Generation Interconnection Feasibility Study Report

PJM Generation Interconnection Request Queue Position #T121
Potter 115kV
120 MW
(24 MW capacity)

January 2009

Preface

The intent of the Generation Interconnection Feasibility Study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

The proposed interconnection facilities must be designed in accordance with the FirstEnergy "Requirements for Transmission Connected Facilities" document. Procedures for gaining access to these standards can be found at the link below.

http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

In some instances an Interconnection Customer may not be responsible for 100% of the identified Network Upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Generation Interconnection Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

The Generation Interconnection Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities unless noted in the report. The project Interconnection Customer is responsible for acquiring any necessary right of way and real estate, as well as applying for and obtaining any and all permits unless prior agreement by interested parties allows for other arrangements. For properties currently owned by Transmission Owners, some permitting and real estate costs may be included in the study.

Cost and Timing Estimates

The estimates in this report do not include tax gross-up.

While the information in this transmittal is reasonable for the scope of work defined, it should, however, be noted that the cost figures and time estimates are conceptual in nature at this stage, as an engineering team has not been assigned to the project. Any change to the scope of work will require that the estimates be revisited. The costs are a best estimate, but the Interconnection Customer will be charged for actual costs. Any under-runs or over-runs will be reconciled at the conclusion of the project.

General

The Queue Position #T121 project was studied as a 120MW (Capacity=24MW) injection at two distinct points. Option #1 studied direct connection to the Potter 115 kV substation in the APS area, while Option #2 studied connection into FirstEnergy's Potter-Two Mile 115 kV line. Queue Position #T121 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Simplified one line diagrams of the proposed options are shown in Figure #1 and Figure #2.

Metering

The Interconnection Customer will be required to install and maintain metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM and the Transmission Owner. The PJM requirements for this equipment are listed in Appendix 2, section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D. The PJM and Transmission Owner requirements for Metering Equipment will be discussed in more detail in subsequent studies.

PENELEC Revenue Metering Requirements for Generation Interconnection Customer

Interconnection Customer shall install, own, operate, test and maintain the necessary revenue quality Metering Equipment. This includes current transformers, voltage transformers, mounting structures, wiring, meters, communication circuits, and associated devices. The Metering Equipment must meet the specifications listed in the FirstEnergy connection documents. The FirstEnergy "Requirements for Transmission Connected Facilities" can be retrieved from:

http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

The Metering Equipment shall be located at the generation facility on the high voltage side of the generator step-up transformers or facility main step-up transformer and/or station service power transformers. Power flows to and from the facility shall be compensated to the Point of Interconnection.

Penelec will provide revenue quality Metering Equipment for a station service power supply at a generation facility if the supply is from the local Penelec distribution system.

The revenue quality Metering Equipment shall be capable of collecting and storing bidirectional billing data. The billing data shall be stored in intervals specified by Penelec, typically fifteen minutes or thirty minutes. The Interconnection Customer must provide Penelec with remote access to the billing data in the Metering Equipment via a dedicated voice-grade analog telephone circuit. The Interconnection Customer shall provide Penelec with contact information for the person or persons responsible for meter programming and Metering Equipment maintenance.

The Interconnection Customer shall consult with Penelec regarding the revenue quality metering system design and provide the following information:

- Facility one line and revenue metering installation drawings (schematics, wiring diagrams, etc.)
- Estimated power flows to and from the facility at all revenue metering points

- Current transformer and voltage transformer specifications, including manufacturer, type, nameplate drawings, and certified accuracy test reports
- Revenue meter specifications including manufacturer, type, model number, and accuracy
- Revenue meter program information including but not limited to billing data recorder channel assignments, recorder pulse weights (Ke), and read-only password for access to interval data by the FirstEnergy billing data collection system (MV-90)
- Revenue meter telephone number
- Revenue meter loss compensation data (if applicable)

The Interconnection Customer shall provide Penelec with prior notification of any modifications at the facility that will affect the revenue meter measurements, including substation reconfigurations and meter program changes.

The revenue metering system at each location shall be tested for accuracy by the Interconnection Customer once every two years. The Interconnection Customer shall give reasonable notice to Penelec of the time when the testing is scheduled so that Penelec may have representatives present. Penelec shall have the right to audit the revenue Metering Equipment and/or related documents. The Interconnection Customer shall be given a reasonable period of time to comply with any requests associated with an audit.

Design Requirements

The generation owner is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with the Penelec Transmission System. The generation owner is also responsible for meeting any applicable federal, state, and local codes. It is also the Interconnection Customer's responsibility to obtain any needed right-of-way between the plant site and Penelec's facilities.

Penelec will complete detailed relay coordination studies to identify off-site relay setting changes required due to this generation interconnection during the Facilities Study on construction phase of this project. This may result in additional individual relay replacements being required. These relay replacements will be done at the cost of the Interconnection Customer.

Reactive Power

Requirements to be provided during the System Impact Study or Facilities Study phase of the project studies.

Cost and Timing Estimates

While the information in this transmittal is reasonable for the scope of work defined, it should, however, be noted that the cost figures and time estimates are conceptual in nature at this stage, as an engineering team has not been assigned to the project. Any change to the scope of work will require that the estimates be revisited. The costs are a best estimate, but the Interconnection Customer will be charged for actual costs. Any under-runs or over-runs will be reconciled at the conclusion of the project.

OPTION 1:

Direct Connection

It is proposed that the project be connected at the existing Potter 115 kV Substation. The proposed connection appears feasible, but will be further reviewed in the System Impact Study. The Interconnection Customer is responsible for constructing all of the facilities on its side of the Point of Interconnection.

The AP portion of the project consists of establishing a new line position by extending the #1 115 kV bus at Potter substation and installing a 115 kV breaker, 115 kV meter and associated facilities. The Interconnection Customer will interconnect to the AP system by constructing 115 kV circuits approximately seven miles in length between the customer substation and the new line position at Potter substation. The estimate for this construction is **$821,000 in 2009 dollars** with a leadtime of **18 months**. This estimate does not include the cost of the customer facilities.

While Allegheny Power cannot mandate that our personnel install protective relaying and communications equipment at the generator site, Allegheny Power has responsibility for designing the protection scheme and providing specifications for all relays to be employed on the interconnection breaker terminal at the generation site to assure that the protective relaying equipment will be compatible with that installed on the interconnection breaker terminal at Potter substation. The relaying package will likely include both primary and backup protection. Allegheny Power is also responsible for testing and calibrating all relays and performing all tests to assure that relaying at the generator site is properly installed and functional. The estimated total cost of this engineering and field test effort is **$5,000 in 2009 dollars**.

Note: Purchase and installation of protective relaying and associated equipment at the generation site is not included in this scope of work. This phase of work is the responsibility of the customer.
The estimated cost for Controls Engineering to complete a coordination review of the area, develop new relay settings, and implement the required changes is approximately **$5,000 in 2009 dollars**.

AP will install a 115 kV line breaker on the Farmers Valley circuit in Potter substation. The estimated cost for this work is $250,000 in 2009 dollars.

AP will install a redundant channel direct transfer trip scheme between the breakers at Potter, Farmers Valley (Penelec), Gold (Penelec), and T121. The estimated cost to install this scheme is $475,000 in 2009 dollars (This upgrade has been identified with projects in prior queues, and as such the cost allocation may be reduced).

Potential network impacts were as follows:

Network Impacts

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

No problems were identified

Multiple Facility Contingency
(Double Circuit Tower Line for the full energy output. Stuck breaker and bus fault contingencies will be performed for the System Impact Study)

No problems were identified

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)

No problems were identified

Short Circuit

No existing breakers were identified as requiring replacement on the Allegheny Power system. FirstEnergy breakers under 230kV were not evaluated during this study. No breakers above 230kV were found to be overdutied as a result of the interconnection of this project.

Listed below are the positive and zero sequence source equivalent impedance at the proposed Potter 115kV bus with the generators OPEN.

Positive: (0.01365 + j0.09179)
Zero: (0.05849 + j0.15930)

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

With T121 at full output (120 MW), there is the possibility the project may contribute to voltage collapse issues identified with earlier generation interconnection projects in the PJM queue. To mitigate the voltage concerns, network upgrades estimated to cost approximately $25,000,000 are proposed. Details of the upgrades and T121's contribution, if any, will be determined in the System Impact Study phase.

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

To be determined during the System Impact Study or Facilities Study phase of the study of this project.

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 Interconnection Customer 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 overloaded conditions associated with the overloaded element(s) identified.

As a result of the aggregate energy resources in the area, the following violations were identified:

1. The N36 C-SABINSVI 115kV line loads from 180.5% to 211.6% (DC power flow) of its normal rating (130MVA) for non-contingency condition. This project contributes approximately 40.4MW to the thermal congestion.

2. The GOLD-N36 C 115kV line loads from 91.5% to 122.6% (DC power flow) of its normal rating (130MVA) for non-contingency condition. This project contributes approximately 40.4MW to the thermal congestion.

3. The Q72_TAP-SOUTH TR 115kV line loads from 326.2% to 358.4% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Grover - Towanda 230 kV (PN35A_T100_B). This project contributes approximately 38.3MW to the thermal congestion.

4. The SABINSVI-NILES VA 115kV line loads from 166.4% to 196.4% (DC power flow) of its normal rating (130MVA) for non-contingency condition. This project contributes approximately 39.1MW to the thermal congestion.

5. The NILES VA-MANSFIEL 115kV line loads from 178.9% to 213.9% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Warren – Glade 230 kV(PN28). This project contributes approximately 41.6MW to the thermal congestion.

6. The SOUTH TR-TOWANDA 115kV line loads from 338.8% to 376.4% (DC power flow) of its normal rating (94MVA) for non-contingency condition. This project contributes approximately 35.3MW to the thermal congestion.

7. The Q72_TAP-SOUTH TR 115kV line loads from 297.6% to 329.2% (DC power flow) of its normal rating (119MVA) for non-contingency condition. This project contributes approximately 37.6MW to the thermal congestion.

8. The MANSFIEL-Q72_TAP 115kV line loads from 187.5% to 219.6% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage (GROVER_TWANDA_A). This project contributes approximately 38.1MW to the thermal congestion.

9. The SOUTH TR-TOWANDA 115kV line loads from 425.8% to 459.0% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Grover - Towanda 230 kV (PN35A_T100_B). This project contributes approximately 39.5MW to the thermal congestion.

10. The NILES VA-MANSFIEL 115kV line loads from 151.8% to 184.1% (DC power flow) of its normal rating (119MVA) for non-contingency condition. This project contributes approximately 38.4MW to the thermal congestion.

11. The MANSFIEL-Q72_TAP 115kV line loads from 167.9% to 199.5% (DC power flow) of its normal rating (119MVA) for non-contingency condition. This project contributes approximately 37.6MW to the thermal congestion.

12. The SHADE GP-ROXBURY 115kV line loads from 118.7% to 122.2% (DC power flow) of its emergency rating (150MVA) for the single line contingency outage of Lewistown-S44 230 kV (LM) (PN29_WITH_S44OPT1B). This project contributes approximately 5.3MW to the thermal congestion.

13. The TWOMILE-FARM VLY 115kV line loads from 148.6% to 210.4% (DC power flow) of its emergency rating (179MVA) for the single line contingency outage (MANSFIEL_Q72). This project contributes approximately 110.6MW to the thermal congestion.

14. The 01POTTER-TWOMILE 115kV line loads from 208.8% to 257.9% (DC power flow) of its emergency rating (225MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 110.6MW to the thermal congestion.

15. The FARM VLY-LEWIS RN 115kV line loads from 171.6% to 216.3% (DC power flow) of its emergency rating (146MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 65.3MW to the thermal congestion.

16. The 01POTTER-TWOMILE 115kV line loads from 100.5% to 145.5% (DC power flow) of its normal rating (177MVA) for non-contingency condition. This project contributes approximately 79.6MW to the thermal congestion.

17. The TWOMILE-FARM VLY 115kV line loads from 92.8% to 141.9% (DC power flow) of its normal rating (162MVA) for non-contingency condition. This project contributes approximately 79.6MW to the thermal congestion.

18. The FOREST-01ELKO 230kV line loads from 93.7% to 106.0% (DC power flow) of its emergency rating (505MVA) for the single line contingency outage of Warren – Glade 230 kV (PN28). This project contributes approximately 62.1MW to the thermal congestion.

19. The TOWANDA-E.SAYRE 115kV line loads from 115.5% to 120.6% (DC power flow) of its emergency rating (159MVA) for the single line contingency outage of Lackawanna to North Meshoppen 230 KV (PL63). This project contributes approximately 8.1MW to the thermal congestion.

20. The LEWIS RN-GLADE TP 230kV line loads from 97.5% to 128.1% (DC power flow) of its emergency rating (213MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 65.3MW to the thermal congestion.

21. The LEWIS RN-LEWIS RN 115/230kV transfomer loads from 97.0% to 126.0% (DC power flow) of its emergency rating (225MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 65.3MW to the thermal congestion.

22. The 01SHINGL-LEWISTWN 230kV line loads from 99.4% to 103.9% (DC power flow) of its emergency rating (505MVA) for the single line contingency outage (GROVER_TWANDA_B). This project contributes approximately 22.8MW to the thermal congestion.

23. The FARM VLY-LEWIS RN 115kV line loads from 67.8% to 108.7% (DC power flow) of its normal rating (115MVA) for non-contingency condition. This project contributes approximately 47.1MW to the thermal congestion.

24. The E.SAYRE-N.WAV115 115kV line loads from 147.6% to 162.1% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Potter to Two Mile Run 115 kV(APS-SB-656). This project contributes approximately 17.2MW to the thermal congestion.

25. The HOMER CT-SHELOCTA 230kV line loads from 148.1% to 149.3% (DC power flow) of its emergency rating (854MVA) for the single line contingency outage of Handsome Lake to Wayne 345 kV (PN33A). This project contributes approximately 10.9MW to the thermal congestion.

26. The S44COP1-JUNIATA 230kV line loads from 116.9% to 120.1% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 15.8MW to the thermal congestion.

27. The SHELOCTA-KEYSTONE 230kV line loads from 136.6% to 138.1% (DC power flow) of its emergency rating (854MVA) for the single line contingency outage of Handsome Lake to Wayne (PN33A). This project contributes approximately 12.6MW to the thermal congestion.

28. The HOMER CT-SHELOCTA 230kV line loads from 138.0% to 139.8% (DC power flow) of its normal rating (694MVA) for non-contingency condition. This project contributes approximately 12.2MW to the thermal congestion.

29. The LEWISTWN-S44COP1 230kV line loads from 102.8% to 105.6% (DC power flow) of its emergency rating (617MVA) for the single line contingency outage (GROVER_TWANDA_B). This project contributes approximately 17.4MW to the thermal congestion.

30. The LEWISTWN-S44COP1 230kV line loads from 102.1% to 105.5% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 16.5MW to the thermal congestion.

31. The KEYSTONE-KEYSTONE 230/500kV transformer #4 loads from 120.9% to 123.0% (DC power flow) of its emergency rating (530MVA) for the single contingency outage of the Keystone 230/500 kV Transformer #3 (PJM30). This project contributes approximately 10.8MW to the thermal congestion.

32. The KEYSTONE-KEYSTONE 230/500kV transformer #3 loads from 120.5% to 122.5% (DC power flow) of its emergency rating (534MVA) for the single contingency outage of the Keystone 230/500 KV transformer #4 (PJM31). This project contributes approximately 11.0MW to the thermal congestion.

33. The SHELOCTA-KEYSTONE 230kV line loads from 127.4% to 129.4% (DC power flow) of its normal rating (694MVA) for non-contingency condition. This project contributes approximately 13.8MW to the thermal congestion.

34. The N.MESHPN-OXBOW 230kV line loads from 100.5% to 106.0% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 27.4MW to the thermal congestion.

35. The OXBOW-LACKAWNA 230kV line loads from 100.3% to 105.8% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 27.4MW to the thermal congestion.

36. The JUNIATA-JUNIA-H1 230 kV line loads from 106.1% to 107.9% of its emergency rating (573 MVA) for the single line contingency outage from Dauphin-Juniata (PL10). This project contributes approximately 10.2 MW to the thermal congestion.

37. The FARMERS VALLEY-RIDGWAY 115 kV line loads from 128.0% to 159.1% of its emergency rating (146 MVA) for the single line contingency outage from East Towanda-South Troy-Q72. This project contributes approximately 45.4 MW to the thermal congestion.

38. The MANSFIELD 115/34.5 kV transformer loads from 293.3% to 320.4% of its emergency rating (25.1 MVA) for the single line contingency outage from South Troy-Q72. This project contributes approximately 6.8 MW to the thermal congestion.

39. The SOUTH TROY 115/34.5 kV transformer #1 loads from 290.0% to 313.9% of its emergency rating (21.0 MVA) for the single line contingency outage from East Towanda-South Troy. This project contributes approximately 5.0 MW to the thermal congestion.

40. The SOUTH TROY 115/34.5 kV transformer #2 loads from 295.3% to 319.3% of its emergency rating (20.9 MVA) for the single line contingency outage from East Towanda-South Troy. This project contributes approximately 5.0 MW to the thermal congestion.

41. The TOWANDA-NORTH MESHOPPEN 115 kV line loads from 125.3% to 133.0% of its emergency rating (159 MVA) for the single line contingency outage from North Meshoppen-East Towanda 230. This project contributes approximately 12.1 MW to the thermal congestion.

42. The GROVER 230/34.5 kV transformer loads from 182.6% to 206.1% of its emergency rating (75.9 MVA) for the single line contingency outage from East Towanda-South Troy. This project contributes approximately 17.8 MW to the thermal congestion.

43. The SHAWVILLE-01SHINGLETOWN 230 kV line loads from 102.0% to 105.3% of its emergency rating (505 MVA) for the single line contingency outage from Milesburg-Karthaus(AP170B). This project contributes approximately 16.6 MW to the thermal congestion.

OPTION 2:

Direct Connection

It is proposed that the project be connected at a new 115 kV 3-breaker ring bus on the Potter-Two Mile Run 115 kV line section. The Interconnection Customer is responsible for constructing all of the facilities on its side of the point of interconnection.

The proposed interconnection facilities must be designed in accordance with the FirstEnergy "Requirements for Transmission Connected Facilities" document. Procedures for gaining access to these standards can be found at the link below.

http://www.firstenergycorp.com/feconnect/Requirements_for_Transmission_Connected_Facilities.html

Below are conceptual estimates for the engineering/construction associated with Direct Connection requirements based upon similar projects that have been designed and/or constructed.

Option 2

Item	Description	Conceptual Cost Estimate
1	New 115 kV 3-breaker ring bus termination point at a new interconnection substation within 5 miles of Potter Substation.	$2,763,000
2	New 115 kV loop from Potter-Two Mile Run 115 kV line section into interconnection substation.	$250,000
3	115 kV transmission line extending from interconnection substation to the generation plant substation.	N/A Interconnection Customer cost. Line built, owned and maintained by the Interconnection Customer.
4	Relay and control work at Farmers Valley 115 kV Substation.	$250,000
5	Relay and control work at Potter 115 kV Substation.	$250,000
6	Fiber optic cable installation may be required from Potter Substation to the T121 interconnection substation (approximately 5 miles or less). To be confirmed in the System Impact Study.	$500,000

Conceptual Estimate: **$4,013,000**

Lead Time: 2.0 years from signed ISA

Notes:

- Detailed Engineering & Construction Estimates TBD via Facility Study

The above estimates do not include 1) tax gross-up, 2) property costs and site development up to rough grade which is to be provided by the Interconnection Customer, 3) interconnection metering and generation SCADA to be provided by the Interconnection Customer, 4) engineering and field activities for design review and commissioning of the Interconnection Customer's facilities, and 5) Real estate costs that may be required for right-of-way easements to extend the 115 kV line.

Potential network impacts were as follows:

Network Impacts

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

No problems were identified

Multiple Facility Contingency
(Double Circuit Tower Line for the full energy output. Stuck breaker and bus fault contingencies will be performed for the System Impact Study)

No problems were identified

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)

No problems were identified

Short Circuit

PJM studied the 230kV and above voltage systems and found no new breakers to be overdutied, and no addition to the fault current associated with any previously identified overdutied breakers. Additional short circuit study will be conducted during the System Impact Study phase of this project.

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

With T121 at full output (120 MW), there is the possibility the project may contribute to voltage collapse issues identified with earlier generation interconnection projects in the PJM queue. To mitigate the voltage concerns, network upgrades estimated to cost approximately $25,000,000 are proposed. Details of the upgrades and T121's contribution, if any, will be determined in the System Impact Study phase.

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

To be determined during the System Impact Study or Facilities Study phase of the study of this project.

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 Interconnection Customer 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 overloaded conditions associated with the overloaded element(s) identified.

As a result of the aggregate energy resources in the area, the following violations were identified:

1.

1. The N36 C-SABINSVI 115kV line loads from 180.5% to 206.4% (DC power flow) of its normal rating (130MVA) for non-contingency condition. This project contributes approximately 33.6MW to the thermal congestion.

2. The GOLD-N36 C 115kV line loads from 91.5% to 117.3% (DC power flow) of its normal rating (130MVA) for non-contingency condition. This project contributes approximately 33.6MW to the thermal congestion.

3. The Q72_TAP-SOUTH TR 115kV line loads from 326.2% to 353.1% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Grover - Towanda 230 kV(PN35A_T100_B). This project contributes approximately 32.0MW to the thermal congestion.

4. The SABINSVI-NILES VA 115kV line loads from 166.4% to 191.4% (DC power flow) of its normal rating (130MVA) for non-contingency condition. This project contributes approximately 32.5MW to the thermal congestion.

5. The NILES VA-MANSFIEL 115kV line loads from 178.9% to 208.6% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Warren – Glade 230 kV (PN28). This project contributes approximately 35.4MW to the thermal congestion.

6. The SOUTH TR-TOWANDA 115kV line loads from 338.8% to 370.1% (DC power flow) of its normal rating (94MVA) for non-contingency condition. This project contributes approximately 29.4MW to the thermal congestion.

7. The Q72_TAP-SOUTH TR 115kV line loads from 297.6% to 323.9% (DC power flow) of its normal rating (119MVA) for non-contingency condition. This project contributes approximately 31.3MW to the thermal congestion.

8. The MANSFIEL-Q72_TAP 115kV line loads from 187.5% to 214.3% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage (GROVER_TWANDA_A). This project contributes approximately 31.9MW to the thermal congestion.

9. The SOUTH TR-TOWANDA 115kV line loads from 425.8% to 453.5% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Grover - Towanda 230 kV (PN35A_T100_B). This project contributes approximately 33.0MW to the thermal congestion.

10. The NILES VA-MANSFIEL 115kV line loads from 151.8% to 178.6% (DC power flow) of its normal rating (119MVA) for non-contingency condition. This project contributes approximately 32.0MW to the thermal congestion.

11. The MANSFIEL-Q72_TAP 115kV line loads from 167.9% to 194.2% (DC power flow) of its normal rating (119MVA) for non-contingency condition. This project contributes approximately 31.3MW to the thermal congestion.

12. The SHADE GP-ROXBURY 115kV line loads from 118.7% to 122.4% (DC power flow) of its emergency rating (150MVA) for the single line contingency outage of Lewistown-S44 (LM) (PN29_WITH_S44OPT1B). This project contributes approximately 5.5MW to the thermal congestion.

13. The TWOMILE-FARM VLY 115kV line loads from 148.6% to 211.3% (DC power flow) of its emergency rating (179MVA) for the single line contingency outage (MANSFIEL_Q72). This project contributes approximately 112.2MW to the thermal congestion.

14. The #21COP2-TWOMILE 115kV line loads from 208.4% to 258.3% (DC power flow) of its emergency rating (225MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 112.2MW to the thermal congestion.

15. The FARM VLY-LEWIS RN 115kV line loads from 171.6% to 216.9% (DC power flow) of its emergency rating (146MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 66.2MW to the thermal congestion.

16. The #21COP2-TWOMILE 115kV line loads from 100.0% to 148.8% (DC power flow) of its normal rating (177MVA) for non-contingency condition. This project contributes approximately 86.4MW to the thermal congestion.

17. The TWOMILE-FARM VLY 115kV line loads from 92.8% to 146.1% (DC power flow) of its normal rating (162MVA) for non-contingency condition. This project contributes approximately 86.4MW to the thermal congestion.

18. The FOREST-01ELKO 230kV line loads from 93.7% to 107.1% (DC power flow) of its emergency rating (505MVA) for the single line contingency outage of Warren – Glade 230 kV (PN28). This project contributes approximately 67.5MW to the thermal congestion.

19. The RIDGWAY-WHETSTON 115kV line loads from 86.1% to 100.9% (DC power flow) of its emergency rating (159MVA) for the single line contingency outage of Forest – Elko 230 (PN9). This project contributes approximately 23.7MW to the thermal congestion.

20. The TOWANDA-E.SAYRE 115kV line loads from 115.5% to 119.9% (DC power flow) of its emergency rating (159MVA) for the single line contingency outage of Lackawanna to North Meshoppen 230 kV(PL63). This project contributes approximately 7.0MW to the thermal congestion.

21. The LEWIS RN-GLADE TP 230kV line loads from 97.5% to 128.6% (DC power flow) of its emergency rating (213MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 66.2MW to the thermal congestion.

22. The LEWIS RN-LEWIS RN 115/230kV transformer loads from 97.0% to 126.4% (DC power flow) of its emergency rating (225MVA) for the single line contingency outage (SOUTHTR_Q72). This project contributes approximately 66.2MW to the thermal congestion.

23. The 01SHINGL-LEWISTWN 230kV line loads from 99.4% to 104.2% (DC power flow) of its emergency rating (505MVA) for the single line contingency outage (GROVER_TWANDA_B). This project contributes approximately 24.1MW to the thermal congestion.

24. The FARM VLY-LEWIS RN 115kV line loads from 67.8% to 112.2% (DC power flow) of its normal rating (115MVA) for non-contingency condition. This project contributes approximately 51.1MW to the thermal congestion.

25. The E.SAYRE-N.WAV115 115kV line loads from 107.0% to 112.8% (DC power flow) of its emergency rating (119MVA) for the single line contingency outage of Lackawanna to North Meshoppen 230 kV (PL63). This project contributes approximately 7.0MW to the thermal congestion.

26. The HOMER CT-SHELOCTA 230kV line loads from 148.1% to 149.3% (DC power flow) of its emergency rating (854MVA) for the single line contingency outage of Handsome Lake to Wayne 345 kV (PN33A). This project contributes approximately 10.7MW to the thermal congestion.

27. The S44COP1-JUNIATA 230kV line loads from 116.9% to 120.2% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 16.5MW to the thermal congestion.

28. The SHELOCTA-KEYSTONE 230kV line loads from 136.6% to 138.1% (DC power flow) of its emergency rating (854MVA) for the single line contingency outage of Handsome Lake to Wayne 345kV (PN33A). This project contributes approximately 12.6MW to the thermal congestion.

29. The HOMER CT-SHELOCTA 230kV line loads from 138.0% to 139.8% (DC power flow) of its normal rating (694MVA) for non-contingency condition. This project contributes approximately 12.2MW to the thermal congestion.

30. The LEWISTWN-S44COP1 230kV line loads from 102.8% to 105.8% (DC power flow) of its emergency rating (617MVA) for the single line contingency outage (GROVER_TWANDA_B). This project contributes approximately 18.5MW to the thermal congestion.

31. The LEWISTWN-S44COP1 230kV line loads from 102.1% to 105.5% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 16.5MW to the thermal congestion.

32. The KEYSTONE-KEYSTONE 230/500kV transformer #4 loads from 120.9% to 123.0% (DC power flow) of its emergency rating (530MVA) for the single contingency outage of the Keystone 230/500 kV transformer #3 (PJM30). This project contributes approximately 11.0MW to the thermal congestion.

33. The KEYSTONE-KEYSTONE 230/500kV transformer #3 loads from 120.5% to 122.5% (DC power flow) of its emergency rating (534MVA) for the single contingency outage of the Keystone 230/500kV transformer #4 (PJM31). This project contributes approximately 11.0MW to the thermal congestion.

34. The SHELOCTA-KEYSTONE 230kV line loads from 127.4% to 129.5% (DC power flow) of its normal rating (694MVA) for non-contingency condition. This project contributes approximately 14.0MW to the thermal congestion.

35. The N.MESHPN-OXBOW 230kV line loads from 100.5% to 105.5% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 24.9MW to the thermal congestion.

36. The OXBOW-LACKAWNA 230kV line loads from 100.3% to 105.3% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 24.9MW to the thermal congestion.

37. The JUNIATA-JUNIA-H1 230 kV line loads from 106.1% to 107.9% of its emergency rating (573 MVA) for the single line contingency outage from Dauphin-Juniata (PL10). This project contributes approximately 10.2 MW to the thermal congestion.

38. The FARMERS VALLEY-RIDGWAY 115 kV line loads from 128.0% to 159.1% of its emergency rating (146 MVA) for the single line contingency outage from East Towanda-

South Troy-Q72. This project contributes approximately 45.4 MW to the thermal congestion.

39. The MANSFIELD 115/34.5 kV transformer loads from 293.3% to 320.4% of its emergency rating (25.1 MVA) for the single line contingency outage from South Troy-Q72. This project contributes approximately 6.8 MW to the thermal congestion.

40. The SOUTH TROY 115/34.5 kV transformer #1 loads from 290.0% to 313.9% of its emergency rating (21.0 MVA) for the single line contingency outage from East Towanda-South Troy. This project contributes approximately 5.0 MW to the thermal congestion.

41. The SOUTH TROY 115/34.5 kV transformer #2 loads from 295.3% to 319.3% of its emergency rating (20.9 MVA) for the single line contingency outage from East Towanda-South Troy. This project contributes approximately 5.0 MW to the thermal congestion.

42. The TOWANDA-NORTH MESHOPPEN 115 kV line loads from 125.3% to 133.0% of its emergency rating (159 MVA) for the single line contingency outage from North Meshoppen-East Towanda 230. This project contributes approximately 12.1 MW to the thermal congestion.

43. The GROVER 230/34.5 kV transformer loads from 182.6% to 206.1% of its emergency rating (75.9 MVA) for the single line contingency outage from East Towanda-South Troy. This project contributes approximately 17.8 MW to the thermal congestion.

44. The SHAWVILLE-01SHINGLETOWN 230 kV line loads from 102.0% to 105.3% of its emergency rating (505 MVA) for the single line contingency outage from Milesburg-Karthaus(AP170B). This project contributes approximately 16.6 MW to the thermal congestion.

Figure 1

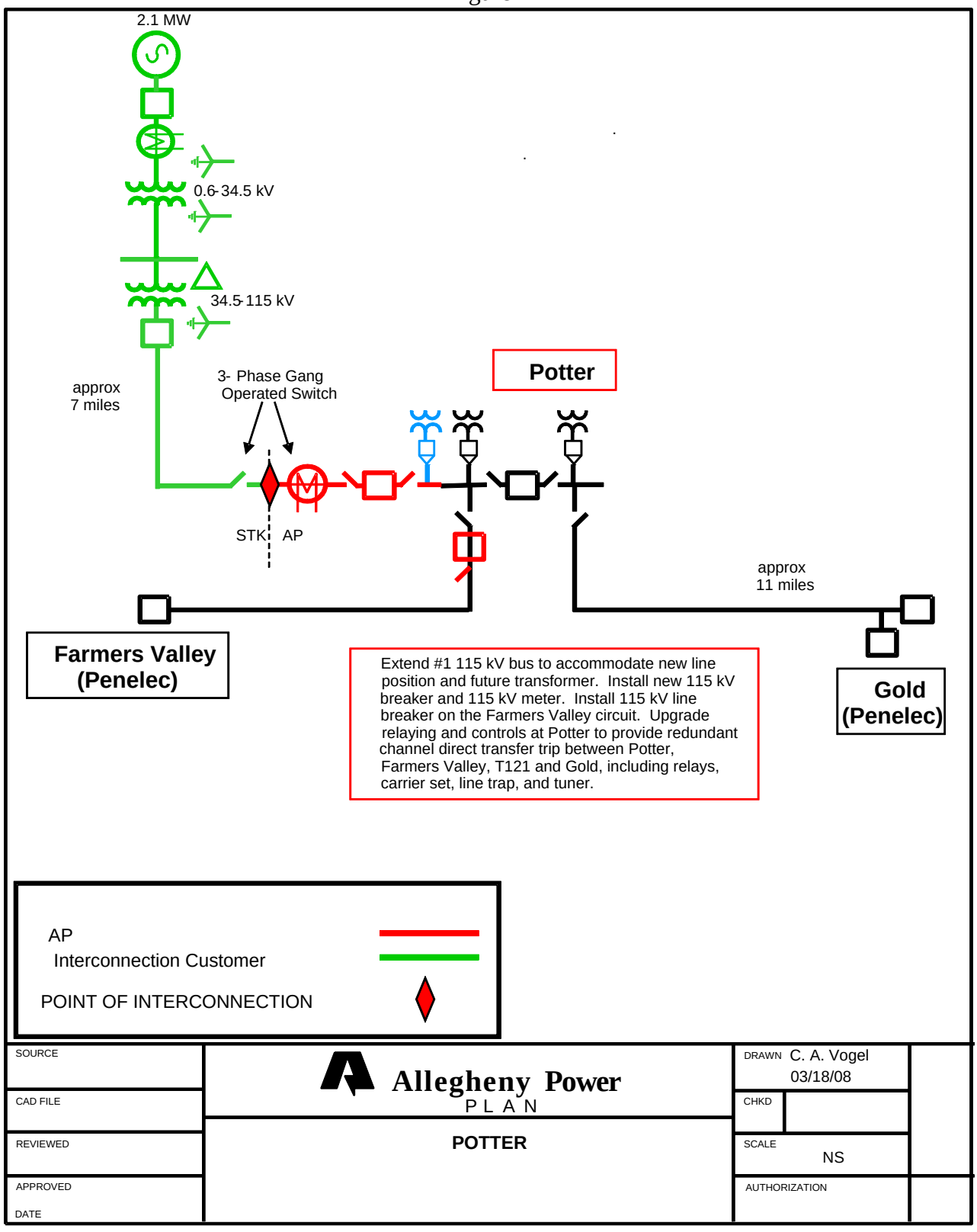

Figure 2

Option 2