Generation Interconnection Feasibility Study Report Queue Position X3-014

The Interconnection Customer (IC) has proposed a 300 MWE (300 MWC, 300 MW MFO) natural gas fueled 1x1 combined cycle generating facility. The project is to be located in Bridgeville, Delaware. PJM studied X3-014 as a 300 MW injection into the Delmarva Power and Light (DPL) system at the X2-066 TAP 138kV substation adjacent to the South Harrington - North Seaford 138kV circuit. The project was evaluated for compliance with reliability criteria for summer peak conditions in 2015. The proposed in-service date, as stated in Attachment N, is June 01, 2016.

Point of Interconnection

X3-014 will interconnect with the Delmarva Power and Light transmission system at a new three (3) breaker ring bus substation to be constructed adjacent to the South Harrington-North Seaford 138kV circuit.

Direct Connection Requirements

Transmission Owner Scope of Direct Connection Work

The scope of work and estimated costs for the direct connection facilities is as follows:

Attachment Facilities:

Substation Engineering Estimate:
Scope: Construct a 138kV three-breaker ring bus substation, inclusive of a terminal position for queue project.
Estimate: $4,500,000
Construction Time: 24 – 36 months

Transmission Engineering Estimate:
Scope: Install a self-supporting 138kV steel pole with a concrete foundation, motor operated disconnects and a short span to PHI substation.
Estimate: $150,000
Construction Time: 24 months.

Note: If location of generator is greater than 500 feet from substation an additional Interconnection Customer circuit breaker will be required.

Contribution in Aid of Construction (CIAC) tax will be included upon further study.

Transmission Owner Special Operating Requirements

- PHI will require the capability to remotely trip the generator from its System Operations facility. Such tripping may be facilitated by either a generator breaker, inverter (if so

equipped), or a line recloser, depending upon the specific circumstances and the evaluation of PHI.

- It is the Interconnection Customer's responsibility to send the data that PJM and PHI requires directly to PJM. The Interconnection Customer will grant permission for PJM to send the PHI the following telemetry that the Interconnection Customer sends to PJM: real time MW, MVAR, volts, amperes, generator/status, and interval MWH and MVARH.

- The Interconnection Customer will be required to make provisions for a voice quality phone line within approximately 3 feet of each PHI metering position to facilitate remote interrogation and data collection.

- A mutually acceptable means of interrupting and disconnecting the generator with a visible break, able to be tagged and locked out, shall be worked out between the Interconnection Customer and PHI.

Interconnection Customer Scope of Direct Connection Work

The Interconnection Customer (IC) is responsible for all design and construction related activities on their side of the Point of Interconnection. Site preparation, including grading and an access road, as necessary, is assumed to be by the IC. Route selection, line design, and right-of-way acquisition of the direct connect facilities is not included in this report and is the responsibility of the IC. The Interconnection Customer may be responsible for contributing to future O & M costs associated with the direct connect facilities.

Protective relaying and metering design and installation must comply with PHI's applicable standards. The IC is also required to provide revenue metering and real-time telemetering data to PJM in conformance with the requirements contained in PJM Manuals M-01 and M-14 and the PJM Tariff.

The Interconnection Customer will purchase and install all metering instrument transformers as well as construct a metering structure per PHI's specifications. The secondary wiring connections at the instrument transformers will be completed by the interconnection customer's contractors and inspected by PHI, while the secondary wiring work at the metering enclosure will be completed by PHI's meter technicians. The metering control cable and meter cabinets will be supplied by PHI and installed by the interconnection customer's contractors. PHI's meter technicians will program and install two solid state multi function meters (Primary & Backup) for the new metering position. Each meter will be equipped with load profile, telemetry, and form-c pulse outputs.

Transmission Network Impacts

Potential transmission network impacts are as follows:

Generator Deliverability

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

1. (DP&L) The Laurel-W1-070 TAP 69 kV line (from bus 232249 to bus 901330 ckt 1) loads from 62.11% to 110.22% (DC power flow) of its emergency rating (43 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 20.68 MW to the thermal violation.

2. (DP&L) The South Harrington-South Harington 138/69 kV transformer (from bus 232114 to bus 232240 ckt 1) loads from 96.83% to 122.42% (DC power flow) of its emergency rating (143 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 36.59 MW to the thermal violation.

3. (DP&L) The Laurel-Short 69 kV line (from bus 232249 to bus 232828 ckt 1) loads from 59.28% to 109.99% (DC power flow) of its emergency rating (57 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 28.90 MW to the thermal violation.

4. (PECO) The Nottingham-Nottingham Reactor 230 kV line (from bus 213844 to bus 213846 ckt 1) loads from 97.79% to 98.64% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 32.76 MW to the thermal violation.

5. (DP&L) The South Harrington-Felton 138 kV line (from bus 232114 to bus 232112 ckt 1) loads from 62.77% to 105.87% (DC power flow) of its emergency rating (242 MVA) for the single contingency 'CKT 13774'. This project contributes approximately 104.30 MW to the thermal violation.

6. (DP&L) The North Seaford-North Seaford 138/69 kV transformer (from bus 232118 to bus 232246 ckt 2) loads from 88.15% to 126.45% (DC power flow) of its emergency rating (143 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 54.77 MW to the thermal violation.

7. (DP&L) The Kratz-South Harington 69 kV line (from bus 232823 to bus 232240 ckt 1) loads from 59.01% to 113.21% (DC power flow) of its emergency rating (93 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 50.41 MW to the thermal violation.

8. (DP&L) The Pine Street-Dupont - Seaford 69 kV line (from bus 232824 to bus 232247 ckt 1) loads from 93.76% to 141.55% (DC power flow) of its emergency rating (137 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 65.47 MW to the thermal violation.

9. (DP&L) The Sharptown-Vienna 69 kV line (from bus 232239 to bus 232241 ckt 1) loads from 56.69% to 104.8% (DC power flow) of its emergency rating (43 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 20.68 MW to the thermal violation.

10. (DP&L) The Greenwood-Kratz 69 kV line (from bus 232244 to bus 232823 ckt 1) loads from 73.35% to 127.55% (DC power flow) of its emergency rating (93 MVA) for the single

contingency 'CKT 13771_X2-066A'. This project contributes approximately 50.41 MW to the thermal violation.

11. (DP&L) The Kratz-Greenwood 69 kV line (from bus 232823 to bus 232244 ckt 1) loads from 77.61% to 101.51% (DC power flow) of its emergency rating (93 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 22.23 MW to the thermal violation.

12. (PECO) The Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) loads from 97.72% to 98.57% (DC power flow) of its emergency rating (627 MVA) for the single contingency 'PJM17'. This project contributes approximately 32.76 MW to the thermal violation.

13. (DP&L) The W1-070 TAP-Sharptown 69 kV line (from bus 901330 to bus 232239 ckt 1) loads from 69.37% to 117.47% (DC power flow) of its emergency rating (43 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 20.68 MW to the thermal violation.

14. (DP&L) The South Harington-Harrington 69 kV line (from bus 232240 to bus 232217 ckt 1) loads from 78.61% to 107.46% (DC power flow) of its emergency rating (91 MVA) for the single contingency 'CKT 13709'. This project contributes approximately 26.25 MW to the thermal violation.

15. (DP&L) The Bridgeville-Taylor 69 kV line (from bus 232245 to bus 232825 ckt 1) loads from 85.44% to 120.18% (DC power flow) of its emergency rating (64 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 22.23 MW to the thermal violation.

16. (DP&L) The Kent-New Meredith 69 kV line (from bus 232215 to bus 232812 ckt 1) loads from 90.57% to 124.17% (DC power flow) of its emergency rating (93 MVA) for the single contingency 'CKT 13774'. This project contributes approximately 31.25 MW to the thermal violation.

17. (DP&L) The South Harington-Kratz 69 kV line (from bus 232240 to bus 232823 ckt 1) loads from 91.96% to 115.86% (DC power flow) of its emergency rating (93 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 22.23 MW to the thermal violation.

18. (DP&L) The Milford-Milford 138/230 kV transformer (from bus 232113 to bus 232004 ckt 1) loads from 66.50% to 116.16% (DC power flow) of its emergency rating (373 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 185.24 MW to the thermal violation.

Multiple Facility Contingency

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

19. (DP&L) The Steele-Oil City 138 kV line (from bus 232103 to bus 232801 ckt 1) loads from 95.23% to 97.59% (DC power flow) of its emergency rating (159 MVA) for the tower contingency 'DBL_1NCB'. This project contributes approximately 23.14 MW to the thermal violation.

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)

20. (DP&L) The Darley-Citisteel Tap 69 kV line (from bus 231205 to bus 231213 ckt 1) loads from 101.31% to 102.67% (DC power flow) of its emergency rating (137 MVA) for the tower contingency 'DBL_5NC'. This project contributes approximately 11.54 MW to the thermal violation.

21. (BG&E) The North West 2311 & 2310-Granite 2311 & 2312 230 kV line (from bus 220962 to bus 220972 ckt 1) loads from 132.74% to 140.04% (DC power flow) of its emergency rating (621 MVA) for the single contingency 'PP1EB'. This project contributes approximately 21.82 MW to the thermal violation.

22. (PECO) The Richmond-Waneeta 3 230 kV line (from bus 213922 to bus 214012 ckt 1) loads from 125.51% to 125.99% (DC power flow) of its emergency rating (914 MVA) for the single contingency 'CHIC125'. This project contributes approximately 27.10 MW to the thermal violation.

23. (DP&L) The South Harrington-Milford 138 kV line (from bus 232114 to bus 232113 ckt 1) loads from 130.70% to 207.25% (DC power flow) of its emergency rating (242 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 185.24 MW to the thermal violation.

24. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 2) loads from 113.05% to 113.25% (DC power flow) of its emergency rating (941 MVA) for the single contingency 'PP1EC'. This project contributes approximately 25.70 MW to the thermal violation.

25. (DP&L) The Milford-Steele 230 kV line (from bus 232004 to bus 232000 ckt 1) loads from 152.78% to 182.45% (DC power flow) of its emergency rating (551 MVA) for the tower contingency 'DBL_4NC'. This project contributes approximately 163.52 MW to the thermal violation.

26. (DP&L) The Conaway-Indian River 2&3 138 kV line (from bus 232136 to bus 232121 ckt 1) loads from 117.42% to 193.51% (DC power flow) of its emergency rating (242 MVA) for the

single contingency 'CKT 13771_X2-066A'. This project contributes approximately 184.12 MW to the thermal violation.

27. (PECO/BG&E) The Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) loads from 129.39% to 130.48% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 32.76 MW to the thermal violation.

28. (PSEG/PECO) The Camden-Richmond 230 kV line (from bus 219125 to bus 213922 ckt 1) loads from 136.85% to 137.3% (DC power flow) of its emergency rating (1037 MVA) for the single contingency 'CHIC125'. This project contributes approximately 29.13 MW to the thermal violation.

29. (PL/METED) The Brunner Island Bus-Yorkana 230 kV line (from bus 207922 to bus 204515 ckt 1) loads from 136.52% to 136.91% (DC power flow) of its emergency rating (617 MVA) for the single contingency 'PJM17'. This project contributes approximately 15.12 MW to the thermal violation.

30. (PL/BG&E) The Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) loads from 106.44% to 107.08% (DC power flow) of its emergency rating (531 MVA) for the single contingency 'PJM17'. This project contributes approximately 21.24 MW to the thermal violation.

31. (BG&E) The North West 2326 & 2322-Granite 2326 & 2332 230 kV line (from bus 220961 to bus 220973 ckt 1) loads from 110.16% to 117.4% (DC power flow) of its emergency rating (728 MVA) for the single contingency 'PP1EB'. This project contributes approximately 21.09 MW to the thermal violation.

32. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 140.41% to 149.43% (DC power flow) of its emergency rating (2815 MVA) for the single contingency 'PJM89_A'. This project contributes approximately 127.60 MW to the thermal violation.

33. (PJM) The Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) loads from 146.32% to 147.12% (DC power flow) of its normal rating (2490 MVA) for non contingency condition. This project contributes approximately 123.48 MW to the thermal violation.

34. (DP&L) The Greenwood-Bridgeville 69 kV line (from bus 232244 to bus 232245 ckt 1) loads from 112.80% to 147.54% (DC power flow) of its emergency rating (64 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 22.23 MW to the thermal violation.

35. (DP&L) The New Meredith-Church 69 kV line (from bus 232812 to bus 232203 ckt 1) loads from 107.61% to 143.69% (DC power flow) of its emergency rating (93 MVA) for the tower contingency 'DBL_4NC'. This project contributes approximately 33.55 MW to the thermal violation.

36. (DP&L) The North Seaford-Conaway 138 kV line (from bus 232118 to bus 232136 ckt 1) loads from 117.43% to 193.51% (DC power flow) of its emergency rating (242 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 184.12 MW to the thermal violation.

37. (BG&E) The EMORY GRV230-North West 2326 & 2322 230 kV line (from bus 220400 to bus 220961 ckt 1) loads from 104.18% to 105.19% (DC power flow) of its emergency rating (1800 MVA) for the single contingency 'BG_CKT2322A'. This project contributes approximately 18.47 MW to the thermal violation.

38. (DP&L) The Taylor-Bridgeville 69 kV line (from bus 232825 to bus 232245 ckt 1) loads from 143.62% to 222.38% (DC power flow) of its emergency rating (64 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 50.41 MW to the thermal violation.

39. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 141.23% to 141.54% (DC power flow) of its emergency rating (2901 MVA) for the tower contingency 'CNSTN_NWESTA'. This project contributes approximately 93.20 MW to the thermal violation.

40. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 102.85% to 103.33% (DC power flow) of its emergency rating (2901 MVA) for the single contingency 'CNSTN__230-4'. This project contributes approximately 85.55 MW to the thermal violation.

41. (PJM) The Conastone-EMORY GR500 500 kV line (from bus 200004 to bus 200101 ckt 1) loads from 117.45% to 118.02% (DC power flow) of its normal rating (2338 MVA) for non contingency condition. This project contributes approximately 82.53 MW to the thermal violation.

42. (DP&L) The Dupont - Seaford-Laurel 69 kV line (from bus 232247 to bus 232249 ckt 1) loads from 144.46% to 214.84% (DC power flow) of its emergency rating (93 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 65.45 MW to the thermal violation.

43. (DP&L) The X2-066 TAP-South Harrington 138 kV line (from bus 909540 to bus 232114 ckt 1) loads from 213.93% to 330.66% (DC power flow) of its emergency rating (257 MVA) for the single contingency 'CKT 13771_X2-066B'. This project contributes approximately 300.00 MW to the thermal violation.

44. (DP&L) The X2-066 TAP-South Harrington 138 kV line (from bus 909540 to bus 232114 ckt 1) loads from 134.40% to 212.31% (DC power flow) of its normal rating (242 MVA) for non contingency condition. This project contributes approximately 188.54 MW to the thermal violation.

45. (PECO) The Linwood-Chichester 2 230 kV line (from bus 213750 to bus 213490 ckt 1) loads from 114.10% to 114.9% (DC power flow) of its emergency rating (983 MVA) for the single contingency '220-39'. This project contributes approximately 53.65 MW to the thermal violation.

46. (DP&L) The North Seaford-North Seaford 138/69 kV transformer (from bus 232118 to bus 232246 ckt 1) loads from 124.45% to 178.52% (DC power flow) of its emergency rating (113 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 61.10 MW to the thermal violation.

47. (DP&L) The X2-066 TAP-North Seaford 138 kV line (from bus 909540 to bus 232118 ckt 1) loads from 213.93% to 330.66% (DC power flow) of its emergency rating (257 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 300.00 MW to the thermal violation.

48. (PECO) The Linwood-Chichester 2 230 kV line (from bus 213750 to bus 213490 ckt 2) loads from 114.50% to 115.3% (DC power flow) of its emergency rating (983 MVA) for the single contingency '220-43'. This project contributes approximately 53.84 MW to the thermal violation.

49. (DP&L) The Bridgeville-Greenwood 69 kV line (from bus 232245 to bus 232244 ckt 1) loads from 116.26% to 195.02% (DC power flow) of its emergency rating (64 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 50.41 MW to the thermal violation.

50. (DP&L) The Kent-New Meredith 69 kV line (from bus 232215 to bus 232812 ckt 1) loads from 132.51% to 168.58% (DC power flow) of its emergency rating (93 MVA) for the tower contingency 'DBL_4NC'. This project contributes approximately 33.55 MW to the thermal violation.

51. (PJM/AP) The EMORY GR500-Kemptown 500 kV line (from bus 200101 to bus 235632 ckt 1) loads from 122.23% to 122.38% (DC power flow) of its emergency rating (2901 MVA) for the tower contingency 'CNSTN_NWESTB'. This project contributes approximately 91.41 MW to the thermal violation.

52. (DP&L) The North Seaford-Taylor 69 kV line (from bus 232246 to bus 232825 ckt 1) loads from 115.59% to 170.98% (DC power flow) of its emergency rating (91 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 50.41 MW to the thermal violation.

53. (BG&E) The Conastone-EMORY GRV230 230 kV line (from bus 220963 to bus 220400 ckt 1) loads from 128.69% to 128.92% (DC power flow) of its emergency rating (819 MVA) for the single contingency 'PP1EC'. This project contributes approximately 25.40 MW to the thermal violation.

54. (PL/BG&E) The Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) loads from 107.63% to 108.14% (DC power flow) of its emergency rating (485

MVA) for the single contingency 'PJM17'. This project contributes approximately 15.36 MW to the thermal violation.

55. (PJM/METED) The Three Mile Island-Three Mile Island 500/230 kV transformer (from bus 200016 to bus 204514 ckt 2) loads from 123.37% to 126.86% (DC power flow) of its emergency rating (1072 MVA) for the single contingency 'PJM17'. This project contributes approximately 38.07 MW to the thermal violation.

56. (PECO) The Peach Bottom-Cooper 230 kV line (from bus 213869 to bus 214089 ckt 1) loads from 130.86% to 131.96% (DC power flow) of its emergency rating (485 MVA) for the single contingency 'PJM17'. This project contributes approximately 32.76 MW to the thermal violation.

57. (DP&L) The Citisteel Tap-Naamans 69 kV line (from bus 231213 to bus 231211 ckt 1) loads from 115.15% to 116.71% (DC power flow) of its emergency rating (119 MVA) for the tower contingency 'DBL_5NC'. This project contributes approximately 11.54 MW to the thermal violation.

58. (PECO/AE) The Delco Tap-Mickleton 230 kV line (from bus 213559 to bus 228401 ckt 1) loads from 100.29% to 100.85% (DC power flow) of its emergency rating (725 MVA) for the single contingency 'CHIC125'. This project contributes approximately 26.43 MW to the thermal violation.

59. (DP&L) The North Seaford-Pine Street 69 kV line (from bus 232246 to bus 232824 ckt 1) loads from 139.46% to 197.92% (DC power flow) of its emergency rating (112 MVA) for the single contingency 'CKT 13771_X2-066A'. This project contributes approximately 65.47 MW to the thermal violation.

60. (BG&E) The EMORY GRV230-North West 2311 & 2310 230 kV line (from bus 220400 to bus 220962 ckt 1) loads from 104.40% to 105.42% (DC power flow) of its emergency rating (1800 MVA) for the single contingency 'BG_CKT2310A'. This project contributes approximately 18.54 MW to the thermal violation.

Short Circuit

No overstressed breakers were identified.

Stability Analysis

The Stability Analysis will commence during System Impact Study phase of the project.

New System Reinforcements

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

1. To mitigate the (DP&L) Laurel-W1-070 TAP 69kV line (from bus 232249 to bus 901330 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$4,090,000** and will take **30 months** to complete.

2. To mitigate the (DP&L) South Harrington-South Harington 138/69 kV transformer (from bus 232114 to bus 232240 ckt 1) overload will require the following:

    a. Replace the 138/69kV transformer. The estimated cost to perform this work is **$2,800,000** and will take **24 months** to complete.
    b. Replace the stranded bus and two (2) circuit breakers. The estimated cost to perform this work is **$270,000** and will take **18 months** to complete.

3. To mitigate the (DP&L) Laurel-Short 69kV line (from bus 232249 to bus 232828 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$2,625,000** and will take **30 months** to complete.

4. To mitigate the (PECO) Nottingham-Nottingham Reactor 230kV line (from bus 213844 to bus 213846 ckt 1) overload will require replacing line 220-08 reactor and by-pass circuit switcher at Nottingham substation to get a minimum summer emergency rating of 741 MVA. The estimated cost to perform this work is **$1.7M** and will require **24 months** to complete.

5. To mitigate the (DP&L) South Harrington-Felton 138kV line (from bus 232114 to bus 232112 ckt 1) overload will require reconductoring the 138kV circuit. The estimated cost to perform this work is **$7,140,000** and will take **30 months** to complete.

6. To mitigate the (DP&L) North Seaford-North Seaford 138/69 kV transformer (from bus 232118 to bus 232246 ckt 2) overload will require the following:

    a. Replace the 138/69kV autotransformer. The estimated cost to perform this work is **$2,625,000** and will take **24 months** to complete.
    b. Replace the stranded bus. The estimated cost to perform this work is **$200,000** and will take **18 months** to complete.

7. To mitigate the (DP&L) Kratz-South Harington 69kV line (from bus 232823 to bus 232240 ckt 1) will require the following:

    a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$4,500,000** and will take **30 months** to complete.
    b. Replace the tap switch configuration. The estimated cost to perform this work is **$350,000** and will take **18 months** to complete.

8. To mitigate the (DP&L) Pine Street-Dupont - Seaford 69kV line (from bus 232824 to bus 232247 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$1,500,000** and will take **30 months** to complete.

9. To mitigate the (DP&L) Sharptown-Vienna 69kV line (from bus 232239 to bus 232241 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$2,175,000** and will take **30 months** to complete.

10&11. To mitigate the (DP&L) Greenwood-Kratz 69kV line (from bus 232244 to bus 232823 ckt 1) overload will require reconductoring the 69kV circuit and replacing the tap switch configuration. The estimated cost to perform this work is **$357,500** and will take **18 months** to complete.

12. To mitigate the (PECO) Nottingham Reactor-Peach Bottom 230 kV line (from bus 213846 to bus 213869 ckt 1) overload will require reconductoring line 220-08 from Nottingham Reactor to PB Tap to get a minimum summer emergency rating of 741 MVA. The line is approximately 14 miles long. The estimated cost to perform this work is **$10M** and will require **48 months** to complete.

13. To mitigate the (DP&L) The W1-070 TAP-Sharptown 69 kV line (from bus 901330 to bus 232239 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$4,090,000** and will take **30 months** to complete.

14. To mitigate the (DP&L) South Harington-Harrington 69 kV line (from bus 232240 to bus 232217 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$1,425,000** and will take **30 months** to complete.

15&38. To mitigate the (DP&L) Bridgeville-Taylor 69 kV line (from bus 232245 to bus 232825 ckt 1) overload will require the following:

a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$2,700,000** and will take **30 months** to complete.
b. Replace stranded bus, circuit breaker, disconnect switch, and tap switch. The estimated cost to perform this work is **$613,000** and will take **18 months** to complete.

16&50. To mitigate the (DP&L) Kent-New Meredith 69 kV line (from bus 232215 to bus 232812 ckt 1) overloads will require the following:

a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$4,875,000** and will take **30 months** to complete.
b. Replace disconnect switch and upgrade relay. The estimated cost to perform this work is **$420,000** and will take **18 months** to complete.

17. To mitigate the (DP&L) South Harington-Kratz 69 kV line (from bus 232240 to bus 232823 ckt 1) overload will require the following:

a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$4,500,000** and will take **30 months** to complete.
b. Replace tap switch configuration. The estimated cost to perform this work is **$350,000** and will take **18 months** to complete.

18. To mitigate the (DP&L) Milford-Milford 138/230 kV transformer (from bus 232113 to bus 232004 ckt 1) overload will require the following:

    a. Replace the 138/69kV autotransformer. The estimated cost to perform this work is **$4,000,000** and will take **24 months** to complete.
    b. Replace two (2) circuit breakers and three (3) disconnect switches. The estimated cost to perform this work is **$375,000** and will take **18 months** to complete.

19. To mitigate the (DP&L) Steele-Oil City 138 kV line (from bus 232103 to bus 232801 ckt 1) overload will require the rebuilding of 0.56 miles of 477 ACSR and the replacement of associated equipment. The estimated cost to perform this work is **$900,000** and will take **12-18 months** to complete assuming there are no major regulatory or environmental impacts.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project.

20. To mitigate the (DP&L) Darley-Citisteel Tap 69 kV line (from bus 231205 to bus 231213 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$710,000** and will take **24-30 months** to complete.

21&31. To mitigate the (BG&E) North West 2311 & 2310-Granite 2311 & 2312 230kV line (from bus 220962 to bus 220972 ckt 1) and the North West 2326 & 2322-Granite 2326 & 2332 230kV line (from bus 220961 to bus 220973 ckt 1) overloads will require reconductoring the circuit with 2167 ACSR and upgrading substation terminal equipment. The estimated cost to perform this work is **$23,600,000** and will take **6 years** to complete.

22. To mitigate the (PECO) Richmond-Waneeta 3 230kV line overload will require reconductoring the aerial portion of the line which meets the minimum rating requirement of 2882A. This will result in a 249A = 99 MVA margin when compared to the new aerial conductor rating. Using the Pecos conductor avoids the need to rebuild the line. The total aerial mileage per the PECO 230 kV line length spreadsheet is 2.23 miles. Replace with 2-2000 kcmil AAC 127 Str (Cowslip) with emergency rating of 4130. Remove the existing two UG cables (2-3-1x3000 KCMIL CU HPOFP) and replace with two dielectric (XLPE - cross link polyethelene) cables. The estimated cost to perform this work is **$15,000,000** and will take **3 years** to complete.

23. To mitigate the (DP&L) South Harrington-Milford 138 kV line (from bus 232114 to bus 232113 ckt 1) overload will require the following:

    a. Reconductor the 138kV circuit. The estimated cost to perform this work is **$10,000,000** and will take **30 months** to complete.

b. Replace four (4) circuit breakers, four (4) disconnect switches, and upgrade relays. The estimated cost to perform this work is **$1,158,000** and will take **18 months** to complete.

24, 37, 53, 60. To mitigate the (BG&E) Conastone-EMORY GRV230 230 kV line and the EMORY GRV230-North West 2326 & 2322 230 kV line overloads will require construction of a new double circuit 230kV line from Conastone-NW using 1590 MCM conductor. The estimated cost to perform this work is **$54.7 M** and will take **72-84 months** to complete. It is anticipated that a CPCN will be required. This estimate is based on a cursory review of BGE land for transmission lines. A detailed study will be conducted during the Facilities Study phase.

Details of the work scope include:

a. Substation
   - Conastone - install two (2) new bays with two (2) bus breakers. The estimated cost to perform this work is **$3.6M**.
   - Northwest sub - install two (2) 230KV breakers on existing foundations. The estimated cost to perform this work is **$700,000**. These breakers are 63kA.

b. Transmission Line
   - 230kV line length is 23.7 miles.
   - ROW land - purchase and clear 80' x 3 miles for right of way (10 acres) for the new 230KV double circuit. Estimated cost is **$3M**.
   - Construct a 230KV double circuit. The estimate cost **$47.4M**.

25. To mitigate the (DP&L) Milford-Steele 230 kV line (from bus 232004 to bus 232000 ckt 1) overload will require reconductoring the 230kV circuit. The estimated cost to perform this work is **$35,100,000** and will take **30 months** to complete.

26. To mitigate the (DP&L) Conaway-Indian River 2&3 138 kV line (from bus 232136 to bus 232121 ckt 1) overload will require reconductoring the 138kV circuit. The estimated cost to perform this work is **$7,225,000** and will take **30 months** to complete.

27. To mitigate the (PECO/BG&E) Cooper-Graceton 230 kV line (from bus 214089 to bus 220964 ckt 1) overload will require the following:

PECO scope: Reconductor the 220-93 circuit from Cooper Substation to Graceton substation to get a minimum summer emergency rating of 725 MVA. The line is approximately 4 miles long. The estimated cost to perform this work is **$2.8M** and will take **24 months** to complete. This cost is for the PECO portion only.

BGE scope: Option 1 (230kV)
Construct a 1.8 mile 230kV circuit using 2167 MCM conductor from Graceton substation to the PA border and terminate the circuit at Graceton substation. The estimated cost to perform

this work is **$6M** and will take **60 months** to complete. At the substation install tie breakers. The estimated cost to perform this work is **$400k** and will take **24 months** to complete.

The total cost of **$6.4M** does not include 100' wide ROW which is estimated at **$5M**.

Option 2 (500kV)
Construct a 500kV three (3) breaker ring bus at the Graceton substation. The estimated cost to perform this work is **$8M** and will take **36 months** to complete. Construct a 500kV circuit from Graceton to PA border. The estimated cost to perform this work is **$8M** and will take **64 months** to complete.

The total cost of **$16M** does not include 200' wide ROW which is estimated at **$8M**.

28. To mitigate the (PSEG/PECO) Camden-Richmond 230 kV line overload will require constructing an express circuit from Camden to Richmond. This work has been previously identified as a 2016 RTEP project (b1590). If X2-066 in-service date precedes the RTEP project's in service date the Interconnection Customer may elect to accelerate the project. Costs associated with accelerating this project will be determined during a later study phase. The total cost for the RTEP project is **$40M** with a lead time of **36-48 months**.

29. To mitigate the (PPL/MET-ED) Brunner Island Bus-Yorkana 230 kV line overload will require the following:

    PPL segment:
    To mitigate the Brunner – Yorkana 230kV line overload will require the rebuild and upgrade of approximately 0.6 miles of PPL EU owned Brunner Island – Yorkana 230kV line and the substation line terminal equipment. The existing 1033 kcmil ACSR conductor will be replaced with new 1590 kcmil ACSR conductor or equivalent with an operating temperature of 140deg C to achieve the summer normal and emergency ratings of 712 MVA and 865 MVA respectively. The Yorkana 230kV bay conductors at Brunner Island 230kV switchyard will also be upgraded to conform with the higher line ratings. The estimated cost to perform this work is **$1,300,000** and will take **24 months** to complete.

    MET-ED segment:
    Reconductor 12.5 mile section of the Brunner -Yorkana (1055) 230 kV line with 1590 ACSS conductor. Based on the Feasibility Study review performed, the total cost of this Network Upgrade is **$9,270,900** excluding tax. Should tax need to be added, the total cost will be **$12,382,200**. It is estimated that it will take **3 years** from the full execution of a Construction Service Agreement to complete the work needed to implement this project. Note that a revised estimate will be required if this project proceeds to an Impact Study.

30. To mitigate the (PL/BG&E) Otter Creek Switchyard-Conastone 230 kV line (from bus 208048 to bus 220963 ckt 1) overload will require the following:

    BG&E scope
    Rebuild the 4.7 mile Otter Creek 2302 circuit to the PA border. The estimated cost to perform this work is $**19M** and will take **60 months** to complete. A CPCN will be required.

PPL scope

A project to re-conductor Manor-Conastone with 1590 ACSR is underway. This project will equip the line to handle 653/793 MVA (Summer Normal/Emergency). The estimated cost to perform this work is **$17,000,000** and the expected in service date is **October 2013**.

32&33. To mitigate the (PJM) Peach Bottom-Conastone 500 kV line (from bus 200013 to bus 200004 ckt 1) overloads will require to following:

BGE scope

a. At Conastone construct a new two breaker 4000A bay (breakers D, F) with two 63 kA breakers. Includes line termination structures, allowance for a second line and the relocation of the 500kV cap bank. The estimated cost to perform this work is **$14M** and will take **36 months** to complete.

b. Construct a new 500kV line from Conastone – Peach Bottom rated for a minimum of 2939/3733 SN/SE. Build 9.6 miles 500KV circuit from Conastone to Pennsylvania border. Purchase 150' R/W. The estimated cost to perform this work is **$46.8M** and will take **5-7 years** to complete.

PECO scope

a. Replace existing Peach Bottom-Conastone 500kV Line (5012) terminal equipment at Peach Bottom Substation to match the conductor summer normal and emergency rating of 2920 / 3707 MVA (PECO portion only). The estimated cost to perform this work is **$5M** and will take **3 years** to complete.

b. Build a new second Peach Bottom-Conastone 500kV Line on separate towers from existing 5012 Line with a minimum summer emergency rating of 3510 MVA (PECO portion only). The estimated cost to perform this work is **$20 million** and will take **5 years** to complete. (Right-of-way costs are not included)

34&49. To mitigate the (DP&L) Greenwood-Bridgeville 69 kV line (from bus 232244 to bus 232245 ckt 1) overload and the Bridgeville-Greenwood 69 kV line (from bus 232245 to bus 232244 ckt 1) overloads will require the following:

a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$4,575,000** and will take **30 months** to complete.
b. Replace circuit breaker and strand bus. The estimated cost to perform this work is **$240,000** and will take **18 months** to complete.

35. To mitigate the (DP&L) New Meredith-Church 69 kV line (from bus 232812 to bus 232203 ckt 1) overload will require the following:

a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$8,250,000** and will take **30 months** to complete.

b. Replace tap switch configuration. The estimated cost to perform this work is **$350,000** and will take **18 months** to complete.

36. To mitigate the (DP&L) North Seaford-Conaway 138 kV line (from bus 232118 to bus 232136 ckt 1) overload will require the following:

a. Reconductor the 138kV circuit. The estimated cost to perform this work is **$14,450,000** and will take **30 months** to complete.
b. Replace stranded bus, circuit breaker, and three (3) disconnect switches. The estimated cost to perform this work is **$490,000** and will take **18 months** to complete.

39.40.41.51. To mitigate the Conastone-Emory GR 500kV and Emory GR500-Kemptown 500kV overloads will require upgrading the Conastone bay with two (2) 4000A breakers, four (4) 4000A breaker disconnects and one (1) 4000 A line switch. The estimated cost to perform this work is **$3M** and will **take 24-36 months** to complete.

42. To mitigate the (DP&L) Dupont-Seaford-Laurel 69 kV line (from bus 232247 to bus 232249 ckt 1) loads overload will require the following:

a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$4,350,000** and will take **30 months** to complete.
b. Replace four (4) circuit breakers, disconnect switch, and tap switch configuration. The estimated cost to perform this work is **$686,000** and will take **18 months** to complete.

43&44. To mitigate the (DP&L) X2-066 TAP-South Harrington 138 kV line (from bus 909540 to bus 232114 ckt 1) overloads will require the following:

a. Reconductor the 138kV circuit. The estimated cost to perform this work is **$10,062,500** and will take **30 months** to complete.
b. Replace rigid bus, relays, two (2) circuit breakers, and three (3) disconnect switches. The estimated cost to perform this work is **$660,000** and will take **18 months** to complete.

45&48. To mitigate the Linwood-Chichester 230 kV circuits #1 and #2 overloads will require the installation of a 3rd Linwood-Chichester 230kV line underground with a minimum summer normal and emergency rating of 831/983 MVA. This line is approximately 1.6 miles long. A new 230kV bus position and breaker at Chichester and Linwood Substations will be required for this new line. The estimated cost to perform this work is **$25,000,000** and will take **4 years** to complete. This cost does not include any right-of-way costs which may be required.

46. To mitigate the (DP&L) North Seaford-North Seaford 138/69 kV transformer (from bus 232118 to bus 232246 ckt 1) overload will require the following:

a. Replace the 138/69kV transformer. The estimated cost to perform this work is **$2,650,000** and will take 24 **months** to complete.
b. Replace stranded bus and two (2) disconnect switch. The estimated cost to perform this work is **$260,000** and will take **18 months** to complete.

47. To mitigate the (DP&L) X2-066 TAP-North Seaford 138 kV line (from bus 909540 to bus 232118 ckt 1) overload will require the following:

    a. Reconductor the 138kV circuit. The estimated cost to perform this work is **$10,062,500** and will take **30 months** to complete.
    b. Replace, two (2) circuit breakers, two (2) disconnect switches, and upgrade relays. The estimated cost to perform this work is **$660,000** and will take **18 months** to complete.

52. To mitigate the (DP&L) North Seaford-Taylor 69 kV line (from bus 232246 to bus 232825 ckt 1) overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$1,125,000** and will take **30 months** to complete.

54. The (PL/BG&E) Safe Harbor Units 3-4 Tap-Graceton 230 kV line (from bus 208071 to bus 220964 ckt 1) overload will be mitigated by baseline upgrade b0497 which will remove limitations at the Graceton substation.

55. To mitigate the 3 MILE I-TMI 500/230kV (METED) transformer overload would require the addition of a second 500/230kV transformer at TMI as well as transmission line upgrades between the 230kV and 500kV substations. The estimated cost to perform this work is **$15M** and will take **36 months** to complete.

56. To mitigate the (PECO) Peach Bottom-Cooper 230 kV line overload will require reconductoring the 220-08 line from PB Tap to Cooper Substation to get a minimum summer emergency rating of 741 MVA. The line is approximately 1.4 miles long. The estimated cost to perform this work is **$1.0M** and will take **24 months** to complete.

57. To mitigate the (DP&L) Citisteel Tap-Naamans 69 kV line overload will require reconductoring the 69kV circuit. The estimated cost to perform this work is **$240,000** and will take **30 months** to complete.

58. To mitigate the DELCOTAP-MCKLTON 230kV (AE/PECO) overload would require upgrading the 2-954 AL 230kV strand bus at Mickleton to 2-1590 AL. The estimated cost to perform this work is **$74,000** and will take **6-12 months** to complete.

59. To mitigate the (DP&L) North Seaford-Pine Street 69 kV line (from bus 232246 to bus 232824 ckt 1) overload will require the following:

    a. Reconductor the 69kV circuit. The estimated cost to perform this work is **$975,000** and will take **30 months** to complete.

b. Replace, two (2) disconnect switches and stranded bus. The estimated cost to perform this work is **$260,000** and will take **18 months** to complete.

Other Charges

PHI reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering and telecommunications facilities, owned by PHI.