

## W2-004 Essex 138kV

### **Generation Interconnection**

#### **Network Impacts**

Queue project W2-004 was studied as a(n) 45MW ( 45MW of which was Capacity) injection into PSE&G's system at two optional points of interconnection. The primary option was a direct connection to the Essex 138kV substation, while the secondary option was a direct connection to the Foundry Street 138kV substation. Project W2-004 was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

#### Option #1 – Essex 138kV

#### **Generator Deliverability**

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

1. The Hudson 1-6 230/138 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 45.14% to 45.63% (DC power flow) of its normal rating (265 MVA) for non-contingency condition. This project contributes approximately 8.13 MW to cause the thermal violation.
2. The Hudson 7-12 230/138 kV transformer (from bus 217137 to bus 217001 ckt 1) loads from 52.12% to 52.64% (DC power flow) of its emergency rating (441 MVA) for the single line contingency ('KARNY-MARN'). This project contributes approximately 14.12 MW to cause the thermal violation.
3. The Marion 1-Homestead “E” 138 kV line (from bus 217058 to bus 216903 ckt 1) loads from 93.24% to 93.5% (DC power flow) of its emergency rating (316 MVA) for the single line contingency ('PS70'). This project contributes approximately 5.04 MW to cause the thermal violation.
4. The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 86.77% to 87.36% (DC power flow) of its normal rating (361 MVA) for non-contingency condition. This project contributes approximately 13.12 MW to cause the thermal violation.
5. The Kearny 4-6-MARION 3 138 kV line (from bus 217061 to bus 217137 ckt 1) loads from 94.89% to 97.6% (DC power flow) of its normal rating (293 MVA) for non-contingency condition. This project contributes approximately 7.93 MW to cause the thermal violation.

#### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)*

No problems identified.

## **Short Circuit**

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

No problems identified.

## **Contribution to Previously Identified Overloads**

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

6. The Essex-Hudson 1-6 230 kV line (from bus 217079 to bus 217000 ckt 1) loads from 117.57% to 117.92% (DC power flow) of its emergency rating (815 MVA) for the single line contingency ('PS20'). This project contributes approximately 17.55 MW to cause the thermal violation.

7. The Newport-Hoboken "R" 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 130.36% to 130.53% (DC power flow) of its emergency rating (521 MVA) for the single line contingency ('PS50'). This project contributes approximately 5.38 MW to cause the thermal violation.

8. The Kearny 4-6-Marion 3 138 kV line (from bus 217061 to bus 217137 ckt 1) loads from 124.39% to 124.9% (DC power flow) of its emergency rating (370 MVA) for the tower line contingency ('27PS'). This project contributes approximately 11.74 MW to cause the thermal violation.

9. The Hudson1-6-South Waterfront "P" 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 133.83% to 134.03% (DC power flow) of its emergency rating (750 MVA) for the single line contingency ('MAR\_BERF'). This project contributes approximately 9.01 MW to cause the thermal violation.

10. The Hudson 1-6-South Waterfront "P" 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 143.32% to 143.52% (DC power flow) of its normal rating (500 MVA) for non-contingency condition. This project contributes approximately 6.38 MW to cause the thermal violation.

11. The South Waterfront-Newport "R" 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 144.98% to 145.15% (DC power flow) of its emergency rating (490 MVA) for the single line contingency ('PS50'). This project contributes approximately 5.38 MW to cause the thermal violation.

12. The Hudson 1-6 230/138 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 123.65% to 124.34% (DC power flow) of its emergency rating (296 MVA) for the tower line contingency ('27PS'). This project contributes approximately 13.16 MW to cause the thermal violation.

13. The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 143.12% to 143.81% (DC power flow) of its emergency rating (456 MVA) for the tower line contingency ('27PS'). This project contributes approximately 20.27 MW to cause the thermal violation.

### **New System Reinforcements**

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

1. The overload on the Hudson 1-6 transformer can be alleviated by replacing the transforme at an estimated cost of \$13.5 million and will require 36 months to complete. (No cost allocation to W2-004)
2. The overload on the Hudson 7-12 transformer can be alleviated by replacing the transforme at an estimated cost of \$13.5 million and will require 36 months to complete. (No cost allocation to W2-004)
3. The overload on the Marion 1-Homestead E-1305-1 138kV circuit can be alleviated by reconductoring that will cost \$5 million and will require 12 months to complete. (The W2-004 project will have cost allocation if the cost of this project remains \$5 million or below)
4. The overload on the Kearny-Marion N-1314 138kV circuit can be alleviated by reconductoring that will cost \$27 million and take 36-48 months to complete. (No cost allocation to W2-004)
5. The overload on the Kearny-Marion U-1321 138kV circuit can be alleviated by reconductoring that will cost \$27 million and take 36-48 months to complete. (No cost allocation to W2-004)

The W2-004 project does not cause the facilities to be overloaded and will only receive a cost allocation to any of the 5 upgrades above if the cost for that upgrade is \$5 million or less. Once the W2-024 report is complete and the cost of the upgrades are known this report will be revised to include the results.

### **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)*

6. The overload on the Essex-Hudson will be alleviated by reconductoring the overhead line at a cost of **\$13 million**. It will require 24 months to complete.
7. The Newport – Hoboken R 230kV circuit overload can be alleviated by installing a 4 breaker ring bus at 49<sup>th</sup> street which taps Hoboken – Bergen. The line from 49<sup>th</sup> street to Bergen will

also need to be reconductored with 1590 ACSS wire. The upgrade will cost approximately **\$21.3**. It will take 24 months to complete.

8. The Kearny 4-6 Marion 3 138kV circuit will be alleviated by reconductoring the overhead line at a cost of **\$4 million**. It will require 12 months to complete.

9 & 10. The Hudson-South Waterfront 230kV line overloads can be alleviated by constructing a new (second) pipe type cable circuit between Hudson and South Waterfront 230 kV stations on existing or a new right-of-way. The new circuit needs to be terminated at Hudson and South Waterfront. The termination at Hudson involves expanding the switchyard. The estimated cost is **\$50M**. It will require 60 months to complete.

Construct a new (second) pipe type cable circuit between Hudson and South Waterfront 230 kV stations on existing or a new right-of-way. The new circuit needs to be terminated at Hudson and South Waterfront. The termination at Hudson involves expanding the switchyard.

11. The overload on the South Waterfront-Newport “R” circuit will be alleviated by replacing the underground circuit at a cost of **\$15 million**. It will require 24 months to complete.

12. The overload on the Hudson 1-6 230/138kV transformer will be alleviated by replacing the transformer with one of higher rating at a cost of **\$9 million**. It will require 24 months to complete.

13. The overload on the Kearny 1-3-Marion 1 138kV circuit will be alleviated by reconductoring ½ mile of the circuit, replacing circuit breakers and disconnect switches at Kearny station, and replacing circuit breakers and disconnect switches at Marion station at a cost of **\$4 million**. It will require 12 months to complete.

## Option #2 – Foundry St 138kV

### **Generator Deliverability**

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

1. The Hudson 1-6 230/138 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 45.14% to 45.65% (DC power flow) of its normal rating (265 MVA) for non-contingency condition. This project contributes approximately 8.4 MW to cause the thermal violation.

2. The Hudson 7-12 230/138 kV transformer (from bus 217137 to bus 217001 ckt 1) loads from 52.12% to 52.69% (DC power flow) of its emergency rating (441 MVA) for the single line contingency ('KRNY-MARN'). This project contributes approximately 15.56 MW to cause the thermal violation.

3. The Marion 1-Homestead E 138 kV line (from bus 217058 to bus 216903 ckt 1) loads from 93.24% to 93.51% (DC power flow) of its emergency rating (316 MVA) for the single line

contingency ('PS70'). This project contributes approximately 5.15 MW to cause the thermal violation.

4. The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 86.77% to 87.37% (DC power flow) of its normal rating (361 MVA) for non-contingency condition. This project contributes approximately 13.39 MW to cause the thermal violation.

### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)*

No problems identified.

### **Short Circuit**

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

No problems identified.

### **Contribution to Previously Identified Overloads**

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

5. The Essex-Hudson 1-6 230 kV line (from bus 217079 to bus 217000 ckt 1) loads from 117.57% to 117.89% (DC power flow) of its emergency rating (815 MVA) for the single line contingency ('PS20'). This project contributes approximately 16.04 MW to cause the thermal violation.

6. The Newport-Hoboken "R" 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 130.36% to 130.53% (DC power flow) of its emergency rating (521 MVA) for the single line contingency ('PS50'). This project contributes approximately 5.53 MW to cause the thermal violation.

7. The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 133.83% to 134.01% (DC power flow) of its emergency rating (750 MVA) for the single line contingency ('MAR\_BERF'). This project contributes approximately 8.28 MW to cause the thermal violation.

8. The Hudson 1-6-South Waterfront 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 143.32% to 143.5% (DC power flow) of its normal rating (500 MVA) for non-contingency condition. This project contributes approximately 5.75 MW to cause the thermal violation.

9. The South Waterfront P-Newport R 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 144.98% to 145.16% (DC power flow) of its emergency rating (490 MVA) for the single

line contingency ('PS50'). This project contributes approximately 5.53 MW to cause the thermal violation.

10. The Hudson 1-6 230/138 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 123.65% to 124.33% (DC power flow) of its emergency rating (296 MVA) for the tower line contingency ('27PS'). This project contributes approximately 13.01 MW to cause the thermal violation.

11. The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 143.12% to 143.8% (DC power flow) of its emergency rating (456 MVA) for the tower line contingency ('27PS'). This project contributes approximately 19.95 MW to cause the thermal violation.

### **System Reinforcements**

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

1. The overload on the Hudson 1-6 transformer can be alleviated by replacing the transformer at an estimated cost of \$13.5 million and will require 36 months to complete. (No cost allocation to W2-004)
2. The overload on the Hudson 7-12 transformer can be alleviated by replacing the transformer at an estimated cost of \$13.5 million and will require 36 months to complete. (No cost allocation to W2-004)
3. The overload on the Marion 1-Homestead E-1305-1 138kV circuit can be alleviated by reconductoring that will cost \$5 million and will require 12 months to complete. (The W2-004 project will have cost allocation if the cost of this project remains \$5 million or below)
4. The overload on the Kearny-Marion N-1314 138kV circuit can be alleviated by reconductoring that will cost \$27 million and take 36-48 months to complete. (No cost allocation to W2-004)

The W2-004 project does not cause the facilities to be overloaded and will only receive a cost allocation to any of the 5 upgrades above if the cost for that upgrade is \$5 million or less. Once the W2-024 report is complete and the cost of the upgrades are known this report will be revised to include the results.

### **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)*

5. The overload on the Essex-Hudson will be alleviated by reconductoring the overhead line at a cost of **\$13 million**. It will require 24 months to complete.

6. The Newport – Hoboken R 230kV circuit overload can be alleviated by installing a 4 breaker ring bus at 49<sup>th</sup> street which taps Hoboken – Bergen. The line from 49<sup>th</sup> street to Bergen will also need to be reconductored with 1590 ACSS wire. The upgrade will cost approximately **\$21.3**. It will take 24 months to complete.

7-8. The Hudson-South Waterfront 230kV line overloads can be alleviated by constructing a new (second) pipe type cable circuit between Hudson and South Waterfront 230 kV stations on existing or a new right-of-way. The new circuit needs to be terminated at Hudson and South Waterfront. The termination at Hudson involves expanding the switchyard. The estimated cost is **\$50M**. It will require 60 months to complete.

Construct a new (second) pipe type cable circuit between Hudson and South Waterfront 230 kV stations on existing or a new right-of-way. The new circuit needs to be terminated at Hudson and South Waterfront. The termination at Hudson involves expanding the switchyard.

9. The overload on the South Waterfront-Newport “R” circuit will be alleviated by replacing the underground circuit at a cost of **\$15 million**. It will require 24 months to complete.

10. The overload on the Hudson 1-6 230/138kV transformer will be alleviated by replacing the transformer with one of higher rating at a cost of **\$9 million**. It will require 24 months to complete.

11. The overload on the Kearny 1-3-Marion 1 138kV circuit will be alleviated by reconductoring ½ mile of the circuit, replacing circuit breakers and disconnect switches at Kearny station, and replacing circuit breakers and disconnect switches at Marion station at a cost of **\$4 million**. It will require 12 months to complete.

## W2-004 Essex 138kV

### **Generation Interconnection**

#### **Network Impacts**

Queue project W2-004 was studied as a(n) 45MW ( 45MW of which was Capacity) injection into PSE&G's system at two optional points of interconnection. The primary option was a direct connection to the Essex 138kV substation, while the secondary option was a direct connection to the Foundry Street 138kV substation. Project W2-004 was evaluated for compliance with reliability criteria for summer peak conditions in 2014. Potential network impacts were as follows:

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2. The Hudson 7-12 230/138 kV transformer (from bus 217137 to bus 217001 ckt 1) loads from 52.12% to 52.64% (DC power flow) of its emergency rating (441 MVA) for the single line contingency ('KRNY-MARN'). This project contributes approximately 14.12 MW to cause the thermal violation.
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#### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)*

No problems identified.

#### **Short Circuit**

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

No problems identified.

### **Contribution to Previously Identified Overloads**

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6. The Essex-Hudson 1-6 230 kV line (from bus 217079 to bus 217000 ckt 1) loads from 117.57% to 117.92% (DC power flow) of its emergency rating (815 MVA) for the single line contingency ('PS20'). This project contributes approximately 17.55 MW to cause the thermal violation.

7. The Newport-Hoboken "R" 230 kV line (from bus 217075 to bus 217073 ckt 1) loads from 130.36% to 130.53% (DC power flow) of its emergency rating (521 MVA) for the single line contingency ('PS50'). This project contributes approximately 5.38 MW to cause the thermal violation.

8. The Kearny 4-6-Marion 3 138 kV line (from bus 217061 to bus 217137 ckt 1) loads from 124.39% to 124.9% (DC power flow) of its emergency rating (370 MVA) for the tower line contingency ('27PS'). This project contributes approximately 11.74 MW to cause the thermal violation.

9. The Hudson1-6-South Waterfront "P" 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 133.83% to 134.03% (DC power flow) of its emergency rating (750 MVA) for the single line contingency ('MAR\_BERF'). This project contributes approximately 9.01 MW to cause the thermal violation.

10. The Hudson 1-6-South Waterfront "P" 230 kV line (from bus 217000 to bus 217117 ckt 1) loads from 143.32% to 143.52% (DC power flow) of its normal rating (500 MVA) for non-contingency condition. This project contributes approximately 6.38 MW to cause the thermal violation.

11. The South Waterfront-Newport "R" 230 kV line (from bus 217117 to bus 217075 ckt 1) loads from 144.98% to 145.15% (DC power flow) of its emergency rating (490 MVA) for the single line contingency ('PS50'). This project contributes approximately 5.38 MW to cause the thermal violation.

12. The Hudson 1-6 230/138 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 123.65% to 124.34% (DC power flow) of its emergency rating (296 MVA) for the tower line contingency ('27PS'). This project contributes approximately 13.16 MW to cause the thermal violation.

13. The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 143.12% to 143.81% (DC power flow) of its emergency rating (456 MVA) for the tower line contingency ('27PS'). This project contributes approximately 20.27 MW to cause the thermal violation.

### **New System Reinforcements**

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

1. To be determined during W2-024 review.
2. To be determined during W2-024 review.
3. To be determined during W2-024 review.
4. To be determined during W2-024 review.
5. To be determined during W2-024 review.

The W2-004 project does not cause the facilities to be overloaded and will only receive a cost allocation to any of the 5 upgrades above if the cost for that upgrade is \$5 million or less. Once the W2-024 report is complete and the cost of the upgrades are known this report will be revised to include the results.

### **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)*

6. The overload on the Essex-Hudson will be alleviated by reconductoring the overhead line at a cost of **\$13 million**. It will require 24 months to complete.
7. The Newport – Hoboken R 230kV circuit overload can be alleviated by installing a 4 breaker ring bus at 49<sup>th</sup> street which taps Hoboken – Bergen. The line from 49<sup>th</sup> street to Bergen will also need to be reconducted with 1590 ACSS wire. The upgrade will cost approximately **\$21.3**. It will take 24 months to complete.
8. The Kearny 4-6 Marion 3 138kV circuit will be alleviated by reconductoring the overhead line at a cost of **\$4 million**. It will require 12 months to complete.
- 9 & 10. The Hudson-South Waterfront 230kV line overloads can be alleviated by constructing a new (second) pipe type cable circuit between Hudson and South Waterfront 230 kV stations on existing or a new right-of-way. The new circuit needs to be terminated at Hudson and South

Waterfront. The termination at Hudson involves expanding the switchyard. The estimated cost is **\$50M**. It will require 60 months to complete.

Construct a new (second) pipe type cable circuit between Hudson and South Waterfront 230 kV stations on existing or a new right-of-way. The new circuit needs to be terminated at Hudson and South Waterfront. The termination at Hudson involves expanding the switchyard.

11. The overload on the South Waterfront-Newport “R” circuit will be alleviated by replacing the underground circuit at a cost of **\$15 million**. It will require 24 months to complete.

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13. The overload on the Kearny 1-3-Marion 1 138kV circuit will be alleviated by reconductoring ½ mile of the circuit, replacing circuit breakers and disconnect switches at Kearny station, and replacing circuit breakers and disconnect switches at Marion station at a cost of **\$4 million**. It will require 12 months to complete.

#### Option #2 – Foundry St 138kV

##### **Generator Deliverability**

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

1. The Hudson 1-6 230/138 kV transformer (from bus 217058 to bus 217000 ckt 1) loads from 45.14% to 45.65% (DC power flow) of its normal rating (265 MVA) for non-contingency condition. This project contributes approximately 8.4 MW to cause the thermal violation.

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4. The Kearny 1-3-Marion 1 138 kV line (from bus 217060 to bus 217058 ckt 1) loads from 86.77% to 87.37% (DC power flow) of its normal rating (361 MVA) for non-contingency condition. This project contributes approximately 13.39 MW to cause the thermal violation.

##### **Multiple Facility Contingency**

*(Double Circuit Tower Line, Line with Failed Breaker and Bus Fault contingencies for the full energy output)*

No problems identified.

### **Short Circuit**

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

No problems identified.

### **Contribution to Previously Identified Overloads**

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### **System Reinforcements**

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