

***Generation Interconnection Feasibility Study  
Report***

***PJM Generation Interconnection Request  
Queue Position #R32  
Salix-Claysburg 115kV  
75 MW  
(15MW capacity)***

**September 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/trans-standard.html>

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 #R32 project was studied as a 75MW (15MW Capacity Resource) interconnection as a tap between Salix – Claysburg 115 kV line. Project #R32 was evaluated for compliance with reliability criteria for summer peak conditions in 2011. A simplified one line diagram of the proposed project is shown in Figure #1.

## **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*

Reactive Power requirements will be specified during the System Impact Study and / or the Facilities Study phase of the project.

## **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 developer will be charged for actual costs. Any under-runs or over-runs will be reconciled at the conclusion of the project.

## **Direct Connection Facilities**

Connection to the Salix – Claysburg 115kV line would be through a proposed 115 kV substation (Krayn Substation) designed with a 4 breaker ring bus (see Figure 1). This substation was proposed by the developer for project O18 and provides a position on the ring bus to connect project R32. Assuming connection of R32 onto the ring bus at Krayn Substation the developer will have to construct the line section and dead-end structure into the substation. This substation will be built

for the sole benefit of the developer and may thus be subject to ongoing maintenance costs. The developer 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.pjm.com/planning/trans-standard.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.

Item	Description	Conceptual Cost Estimate
1	Proposed Krayn Substation 4-breaker ring bus termination point.	N/A – substation being built under the O18 project
2	New 115 kV line into interconnection substation.	\$250,000
3	115 kV transmission line extending from the new interconnection substation structure to the generation plant substation.	N/A Developer cost. Line built, owned and maintained by the developer.

Conceptual Estimate:

\$250,000

Estimated Lead Time:

0.5 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 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.

Potential network impacts were as follows:

## **R08Op2, R09Op1 & R32**

### **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)*

The mitigations shown below present one method to eliminate overloads but addresses the limited scope of this project (R032) only. If several of these projects become feasible the best/least cost solution may be to build 230 kV line(s) to shunt the power onto the 230 kV which would eliminate the majority of 115 kV overloads. The 230 kV options can be explored in an impact study when the scope of active project become better defined.

1. The Claysburg – R09opt1 115 kV line is overloaded at 221% (396 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 29 MW to this overload.
2. The Summit – R09OPT1 115 kV line is overloaded at 240% (429 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 29 MW to this overload.
3. The Somerset – Q34 115 kV line is overloaded at 113% (179 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload.
4. The Q34 - Rockwood 115 kV line is overloaded at 138% (219 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload.
5. The Hillclay – Hilltop 115 kV line is overloaded at 250% (448 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to

Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 33 MW to this overload

6. The Hilltop – Rosedale 115 kV line is overloaded at 155% (277 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 25 MW to this overload
7. The Rosedale – Cooper 115 kV line is overloaded to 120% (216 MVA) of its emergency rating (180 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 19 MW to the overload
8. The Cooper - Seward 115 kV line is overloaded to 114% (210 MVA) of its emergency rating (184 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 20 MW to the overload.

### **New System Reinforcements**

None required

### **Contribution to Previously Identified System Reinforcements**

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

1. The Claysburg – R09opt1 115 kV line is overloaded at 221% (396 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 29 MW to this overload. To mitigate this overload would require the replacement of a 115kV disconnect switch, replacement of a 115kV line trap, and replacement of a 115kV substation conductor at the Claysburg substation as well as replacement of two (2) 115kV disconnect switches, a 115kV line trap, replacement of a 115kV CT circuit, replacement of a 115kV circuit breaker and substation conductor at the Summit substation. Additionally, approximately 12.13 miles of 115kV conductor must be upgraded / replaced. Total cost is estimated to be \$7,295,000.
2. The Summit – R09OPT1 115 kV line is overloaded at 240% (429 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 29 MW to this overload. Mitigation of this overload is accomplished through the upgrades specified in #1 above.

3. The Somerset – Q34 115 kV line is overloaded at 113% (179 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload. To mitigate this overload requires the replacement of a 115kV disconnect switch and two (2) 115kV CT circuits at the Somerset substation as well as the replacement of a 115kV disconnect switch at the Rockwood substation. Additionally, approximately 8.12 miles of 115kV conductor must be upgraded / replaced. The total cost of this upgrade is estimated to be \$2,643,000.
4. The Q34 - Rockwood 115 kV line is overloaded at 138% (219 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload. Mitigation of this overload is accomplished through the upgrades specified in #3 above.
5. The Hillclay – Hilltop 115 kV line is overloaded at 250% (448 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 33 MW to this overload. To mitigate this overload would require the replacement of a 115kV disconnect switch, a 115kV line trap, two (2) 115kV CT circuits, a 115kV circuit breaker, and substation conductor at the Hilltop substation as well as the upgrade / replacement of approximately 4.73 miles of 115kV conductor. The total estimated cost to mitigate this overload is approximately \$2,095,750.
6. The Hilltop – Rosedale 115 kV line is overloaded at 155% (277 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 25 MW to this overload. To mitigate this overload would require the replacement of a 115kV disconnect switch, a 115kV line trap, a 115kV CT circuit, and substation conductor at the Hilltop substation. The total estimated cost to mitigate this overload is approximately \$445,000.
7. The Rosedale – Cooper 115 kV line is overloaded to 120% (216 MVA) of its emergency rating (180 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 19 MW to the overload. To mitigate this overload would require the replacement of a 115KV line trap, and a 115kV CT circuit at the Cooper substation. The total estimated cost to mitigate this overload is approximately \$240,000.
8. The Cooper - Seward 115 kV line is overloaded to 114% (210 MVA) of its emergency rating (184 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 20 MW to the overload. To mitigate this overload would require the replacement of a 115kV line trap at the Cooper substation. The total estimated cost to mitigate this overload is approximately \$115,000.

## **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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

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

1. The Keystone – Conemaugh 500 kV line is overloaded at 160% (4821 MVA) of its emergency rating (3013 MVA) for the outage of Juniata – Keystone 500 kV line (Cont Id. PJM24B). The R32 project contributes approximately 8 MW to the overload.
2. The Keystone – Juniata-Keystone 500 kV line is overloaded at 135% (4725 MVA) of its emergency rating (3500 MVA) for the outage of Conemaugh – Keystone 500 kV line (Cont Id. PJM21). The R32 project contributes approximately 7 MW to the overload.
3. The Altoona – Raystown 230 kV line is overloaded to 142% (787 MVA) of its emergency rating (554 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 15 MW to the overload.
4. The Glory – Dixonville 115 kV line is overloaded to 191% of its emergency rating (124 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to the overload.
5. The Raystown – Lewistown 230 kV line is overloaded to 141% (781 MVA) of its emergency rating (554 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 16 MW to the overload.
6. The Summit – Q53 115 kV line is overloaded to 124% of its emergency rating (229 MVA) for the outage of Altoona – N39 230 kV line and Altoona 230/46 kV transformer (PN48A). The R32 project contributes approximately 9 MW to the overload.
7. The Q53 - Westfall 115 kV line is overloaded to 136% of its emergency rating (229 MVA) for the outage of Altoona – N39 230 kV line and Altoona 230/46 kV transformer (PN48A). The R32 project contributes approximately 9 MW to the overload.
8. The Tyrone N – Q36 115 kV line is overloaded to 114% of its emergency rating (146 MVA) for the outage of Lewistown - Raystown – Altoona 230 kV line (PN38). The R32 project contributes approximately 8 MW to the overload.

9. The Philips B – Shaw. 2 115 kV line is overloaded to 107% of its emergency rating (146 MVA) for the outage of Lewistown - Raystown – Altoona 230 kV line (PN38). The R32 project contributes approximately 6 MW to the overload.
10. The Timblin – Piney 115 kV line is overloaded to 135% of its emergency rating (124 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to the overload.
11. The Trade City - Timblin 115 kV line is overloaded to 143% of its emergency rating (146 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to the overload.
12. The Tower51 – Seward 115 kV line is overloaded at 219% of its emergency rating (159 MVA) for the outage of Homer Ct – Quemahoning – Hooversville 230 kV line and Hooversville 230/115 kV transformer (Cont Id. PN37). The R32 project contributes approximately 10 MW to this overload.
13. The Hooversville - Tower51 115 kV line is overloaded at 256% of its emergency rating (146 MVA) for the outage of Homer Ct – Quemahoning – Hooversville 230 kV line and Hooversville 230/115 kV transformer (Cont Id. PN37). The R32 project contributes approximately 10 MW to this overload.
14. The Rockwood – Penn-Mar 115 kV line is overloaded at 216% of its emergency rating (143 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
15. The Penn-Mar – Garrett 115 kV line is overloaded at 188% of its emergency rating (167 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
16. The Johnstown – N39 230 kV line is overloaded at 111% of its emergency rating (617 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
17. The Dixonville – Trade City 115 kV line is overloaded at 111% of its emergency rating (197 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to this overload.
18. The Homer City - Shelocta 230 kV line is overloaded at 180% of its emergency rating (854 MVA) for the outage of Erie West – Wayne 345 line and Wayne 345/115 kV transformer (Cont Id. PN32). The R32 project contributes approximately 29 MW to this overload.
19. The Shelocta – Keystone 230 kV line is overloaded at 185% of its emergency rating (854 MVA) for the outage of Erie West – Wayne 345 line and Wayne 345/115 kV transformer (Cont Id. PN32). The R32 project contributes approximately 35 MW to this overload.

20. The Hooversville – Quemahoning 230 kV line is overloaded at 148% of its emergency rating (263 MVA) for the outage of Garrett – Deep Creek – Penn Mar 115 kV line (Cont Id. 585). The R32 project contributes approximately 13 MW to this overload.
21. The Keystone 500/230 kV ckt#3 transformer is overloaded at 213% of its emergency rating (471 MVA) for the outage of Keystone 500/230 kV transformer ckt#4 (Cont Id. PJM31). The R32 project contributes approximately 25 MW to this overload.
22. The Keystone 500/230 kV ckt#4 transformer is overloaded at 215% of its emergency rating (465 MVA) for the outage of Keystone 500/230 kV transformer ckt#3 (Cont Id. PJM30). The R32 project contributes approximately 25 MW to this overload.
23. The Lewistown – Juniata 230 kV line is overloaded at 143% of its emergency rating (617 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 17 MW to this overload.
24. The Garrett – N33C 138 kV line is overloaded at 104% of its emergency rating (201 MVA) for the outage of Carlos 138 kV bus (Cont Id. 584). The R32 project contributes approximately 5 MW to this overload.
25. The 01Albright – N33C 138 kV line is overloaded at 130% of its emergency rating (201 MVA) for the outage of Carlos 138 kV bus (Cont Id. 584). The R32 project contributes approximately 5 MW to this overload.
26. The N39 – Altoona 230 kV line is overloaded at 128% of its emergency rating (197 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
27. The Q36 – PhilipsBurgh 115 kV line is overloaded at 142% of its emergency rating (197 MVA) for the outage of Lewistown - Raystown – Altoona 230 kV line (PN38). The R32 project contributes approximately 8 MW to this overload.
28. The Somerset – Pride 115 kV line is overloaded at 249% of its normal rating (115 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.
29. The P60C – Allegheny 115 kV line is overloaded at 185% of its normal rating (115 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.
30. The Allegheny – Pride 115 kV line is overloaded at 177% of its emergency rating (115 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.
31. The Oxbow - Lackawanna 230 kV line is overloaded at 147% of its emergency rating (504 MVA) for the generator outage of unit#1 at Susquehanna 24 kV substation (Cont Id. PL57). The R32 project contributes approximately 5 MW to this overload.

32. The North Meshoppen - Oxbow 230 kV line is overloaded at 123% of its normal rating (499 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.

### **Short Circuit**

PJM studied the 230kV and above system which identified no breakers to be overdutied as a result of this option. Additional short circuit study shall occur during the System Impact Study.

### **R08Op2, R09Op2 & R32**

#### **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)*

The mitigations shown below present one method to eliminate overloads but addresses the limited scope of this project (R032) only. If several of these projects become feasible the best/least cost solution may be to build 230 kV line(s) to shunt the power onto the 230 kV which would eliminate the majority of 115 kV overloads. The 230 kV options can be explored in an impact study when the scope of active project become better defined.

1. The Cooper - Seward 115 kV line is overloaded from 99% to 110% (202 MVA) of its emergency rating (184 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 20 MW to the overload.
2. The Garrett – N33C 138 kV line is overloaded from 99% to 102% of its emergency rating (201 MVA) for the **tower** outage of Frostburg to Ridgeley 138 kV line (Cont Id. 154). The R32 project contributes approximately 5 MW to this overload.

#### **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)*

3. The Claysburg - Summit 115 kV line is overloaded at 220% (394 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 29 MW to this overload.

4. The Somerset – Q34 115 kV line is overloaded at 111% (176 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload.
5. The Q34 - Rockwood 115 kV line is overloaded at 136% (216 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload.
6. The Hillclay – Hilltop 115 kV line is overloaded at 244% (400 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 33 MW to this overload.
7. The Hilltop – Rosedale 115 kV line is overloaded at 151% (270 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 25 MW to this overload.
8. The Rosedale – Cooper 115 kV line is overloaded to 116% (208 MVA) of its emergency rating (180 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 19 MW to the overload.

### **New System Reinforcements**

1. The Cooper - Seward 115 kV line is overloaded from 99% to 110% (202 MVA) of its emergency rating (184 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 20 MW to the overload. To mitigate this overload would require the replacement of a 115kV line trap at the Cooper substation. The total estimated cost to mitigate this overload is approximately \$115,000.
2. The Garrett – N33C 138 kV line is overloaded from 99% to 102% of its emergency rating (201 MVA) for the **tower** outage of Frostburg to Ridgeley 138 kV line (Cont Id. 154). The R32 project contributes approximately 5 MW to this overload. The estimated cost for this work is \$1,575,000 in 2009 dollars.

### **Contribution to Previously Identified System Reinforcements**

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

3. The Claysburg - Summit 115 kV line is overloaded at 220% (394 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 29 MW to

this overload. To mitigate this overload would require the replacement of a 115kV disconnect switch, replacement of a 115kV line trap, and replacement of a 115kV substation conductor at the Claysburg substation as well as replacement of two (2) 115kV disconnect switches, a 115kV line trap, replacement of a 115kV CT circuit, replacement of a 115kV circuit breaker and substation conductor at the Summit substation. Additionally, approximately 12.13 miles of 115kV conductor must be upgraded / replaced. Total cost is estimated to be \$7,295,000.

4. The Somerset – Q34 115 kV line is overloaded at 111% (176 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload. To mitigate this overload requires the replacement of a 115kV disconnect switch and two (2) 115kV CT circuits at the Somerset substation as well as the replacement of a 115kV disconnect switch at the Rockwood substation. Additionally, approximately 8.12 miles of 115kV conductor must be upgraded / replaced. The total cost of this upgrade is estimated to be \$2,643,000.
5. The Q34 - Rockwood 115 kV line is overloaded at 136% (216 MVA) of its emergency rating (159 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 9 MW to this overload. Mitigation of this overload is accomplished through the upgrades specified in #4 above.
6. The Hillclay – Hilltop 115 kV line is overloaded at 244% (400 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 33 MW to this overload. To mitigate this overload would require the replacement of a 115kV disconnect switch, a 115kV line trap, two (2) 115kV CT circuits, a 115kV circuit breaker, and substation conductor at the Hilltop substation as well as the upgrade / replacement of approximately 4.73 miles of 115kV conductor. The total estimated cost to mitigate this overload is approximately \$2,095,750.
7. The Hilltop – Rosedale 115 kV line is overloaded at 151% (270 MVA) of its emergency rating (179 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 25 MW to this overload. To mitigate this overload would require the replacement of a 115kV disconnect switch, a 115kV line trap, a 115kV CT circuit, and substation conductor at the Hilltop substation. The total estimated cost to mitigate this overload is approximately \$445,000.
8. The Rosedale – Cooper 115 kV line is overloaded to 116% (208 MVA) of its emergency rating (180 MVA) for the **tower** outage of Homer City to Quemahoning and Seward to Tower 230 kV line (Cont Id. 2PN). The R32 project contributes approximately 19 MW to the overload. To mitigate this overload would require the replacement of a 115KV line trap, and a 115kV CT circuit at the Cooper substation. The total estimated cost to mitigate this overload is approximately \$240,000.

### **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 Transmission Interconnection Request. Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

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

1. The Keystone – Conemaugh 500 kV line is overloaded at 160% of its emergency rating (3013 MVA) for the outage of Juniata – Keystone 500 kV line (Cont Id. PJM24B). The R32 project contributes approximately 8 MW to the overload.
2. The Keystone – Juniata-Keystone 500 kV line is overloaded at 135% of its emergency rating (3500 MVA) for the outage of Conemaugh – Keystone 500 kV line (Cont Id. PJM21). The R32 project contributes approximately 7 MW to the overload.
3. The Altoona – Raystown 230 kV line is overloaded to 143% of its emergency rating (554 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 15 MW to the overload.
4. The Glory – Dixonville 115 kV line is overloaded to 190% of its emergency rating (124 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to the overload.
5. The Raystown – Lewistown 230 kV line is overloaded to 143% of its emergency rating (554 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 16 MW to the overload.
6. The Summit – Q53 115 kV line is overloaded to 120% of its emergency rating (229 MVA) for the outage of Altoona – N39 230 kV line and Altoona 230/46 kV transformer (PN48A). The R32 project contributes approximately 9 MW to the overload.
7. The Q53 - Westfall 115 kV line is overloaded to 132% of its emergency rating (229 MVA) for the outage of Altoona – N39 230 kV line and Altoona 230/46 kV transformer (PN48A). The R32 project contributes approximately 9 MW to the overload.
8. The Tyrone N – Q36 115 kV line is overloaded to 111% of its emergency rating (146 MVA) for the outage of Lewistown - Raystown – Altoona 230 kV line (PN38). The R32 project contributes approximately 8 MW to the overload.

9. The Philips B – Shaw. 2 115 kV line is overloaded to 104% of its emergency rating (146 MVA) for the outage of Lewistown - Raystown – Altoona 230 kV line (PN38). The R32 project contributes approximately 6 MW to the overload.
10. The Timblin – Piney 115 kV line is overloaded to 134% of its emergency rating (124 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to the overload.
11. The Trade City - Timblin 115 kV line is overloaded to 141% of its emergency rating (146 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to the overload.
12. The Tower51 – Seward 115 kV line is overloaded at 217% of its emergency rating (159 MVA) for the outage of Homer Ct – Quemahoning – Hooversville 230 kV line and Hooversville 230/115 kV transformer (Cont Id. PN37). The R32 project contributes approximately 10 MW to this overload.
13. The Hooversville - Tower51 115 kV line is overloaded at 254% of its emergency rating (146 MVA) for the outage of Homer Ct – Quemahoning – Hooversville 230 kV line and Hooversville 230/115 kV transformer (Cont Id. PN37). The R32 project contributes approximately 10 MW to this overload.
14. The Rockwood – Penn-Mar 115 kV line is overloaded at 215% of its emergency rating (143 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
15. The Penn-Mar – Garrett 115 kV line is overloaded at 187% of its emergency rating (167 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
16. The Johnstown – N39 230 kV line is overloaded at 110% of its emergency rating (617 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
17. The Dixonville – Trade City 115 kV line is overloaded at 110% of its emergency rating (197 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 8 MW to this overload.
18. The Homer City - Shelocta 230 kV line is overloaded at 180% of its emergency rating (854 MVA) for the outage of Erie West – Wayne 345 line and Wayne 345/115 kV transformer (Cont Id. PN32). The R32 project contributes approximately 29 MW to this overload.
19. The Shelocta – Keystone 230 kV line is overloaded at 185% of its emergency rating (854 MVA) for the outage of Erie West – Wayne 345 line and Wayne 345/115 kV transformer (Cont Id. PN32). The R32 project contributes approximately 35 MW to this overload.

20. The Hooversville – Quemahoning 230 kV line is overloaded at 148% of its emergency rating (263 MVA) for the outage of Garrett – Deep Creek – Penn Mar 115 kV line (Cont Id. 585). The R32 project contributes approximately 13 MW to this overload.
21. The Keystone 500/230 kV ckt#3 transformer is overloaded at 213% of its emergency rating (471 MVA) for the outage of Keystone 500/230 kV transformer ckt#4 (Cont Id. PJM31). The R32 project contributes approximately 25 MW to this overload.
22. The Keystone 500/230 kV ckt#4 transformer is overloaded at 215% of its emergency rating (465 MVA) for the outage of Keystone 500/230 kV transformer ckt#3 (Cont Id. PJM30). The R32 project contributes approximately 25 MW to this overload.
23. The Lewistown – Juniata 230 kV line is overloaded at 144% of its emergency rating (617 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 17 MW to this overload.
24. The Juniata – Junia-H1 230 kV line is overloaded at 100% of its emergency rating (573 MVA) for the outage of Dauphin – Juniata 230 kV line and Dauphin 230/69 kV transformer (Cont Id. PL10). The R32 project contributes approximately 6 MW to this overload.
25. The Garrett – N33C 138 kV line is overloaded at 102% of its emergency rating (201 MVA) for the outage of Carlos 138 kV bus (Cont Id. 584). The R32 project contributes approximately 5 MW to this overload.
26. The 01Albright – N33C 138 kV line is overloaded at 128% of its emergency rating (201 MVA) for the outage of Carlos 138 kV bus (Cont Id. 584). The R32 project contributes approximately 5 MW to this overload.
27. The N39 – Altoona 230 kV line is overloaded at 128% of its emergency rating (197 MVA) for the outage of Homer CT – Shelocta – Keystone 230 kV line (Cont Id. PN41). The R32 project contributes approximately 9 MW to this overload.
28. The Q36 – PhilipsBurgh 115 kV line is overloaded at 140% of its emergency rating (197 MVA) for the outage of Lewistown - Raystown – Altoona 230 kV line (PN38). The R32 project contributes approximately 8 MW to this overload.
29. The Somerset – Pride 115 kV line is overloaded at 246% of its normal rating (115 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.
30. The P60C – Allegheny 115 kV line is overloaded at 182% of its normal rating (115 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.
31. The Allegheny – Pride 115 kV line is overloaded at 175% of its emergency rating (115 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.

32. The Oxbow - Lackawanna 230 kV line is overloaded at 147% of its emergency rating (504 MVA) for the generator outage of unit#1 at Susquehanna 24 kV substation (Cont Id. PL57). The R32 project contributes approximately 5 MW to this overload.
33. The North Meshoppen - Oxbow 230 kV line is overloaded at 123% of its normal rating (499 MVA) at base case. The R32 project contributes approximately 5 MW to this overload.

### **Short Circuit**

PJM studied the 230kV and above system which identified no breakers to be overdutied as a result of this option. Additional short circuit study shall occur during the System Impact Study.

Figure #1

