 02RDGVL+ 138.00
  DISCONNECT BUS 239060                             /* 02RDGVL 138.00
  END
```

Please refer to Appendix 17 for a table containing the generators having contribution to this flowgate.

Item 2q. (FE - FE) The 02NAOMI-02WAUSEO 138 kV line (from bus 238521 to bus 239165 ckt 1) loads from 138.25% to 142.54% (**DC power flow**) of its emergency rating (190 MVA) for the bus fault outage of 'C1-BUS-WR002'. This project contributes approximately 8.14 MW to the thermal violation.

```
CONTINGENCY 'C1-BUS-WR002'                          /* RICHLAND 138 L BUS
```

DISCONNECT BRANCH FROM BUS 239070 TO BUS 239071 CKT 1 /* 02RICHLD 138.00 02RICHLN 138.00
END

Please refer to Appendix 18 for a table containing the generators having contribution to this flowgate.

Item 2r. (AEP - AEP) The 05E.LPSC 138/69 kV transformer (from bus 242993 to bus 245792 ckt 1) loads from 140.74% to 142.7% (**DC power flow**) of its emergency rating (69 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 3.0 MW to the thermal violation.

CONTINGENCY 'C5-TWL-WR013' /* RICHL-RIDGV JCT NO.1 & NO.2 138
DISCONNECT BUS 238521 /* 02NAOMI 138.00
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

Please refer to Appendix 19 for a table containing the generators having contribution to this flowgate.

Item 2s. (FE - FE) The 02NAOMI-02MIDW K 138 kV line (from bus 238521 to bus 238960 ckt 1) loads from 137.0% to 142.96% (**DC power flow**) of its emergency rating (191 MVA) for the bus fault outage of 'C1-BUS-WR002'. This project contributes approximately 11.39 MW to the thermal violation.

CONTINGENCY 'C1-BUS-WR002' /* RICHLAND 138 L BUS
DISCONNECT BRANCH FROM BUS 239070 TO BUS 239071 CKT 1 /* 02RICHLD 138.00 02RICHLN 138.00
END

Please refer to Appendix 20 for a table containing the generators having contribution to this flowgate.

Item 2t. (FE - FE) The 02NAOMI-02WAUSEO 138 kV line (from bus 238521 to bus 239165 ckt 1) loads from 140.28% to 144.55% (**DC power flow**) of its emergency rating (190 MVA) for the line fault with failed breaker contingency outage of 'C2-BRK-WR032'. This project contributes approximately 8.12 MW to the thermal violation.

CONTINGENCY 'C2-BRK-WR032' /* RICHLAND 13246 BREAKER
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
REDUCE BUS 239269 SHUNT BY 100 PERCENT /* 02RICHLJ 138.00
DISCONNECT BUS 239065 /* 02RICHG2 13.80
DISCONNECT BUS 239066 /* 02RICHG3 13.80

DISCONNECT BUS 238522 /* 02RCHLN 69.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
DISCONNECT BRANCH FROM BUS 239269 TO BUS 242993 CKT 1 /* 02RICHLJ 138.00 05E.LPSC 138.00
DISCONNECT BRANCH FROM BUS 239269 TO BUS 238511 CKT 1 /* 02RICHLJ 138.00 02GMC-J 138.00
DISCONNECT BUS 238511 /* 02GMC-J 138.00
DISCONNECT BUS 238556 /* 02AYERSV 138.00
END

Please refer to Appendix 21 for a table containing the generators having contribution to this flowgate.

Item 2u. (FE - FE) The 02RDGVL-02RDGVL+ 138 kV line (from bus 239060 to bus 239061 ckt 1) loads from 158.52% to 164.1% (**DC power flow**) of its normal rating (161 MVA) for non-contingency condition. This project contributes approximately 8.98 MW to the thermal violation.

Please refer to Appendix 22 for a table containing the generators having contribution to this flowgate.

Item 2v. (AEP - AEP) The 05LCKWRD-05S HICK 138 kV line (from bus 243029 to bus 243086 ckt 1) loads from 171.95% to 180.11% (**DC power flow**) of its emergency rating (223 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 18.18 MW to the thermal violation.

CONTINGENCY 'C5-TWL-WR013' /* RICHL-RIDGV JCT NO.1 & NO.2 138
DISCONNECT BUS 238521 /* 02NAOMI 138.00
DISCONNECT BUS 239061 /* 02RDGVL+ 138.00
DISCONNECT BUS 239060 /* 02RDGVL 138.00
END

Please refer to Appendix 23 for a table containing the generators having contribution to this flowgate.

Item 2w. (FE - FE) The 02RICHLJ-02RDGVL 138 kV line (from bus 239269 to bus 239060 ckt 1) loads from 173.03% to 178.94% (**DC power flow**) of its normal rating (152 MVA) for non-contingency condition. This project contributes approximately 8.98 MW to the thermal violation.

Please refer to Appendix 24 for a table containing the generators having contribution to this flowgate.

Item 2x. (FE - FE) The 02RICHLD-02RICHLN 138 kV line (from bus 239070 to bus 239071 ckt 1) loads from 195.02% to 202.3% (**DC power flow**) of its normal rating (236

MVA) for non-contingency condition. This project contributes approximately 17.19 MW to the thermal violation.

Please refer to Appendix 25 for a table containing the generators having contribution to this flowgate.

Item 2y. (FE - FE) The 02RICHLN-02RICHLJ 138 kV line (from bus 239071 to bus 239269 ckt 1) loads from 195.02% to 202.3% (**DC power flow**) of its normal rating (236 MVA) for non-contingency condition. This project contributes approximately 17.19 MW to the thermal violation.

Please refer to Appendix 26 for a table containing the generators having contribution to this flowgate.

Item 2z. (FE - FE) The 02RDGVL-02RDGVL+ 138 kV line (from bus 239060 to bus 239061 ckt 1) loads from 190.91% to 197.71% (**DC power flow**) of its emergency rating (194 MVA) for the single line contingency outage of 'B_LINE1_WR_001'. This project contributes approximately 13.19 MW to the thermal violation.

```
CONTINGENCY 'B_LINE1_WR_001'                    /* 3-TERMINAL MIDWAY-
RICHLAND-WAUSEON 138 CK 1
  DISCONNECT BRANCH FROM BUS 238960 TO BUS 238521 CKT 1        /* 02MIDW K
138.00 02NAOMI 138.00
  DISCONNECT BRANCH FROM BUS 239070 TO BUS 238521 CKT 1        /* 02RICHLD
138.00 02NAOMI 138.00
  DISCONNECT BRANCH FROM BUS 238521 TO BUS 239165 CKT 1        /* 02NAOMI
138.00 02WAUSEO 138.00
  END
```

Please refer to Appendix 27 for a table containing the generators having contribution to this flowgate.

Item 2aa. (FE - AEP) The 02RICHLD-05LCKWRD 138 kV line (from bus 239070 to bus 243029 ckt 1) loads from 198.68% to 206.84% (**DC power flow**) of its emergency rating (223 MVA) for the tower line contingency outage of 'C5-TWL-WR013'. This project contributes approximately 18.18 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-WR013'                      /* RICHL-RIDGV JCT NO.1 &
NO.2 138
  DISCONNECT BUS 238521                         /* 02NAOMI 138.00
  DISCONNECT BUS 239061                         /* 02RDGVL+ 138.00
  DISCONNECT BUS 239060                         /* 02RDGVL 138.00
  END
```

Please refer to Appendix 28 for a table containing the generators having contribution to this flowgate.

Item 2bb. (FE - FE) The 02RICHLD-02NAOMI 138 kV line (from bus 239070 to bus 238521 ckt 1) loads from 196.81% to 203.86% (**DC power flow**) of its emergency rating (191 MVA) for the single line contingency outage of 'B_LINE2_WR_037'. This project contributes approximately 13.47 MW to the thermal violation.

```
CONTINGENCY 'B_LINE2_WR_037'                    /* SEG 02RICHLJ TO
02RDGVL 138 CK 1
  DISCONNECT BRANCH FROM BUS 239269 TO BUS 239060 CKT 1          /* 02RICHLJ
138.00 02RDGVL 138.00
  END
```

Please refer to Appendix 29 for a table containing the generators having contribution to this flowgate.

Item 2cc. (FE - FE) The 02RICHLJ-02RDGVL 138 kV line (from bus 239269 to bus 239060 ckt 1) loads from 211.27% to 218.64% (**DC power flow**) of its emergency rating (179 MVA) for the single line contingency outage of 'B_LINE1_WR_001'. This project contributes approximately 13.19 MW to the thermal violation.

```
CONTINGENCY 'B_LINE1_WR_001'                    /* 3-TERMINAL MIDWAY-
RICHLAND-WAUSEON 138 CK 1
  DISCONNECT BRANCH FROM BUS 238960 TO BUS 238521 CKT 1          /* 02MIDW K
138.00 02NAOMI 138.00
  DISCONNECT BRANCH FROM BUS 239070 TO BUS 238521 CKT 1          /* 02RICHLD
138.00 02NAOMI 138.00
  DISCONNECT BRANCH FROM BUS 238521 TO BUS 239165 CKT 1          /* 02NAOMI
138.00 02WAUSEO 138.00
  END
```

Please refer to Appendix 30 for a table containing the generators having contribution to this flowgate.

Item 2dd. (FE - FE) The 02RICHLD-02RICHLN 138 kV line (from bus 239070 to bus 239071 ckt 1) loads from 229.6% to 238.04% (**DC power flow**) of its emergency rating (285 MVA) for the single line contingency outage of 'B_LINE2_WR_001'. This project contributes approximately 24.05 MW to the thermal violation.

```
CONTINGENCY 'B_LINE2_WR_001'                    /* SEG 02RICHLN TO
02NAOMI 138 CK 1
  DISCONNECT BRANCH FROM BUS 239070 TO BUS 238521 CKT 1          /* 02RICHLD
138.00 02NAOMI 138.00
  END
```

Please refer to Appendix 31 for a table containing the generators having contribution to this flowgate.

Item 2ee. (FE - FE) The 02RICHLN-02RICHLJ 138 kV line (from bus 239071 to bus 239269 ckt 1) loads from 229.6% to 238.04% (**DC power flow**) of its emergency rating (285 MVA) for the single line contingency outage of 'B_LINE2_WR_001'. This project contributes approximately 24.05 MW to the thermal violation.

```
CONTINGENCY 'B_LINE2_WR_001'                    /* SEG 02RICHLN TO
02NAOMI 138 CK 1
  DISCONNECT BRANCH FROM BUS 239070 TO BUS 238521 CKT 1        /* 02RICHLD
138.00 02NAOMI 138.00
  END
```

Please refer to Appendix 32 for a table containing the generators having contribution to this flowgate.

Item 2ff. 3(FE - FE) The 02RICHLD-02NAOMI 138 kV line (from bus 239070 to bus 238521 ckt 1) loads from 278.62% to 288.84% (**DC power flow**) of its emergency rating (191 MVA) for the bus fault outage of 'C1-BUS-WR002'. This project contributes approximately 19.53 MW to the thermal violation.

```
CONTINGENCY 'C1-BUS-WR002'                      /* RICHLAND 138 L BUS
  DISCONNECT BRANCH FROM BUS 239070 TO BUS 239071 CKT 1        /* 02RICHLD
138.00 02RICHLN 138.00
  END
```

Please refer to Appendix 33 for a table containing the generators having contribution to this flowgate.

Item 2gg. (FE - FE) The 02RICHLD-02NAOMI 138 kV line (from bus 239070 to bus 238521 ckt 1) loads from 275.57% to 285.76% (**DC power flow**) of its emergency rating (191 MVA) for the line fault with failed breaker contingency outage of 'C2-BRK-WR032'. This project contributes approximately 19.47 MW to the thermal violation.

```
CONTINGENCY 'C2-BRK-WR032'                      /* RICHLAND 13246
BREAKER
  DISCONNECT BUS 239061                         /* 02RDGVL+ 138.00
  REDUCE BUS 239269 SHUNT BY 100 PERCENT                /* 02RICHLJ 138.00
  DISCONNECT BUS 239065                         /* 02RICHG2 13.80
  DISCONNECT BUS 239066                         /* 02RICHG3 13.80
  DISCONNECT BUS 238522                         /* 02RCHLN 69.00
  DISCONNECT BUS 239060                         /* 02RDGVL 138.00
  DISCONNECT BRANCH FROM BUS 239269 TO BUS 242993 CKT 1        /* 02RICHLJ
138.00 05E.LPSC 138.00
  DISCONNECT BRANCH FROM BUS 239269 TO BUS 238511 CKT 1        /* 02RICHLJ
138.00 02GMC-J 138.00
  DISCONNECT BUS 238511                         /* 02GMC-J 138.00
```

DISCONNECT BUS 238556 /* 02AYERSV 138.00
END

Please refer to Appendix 34 for a table containing the generators having contribution to this flowgate.

New System Reinforcements

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

For Item 1a, the overload of the 02RDGVL+-02NAPMUN 138 kV line can be relieved by the following reinforcements:
Create a new 138 kV switching station in the Stryker area. The switching station is a 6-exit breaker-and-a-half configuration with 138kV line exits to Napoleon Muni, Wauseon, Midway, Richland, Ridgeville and Stryker. This also requires bus section breakers to be added at the Stryker, Wauseon, Midway, Richland and Ridgeville. A new 138kV line exit is needed at Napoleon Muni. The total estimated cost is **$71,967,200**, with an extra **$17,155,600** in taxes if applicable, and will take approximately **47 months** to complete this work.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contributions to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study.)

For Item 2a, the overload of the 05GRBLOP-05ROB PK 138 kV line can be relieved by the following reinforcements:

A sag check will be required for the ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 2 to determine if the line section can be operated above its emergency rating of 223 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 7.85 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$31,400** (2013 Dollars). If deemed necessary to rebuild the section of line, the estimated cost is approximately **$11,775,000** (2013 Dollars).

For Item 2b, the overload of the 02NAOMI-02MIDW K 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2c, the overload of the 05E.LPSC 138/69 kV transformer can be relieved by replacing the East Leipsic 138/69 kV transformer. The total estimated cost is **$3,000,000** (2013 Dollars).

For Item 2d, the overload of the 05E.LPSC 138/69 kV transformer can be relieved by the reinforcements from Item 2c.

For Item 2e, the overload of the 02RDGVL+-02NAPMUN 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2f, the overload of the 02RDGVL+-02NAPMUN 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2g, the overload of the 02RDGVL+-02NAPMUN 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2h, the overload of the 05S HICK-05GRBLOP 138 kV line:

A sag check will be required for the ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 1 to determine if the line section can be operated above its emergency rating of 223 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 13.5 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$54,000** (2013 Dollars). If deemed necessary to rebuild section of line, the estimated cost is approximately **$20,250,000** (2013 Dollars).

For Item 2i, the overload of the 02NAOMI-02WAUSEO 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2j, the overload of the 02RICHLD-05LCKWRD 138 kV line:
A sag check will be required for the ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 2 to determine if the line section can be operated above its emergency rating of 223 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 11.04 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$44,160** (2013 Dollars). If deemed necessary to rebuild section of line, the estimated cost is approximately **$16,560,000** (2013 Dollars).
ATSI:
The ATSI portion of this overload can be relieved by the reinforcements from Item 1a.

For Item 2k, the overload of the 02RICHLJ-05E.LPSC 138 kV line:
AEP:

(1) A sag check will be required for the ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 3 to determine if the line section can be operated above its emergency rating of 223 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 10 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$40,000** (2013 Dollars). If deemed necessary to rebuild section of line, the estimated cost is approximately **$15,000,000** (2013 Dollars).

(2) An engineering study will need to be conducted to determine if the Relay Thermal Limit settings can be adjusted to mitigate the overload. A new relay package will be required if the relay thermal settings cannot be adjusted. The estimated cost to complete this work is approximately **$300,000** (2013 Dollars).

(3) Replace East Leipsic wave traps (2). The estimated cost is approximately **$200,000**.

ATSI:
The ATSI portion of this overload can be relieved by the reinforcements from Item 1a.

For Item 2l, the overload of the 05CAMPSS-05E LIMA 138 kV line can be relieved by the following reinforcements:

(1) A sag check will be required for the ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 1 to determine if the line section can be operated above its emergency rating of 223 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 5.3 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$21,200** (2013 Dollars). If deemed necessary to rebuild section of line, the estimated cost is approximately **$7,950,000** (2013 Dollars).

(2) Replace East Lima Line Riser. The estimated cost is approximately **$50,000**.

(3) Replace East Lima Bus Riser. The estimated cost is approximately **$50,000**.

For Item 2m, the overload of the 05RILEYC-05CAMPSS 138 kV line can be relieved by the following reinforcements:

A sag check will be required for the ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 1 to determine if the line section can be operated above its emergency rating of 223 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 8.7 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$34,800** (2013 Dollars). If deemed necessary to rebuild section of line, the estimated cost is approximately **$13,050,000** (2013 Dollars).

For Item 2n, the overload of the 05YELLWC-05RILEYC 138 kV line can be relieved by the following reinforcements:

(1) A sag check will be required for the ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 2 to determine if the line section can be operated above its emergency rating of 223 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 13.6 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$54,400** (2013 Dollars). If deemed necessary to rebuild section of line, the estimated cost is approximately **$20,400,000** (2013 Dollars).

(2) A sag check will be required for the ACSR ~ 795 ~ 45/7 ~ TERN Conductor Section 3 to determine if the line section can be operated above its emergency rating of 251 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 6.9 mile section of line would need to be rebuilt. The estimated cost to complete the sag study is approximately **$27,600** (2013 Dollars). If deemed necessary to rebuild section of line, the estimated cost is approximately **$10,350,000** (2013 Dollars).

For Item 2o, the overload of the 02RDGVL+-02STRYKE 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2p, the overload of the 05S HICK 138/69 kV transformer can be relieved by replacing the South Hicksville 138/69 kV transformer. The estimated cost is approximately **$3,000,000**.

For Item 2q, the overload of the 02NAOMI-02WAUSEO 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2r, the overload of the 05E.LPSC 138/69 kV transformer can be relieved by the reinforcements from Item 2c.

For Item 2s, the overload of the 02NAOMI-02MIDW K 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2t, the overload of the 02NAOMI-02WAUSEO 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2u, the overload of the 02RDGVL-02RDGVL+ 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2v, the overload of the 05LCKWRD-05S HICK 138 kV line can be relieved by the following reinforcements:

(1) Reconductor (Rebuild) 11.7 mile ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 1. The estimated cost is approximately **$17,550,000** (2013 Dollars).
(2) Replace Lockwood CTs. The estimated cost is approximately **$100,000** (2013 Dollars).
(3) Replace Lockwood Risers. The estimated cost is approximately **$100,000** (2013 Dollars).
(4) Replace S. Hicksville Switch. The estimated cost is approximately **$100,000** (2013 Dollars).
(5) Replace Lockwood Switch. The estimated cost is approximately **$100,000** (2013 Dollars).
(6) Replace Lockwood Riser. The estimated cost is approximately **$50,000** (2013 Dollars).
(7) Replace S. Hicksville Riser. The estimated cost is approximately **$50,000** (2013 Dollars).

For Item 2w, the overload of the 02RICHLJ-02RDGVL 138 kV line can be relieved by the reinforcements from Item 1a.

For Item 2x, the overload of the 02RICHLD-02RICHLN 138 kV line can be relieve by replacing the Richland bus section breaker disconnects with 1200A switches. The total estimated cost is **$141,900**, with an extra **$34,300** in taxes if applicable, and will take approximately **8 months** to complete this work.

For Item 2y, the overload of the 02RICHLN-02RICHLJ 138 kV line can be relieved by the reinforcements from Item 2x.

For Item 2z, the overload of the 02RDGVL-02RDGVL+ 138 kV line can be relieved by the following reinforcements:
Separate the 3-terminal Midway – Richland – Wauseon 138 kV line and the 3-terminal Stryker – Napoleon Muni – Ridgeville – Richland 138 kV line. The new 138 kV lines go from Midway – Wauseon, Napoleon Muni – Ridgeville – Richland and Richland – Stryker. The total estimated

cost is **$378,300**, with an extra **$90,000** in taxes if applicable, and will take approximately **9 months** to complete this work.

For Item 2aa, the overload of the 02RICHLD-05LCKWRD 138 kV line can be relieved by the following reinforcements:

AEP:

(1) Reconductor or rebuild, depending on the structures, 11.04 mile ACSR ~ 636 ~ 26/7 ~ GROSBEAK Conductor Section 2. The estimated cost is approximately **$13,248,000** (2013 Dollars).

(2) An engineering study will need to be conducted to determine if the Relay Thermal Limit settings can be adjusted to mitigate the overload. A new relay package will be required if the relay thermal settings cannot be adjusted. Estimated Cost (2013 Dollars): $300,000.

(3) Replace Lockwood Wavetrap. The estimated cost is approximately **$100,000** (2013 Dollars).

(4) Replace Lockwood Bus. The estimated cost is approximately **$50,000** (2013 Dollars).

(5) Replace Lockwood Line Riser. The estimated cost is approximately **$50,000** (2013 Dollars).

ATSI:

The ATSI portion of this overload can be relieved by the reinforcements from Item 1a.

For Item 2bb, the overload of the 02RICHLD-02NAOMI 138 kV line can be relieved by the reinforcements from Item 2z.

For Item 2cc, the overload of the 02RICHLJ-02RDGVL 138 kV line can be relieved by the reinforcements from Item 2z.

For Item 2dd, the overload of the 02RICHLD-02RICHLN 138 kV line can be relieved by the reinforcements from Item 2x.

For Item 2ee, the overload of the 02RICHLN-02RICHLJ 138 kV line can be relieved by the reinforcements from Item 2x.

For Item 2ff, the overload of the 02RICHLD-02NAOMI 138 kV line can be relieved by the reinforcements from Item 2z.

For Item 2gg, the overload of the 02RICHLD-02NAOMI 138 kV line can be relieved by the reinforcements from Item 2z.

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.

Note: Only the most severely overloaded conditions are listed below. 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 shall study all overload conditions associated with the overloaded element(s) identified.

As a result of the aggregate energy resources in the area, no violations were identified.