

***Generation Interconnection Feasibility Study  
Report***

***PJM Generation Interconnection Request  
Queue Position #R45  
Mansfield - Tower Hill 115kV  
70 MW  
(14 MW capacity)***

**December 2008**

## **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 developer 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 developer 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#R45 project was studied as a 70 MW (14 MW of capacity) injection at two distinct points of the Penelec system. Option #1 studies direct connection to Tower Hill 115 kV substation, while option #2 studies the interconnection to tap Mansfield to Tower Hill 115 kV line. Project #R45 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. 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.

## **Design Requirements**

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

FirstEnergy will complete detailed relay coordination studies to identify off-site relay setting changes required due to this generation interconnection during the Facilities Study 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 developer.

## **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.

## Direct Connection Facilities

It is proposed that the project be connected at a new 115 kV ring bus. The developer is responsible for constructing all of the facilities on its side of the Point of Interconnection, which will be between the 115 kV line and the customer substation.

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>

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 1**

Item	Description	Conceptual Cost Estimate
1	New 115 kV 4-breaker ring bus termination point at existing Tower Hill substation.	\$3,350,000
2	New 115 kV loop into Tower Hill 115 kV Substation.	\$250,000
3	115 kV transmission line extending from Tower Hill 115 kV Substation to the generation plant interconnection substation.	N/A Developer cost. Line built, owned and maintained by the developer.
4	Relay and control work at Mansfield 115 kV Substation.	\$250,000
5	Fiber optic cable installation from Mansfield 115 kV Substation to Tower Hill 115 kV Substation (approximately 11 miles)	\$1,100,000

Conceptual Estimate:

**\$4,950,000**

Estimated Lead Time:

2.0 years from signed CSA

Figure 1 provides a conceptual one line diagram of the Option#1 connection.

**Option 2**

Item	Description	Conceptual Cost Estimate
1	New 115 kV 3-breaker ring bus termination point at a new interconnection substation.	\$2,763,000
2	New 115 kV loop into interconnection substation.	\$250,000
3	115 kV transmission line extending from interconnection substation to the generation plant interconnection substation.	N/A Developer cost. Line built, owned and maintained by the developer.
4	Relay and control work at Mansfield 115 kV Substation.	\$250,000
5	Relay and control work at Tower Hill 115 kV Substation.	\$250,000
6	Fiber optic cable installation from Mansfield 115 kV Substation to interconnection substation (approximately 10.75 miles)	\$1,075,000

Conceptual Estimate:

**\$4,588,000**

Estimated Lead Time:

2.0 years from signed CSA

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 developer, 3) interconnection metering and generation SCADA to be provided by the developer, 4) engineering and field activities for design review and commissioning of the developer's facilities, and 5) Real estate costs that may be required for right-of-way easements to extend the 115 kV line.

Figure 2 provides a conceptual one line diagram of the Option#2 connection.

## **Options #1&2:**

With R45 at full output (70 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 R45's contribution, if any, will be determined in the System Impact Study phase.

## **Network Impacts**

Potential network impacts were as follows:

### **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)*

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

## **Stability and Reactive Power Requirement**

*(Results of the dynamic studies should be inserted here)*

To be determined during the System Impact 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 developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

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

1. The Q72 - South Troy 115 kV line is overloaded at 313% of its emergency rating (119 MVA) for the outage of the Warren-Glade 230 kV line (Cont Id. PN28). The R45 project contributes approximately 46 MW to this overload.
2. The South Troy – Towanda 115 kV line is overloaded at 302% of its emergency rating (119 MVA) for the outage of the East Towanda-Grover 230 kV line (Cont Id. PN35B). The R45 project contributes approximately 43 MW to this overload.
3. The Mansfield – Q72 115 kV line is overloaded at 182% of its emergency rating (119 MVA) for the outage of the Warren-Glade 230 kV line (Cont Id. PN28). The R45 project contributes approximately 46 MW to this overload.
4. The Oxbow - Lackawanna 230 kV line is overloaded at 134% of its emergency rating (617 MVA) for the outage of Susquehanna Unit 1 (Cont Id. PL57). The R45 project contributes approximately 25 MW to this overload.
5. The Homer Ct - Shelocta 230 kV line is overloaded at 172% of its emergency rating (854 MVA) for the outage of Erie West-Wayne 345 kV line (Cont Id. PN32). The R45 project contributes approximately 11 MW to this overload.
6. The North Meshoppen – Oxbow 230 kV line is overloaded at 135% of its emergency rating (617 MVA) for the outage of Susquehanna Unit 1 (Cont Id. PL57). The R45 project contributes approximately 25 MW to this overload.
7. The Shelocta – Keystone 230 kV line is overloaded at 180% of its emergency rating (854 MVA) for the outage of Erie West-Wayne 345 kV line (Cont Id. PN32). The R45 project contributes approximately 12 MW to this overload.
8. The Keystone 500/230 kV ckt#3 transformer is overloaded at 155% of its emergency rating (643 MVA) for the outage of the Keystone #4 transformer (Cont Id. PJM31). The R45 project contributes approximately 9 MW to this overload.
9. The Keystone 500/230 kV ckt#4 transformer is overloaded at 157% of its emergency rating (634 MVA) for the outage of the Keystone #3 transformer (Cont Id. PJM30). The R45 project contributes approximately 9 MW to this overload.
10. The Lewistown - Juniata 230 kV line is overloaded at 160% of its emergency rating (615 MVA) for the outage the Homer City-Shelocta-Keystone 230 kV (Cont Id. PN41). The R45 project contributes approximately 9 MW to this overload.

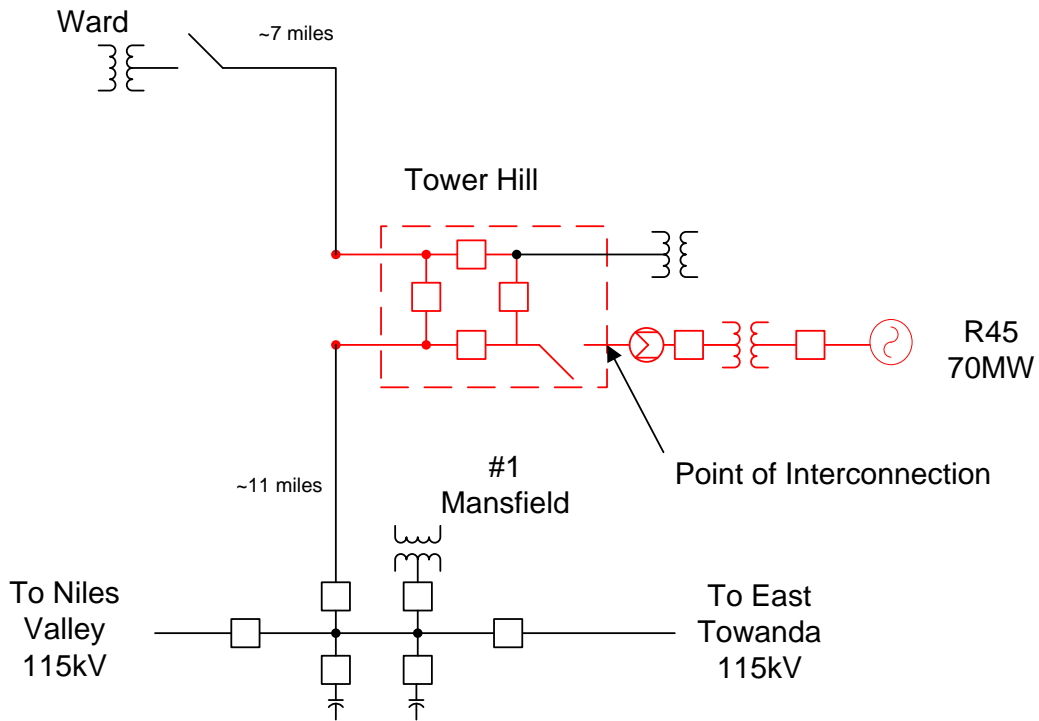
11. The Q72 - South Troy 115 kV line is overloaded at 289% of its normal rating (119 MVA) for non-contingency conditions. The R45 project contributes approximately 46 MW to this overload.
12. The South Troy – Towanda 115 kV line is overloaded at 335% of its normal rating (94 MVA) for non-contingency conditions. The R45 project contributes approximately 43 MW to this overload.
13. The Mansfield – Q72 115 kV line is overloaded at 160% of its normal rating (119 MVA) for non-contingency conditions. The R45 project contributes approximately 46 MW to this overload.
14. The Oxbow - Lackawanna 230 kV line is overloaded at 139% of its normal rating (499 MVA) for non-contingency conditions. The R45 project contributes approximately 25 MW to this overload.
15. The Homer Ct - Shelocta 230 kV line is overloaded at 168% of its normal rating (694 MVA) for the non-contingency conditions. The R45 project contributes approximately 10 MW to this overload.
16. The North Meshoppen – Oxbow 230 kV line is overloaded at 140% of its normal rating (499 MVA) for non-contingency conditions. The R45 project contributes approximately 25 MW to this overload.
17. The Shelocta – Keystone 230 kV line is overloaded at 179% of its normal rating (694 MVA) for non-contingency conditions. The R45 project contributes approximately 12 MW to this overload.
18. The Keystone 500/230 kV ckt#3 transformer is overloaded at 105% of its normal rating (496 MVA) for non-contingency conditions. The R45 project contributes approximately 6 MW to this overload.
19. The Keystone 500/230 kV ckt#4 transformer is overloaded at 105% of its normal rating (493 MVA) for non-contingency conditions. The R45 project contributes approximately 6 MW to this overload.
20. The Lewistown - Juniata 230 kV line is overloaded at 152% of its normal rating (499 MVA) for non-contingency conditions. The R45 project contributes approximately 7 MW to this overload.
21. The East Towanda-North Meshoppen 230 kV line is overloaded at 110% of its emergency rating (554 MVA) for the outage of Susquehanna Unit 1 (Cont Id. PL57). The R45 project contributes approximately 18 MW to this overload.

22. The East Towanda-North Meshoppen 230 kV line is overloaded at 104% of its normal rating (488 MVA) for non-contingency conditions. The R45 project contributes approximately 18 MW to this overload.
23. The Milesburg - Dale 230 kV line is overloaded at 101% of its emergency rating (505 MVA) for the outage of the Shawville-Shingletown 230 kV line (Cont Id. PN26). The R45 project contributes approximately 7 MW to this overload.
24. The L19-Milesburg 230 kV line is overloaded at 104% of its emergency rating (593 MVA) for the outage of the Shawville-Shingletown 230 kV line (Cont Id. PN26). The R45 project contributes approximately 7 MW to this overload.
25. The Potter – Two Mile 115 kV line is overloaded at 194% of its emergency rating (225 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 55 MW to this overload.
26. The Two Mile-Farmers Valley 115 kV line is overloaded at 228% of its emergency rating (179 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 55 MW to this overload.
27. The Farmers Valley-Ridgway 115 kV line is overloaded at 126% of its emergency rating (146 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 22 MW to this overload.
28. The Farmers Valley-Lewis Run 115 kV line is overloaded at 145% of its emergency rating (146 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 33 MW to this overload.
29. The Gold-O52 115 kV line is overloaded at 161% of its emergency rating (225 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 55 MW to this overload.
30. The Mansfield-Niles Valley 115 kV line is overloaded at 169% of its emergency rating (119 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 56 MW to this overload.
31. The Mansfield 115/34.5 kV transformer is overloaded at 374% of its emergency rating (25.1 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 13 MW to this overload.
32. The N36-Gold 115 kV line is overloaded at 232% of its emergency rating (159 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 55 MW to this overload.







33. The O52-Potter 115 kV line is overloaded at 200% of its emergency rating (225 MVA) for the outage of the South Troy-Q72 115 kV line. The R45 project contributes approximately 55 MW to this overload.
34. The South Troy 115/34.5 kV transformer #1 is overloaded at 282% of its emergency rating (21 MVA) for the outage of the East Towanda-South Troy 115 kV line. The R45 project contributes approximately 7 MW to this overload.
35. The South Troy 115/34.5 kV transformer #2 is overloaded at 287% of its emergency rating (20.9 MVA) for the outage of the East Towanda-South Troy 115 kV line. The R45 project contributes approximately 7 MW to this overload.
36. The Grover 230/34.5 kV transformer is overloaded at 176% of its emergency rating (75.9 MVA) for the outage of the East Towanda-South Troy 115 kV line. The R45 project contributes approximately 21 MW to this overload.
37. The East Towanda-North Meshoppen 115 kV line is overloaded at 124% of its emergency rating (159 MVA) for the outage of the East Towanda-North Meshoppen 230 kV line (Cont Id. PN47b). The R45 project contributes approximately 10 MW to this overload.
38. The North Meshoppen 230/115 kV transformer #3 is overloaded at 104% of its emergency rating (201 MVA) for the outage of the East Towanda-North Meshoppen 230 kV line (Cont Id. PN47b). The R45 project contributes approximately 10 MW to this overload.
39. The Shawville-Shingletown 230 kV line is overloaded at 114% of its emergency rating (505 MVA) for the outage of the L19-Milesburg 230 kV line (Cont Id. AP170B). The R45 project contributes approximately 6 MW to this overload.
40. The Shingletown-Lewistown 230 kV line is overloaded at 131% of its emergency rating (505 MVA) for the outage of the Lewistown-Raystown 230 kV line (Cont Id. PN38). The R45 project contributes approximately 8 MW to this overload.
41. The Shingletown-Lewistown 230 kV line is overloaded at 102% of its normal rating (426 MVA) for non-contingency conditions. The R45 project contributes approximately 8 MW to this overload.
42. The Ridgway-Whetstone 115 kV line is overloaded at 105% of its emergency rating (159 MVA) for the outage of the Forest-Elko 230 kV line (Cont Id. PN9). The R45 project contributes approximately 5 MW to this overload.
43. The Blooming Grove-Bushkill 230 kV line is overloaded at 114% of its emergency rating (558 MVA) for the outage of the Wescosville-Alburtis 500 kV line (Cont Id. PJM66). The R45 project contributes approximately 6 MW to this overload.

44. The Lackawanna-Peckville 230 kV line is overloaded at 120% of its emergency rating (574 MVA) for the outage of the Wescosville-Alburtis 500 kV line (Cont Id. PJM66). The R45 project contributes approximately 6 MW to this overload.
45. The Peckville-Peckville H5 230 kV line is overloaded at 125% of its emergency rating (558 MVA) for the outage of the Wescosville-Alburtis 500 kV line (Cont Id. PJM66). The R45 project contributes approximately 6 MW to this overload.
46. The Blooming Grove H2-Blooming Grove 230 kV line is overloaded at 120% of its emergency rating (558 MVA) for the outage of the Wescosville-Alburtis 500 kV line (Cont Id. PJM66). The R45 project contributes approximately 6 MW to this overload.
47. The Peckville H5-Blooming Grove 230 kV line is overloaded at 127% of its emergency rating (558 MVA) for the outage of the Wescosville-Alburtis 500 kV line (Cont Id. PJM66). The R45 project contributes approximately 6 MW to this overload.

**Figure #1**  
(Option 1)

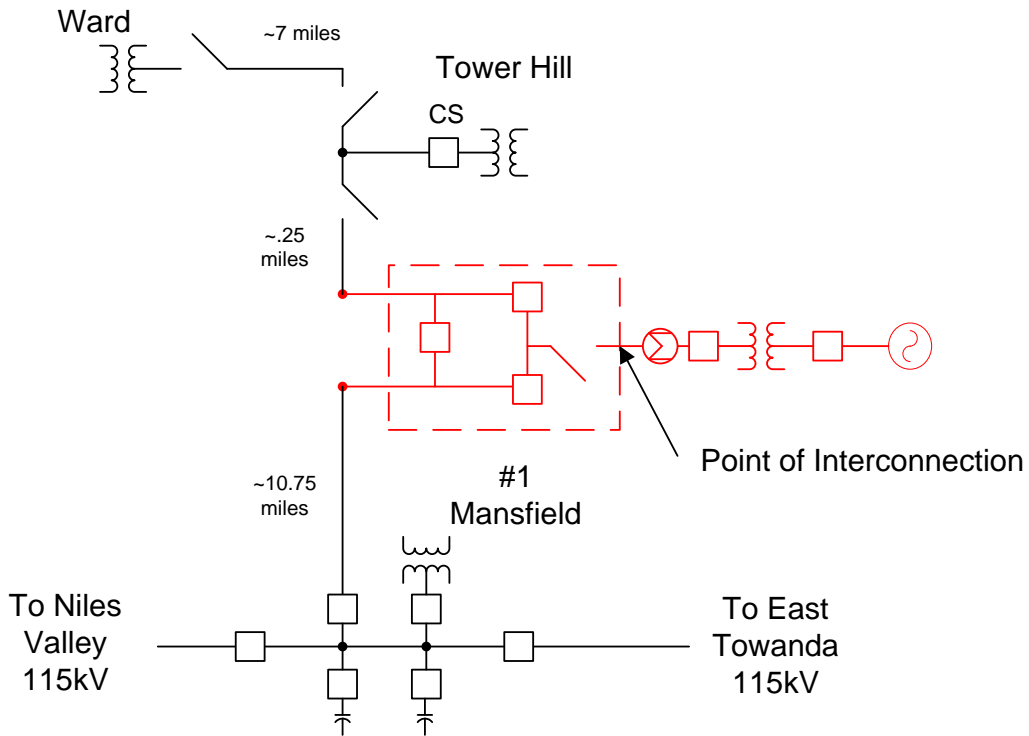


**Legend**

-  Capacitor
-  Generator
-  Breaker
-  Transformer
-  Disconnect Switch
-  Revenue Meter

All facilities depicted in black are existing facilities. All facilities depicted in red are facilities to be added as a result of this Interconnection Request.

Figure #2  
(Option 2)



**Legend**

- |← Capacitor
- ⊕ Generator
- Breaker
- ⌚ Transformer
- |/ Disconnect Switch
- ⊙ Revenue Meter

All facilities depicted in black are existing facilities. All facilities depicted in red are facilities to be added as a result of this Interconnection Request.