

#N02_AEP139 McClung (Old Field Mountain) 138kV Generation Interconnection

This analysis was completed to assess the reliability impact for an increase in generator capability interconnecting to the PJM system as a capacity resource.

Alternative #1 – Radial Connection to McClung

Network Impacts

The transmission system was evaluated with the #N02_AEP139 project as a total injection of 200 MW (40 MW of Capacity) into the McClung (Quinwood) 138 kV substation. Project #N02_AEP139 was evaluated for compliance with reliability criteria for summer peak conditions in 2008. Potential network impacts to the transmission system were as follows:

Generator Deliverability

No problems identified

Multiple Facility Contingency – Tower Line Outages

No problems identified

Short Circuit

No problems identified

New System Reinforcements

None required

Contribution to Previously Identified System Reinforcements

Normal System

Contributes to the overload of two 138kV switches and one 138kV wave trap on the Crupperneck terminal of the Grassy Falls-Crupperneck circuit.

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 Grassy Falls – Nettie 138 kV circuit is overloaded to 285% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The project, with a distribution factor of 74%, contributes approximately 148 MW to the contingency overloaded facility.
2. The Crupperneck – Nettie 138 kV circuit is overloaded to 281% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The project,

with a distribution factor of 74%, contributes approximately 148 MW to the contingency overloaded facility.

3. The Grassy Falls -- McClung 138 kV circuit is overloaded to 181% of its normal rating (80 MVA). The project, with a distribution factor of 82%, contributes approximately 164 MW to the normally overloaded facility.

Network Impact – McClung/Quinwood Station Connection on the AEP 69kV system

The impact of the proposed generation facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria requires that the McClung/Quinwood area meet Single Contingency performance criteria, which is consistent with the AEP FERC Form 715. Therefore, this criterion was used to assess the impact of this proposed facility on the AEP 69kV system. The Invenegy N02_AEP139 project was studied at 200 MW gross output consistent with the interconnection application. The results are summarized below.

In general, PJM does not require system upgrade for delivery of the energy portion of the generation project since PJM is not relying on the energy portion of the generation project to meet the PJM load requirements. Operationally, reliability can be maintained because, for those facilities monitored by PJM Operations, the generation will be reduced (redispatch) to eliminate any overload. The following overloads were identified on the AEP system for the entire output (energy and capacity) of the generation project. These overloaded circuits are not monitored by PJM Operations. PJM will need to review these overloads during the Impact Study to determine if they will require upgrade based on the delivery of the energy and capacity output of the project.

Normal System

- Projected loading of the Layland - McClung 69 kV line loading is up to 123% of its capability

Single Contingency

An outage of the Quinwood - Grassy Falls 138 kV line results in the following three facilities to be loaded to levels well above their respective capabilities:

- Projected loading of the McClung 138/69 kV 130 MVA transformer is up to 122 % of its capability
- Projected loading of the McClung - T-117 69 kV line loading is up to 183% of its capability
- Projected loading of the Layland - McClung 69 kV line loading is up to 217% of its capability

Short Circuit Analysis

No problems identified.

New System Reinforcements

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the addition of this facility at this location. Construction of a 138 kV line from AEP's McClung Station to AEP's Bradley Station and rebuilding of the McClung to Meadow Bridge 69 kV line would mitigate the thermal contingency loadings identified in this study. As previously stated,

the McClung Station cannot be expanded to permit the installation of a 138 kV line terminations and associated equipment and required metering facilities due to land limitations. The new line to Bradley Station will connect to the New Quinwood station.

The required transmission enhancements as identified by this study and associated budgetary cost estimates are listed below.

- Construct a 138 kV line from Quinwood Station to Bradley Station. The new Bradley-Quinwood 138 kV circuit will consist of 26 miles of new 138 kV line and conversion of 10.9 miles of existing 69 kV line to 138 kV operation.

Estimated Cost*	\$18,200,000
Right of Way*	\$ 1,900,000

- Rebuild 15 miles of 69 kV line from McClung Station to Meadow Bridge Station.

Estimated Cost*	\$ 5,921,000
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- Beury Mountain Station: Install steel pole to connect Bradley#2 line, which will become part of the Quinwood - Bradley 138 kV circuit. Disconnect from 69kv switches.

Estimated Cost*	\$ 95,200
Removal Cost*	\$ 5,000

- Bradley Station: Install 138 kV circuit breaker with associated line relaying and controls for the Quinwood circuit. Remove 69 kV circuit breaker "L".

Estimated Cost*	\$ 622,100
Removal Cost*	\$ 7,000

- Quinwood Station: Add a 138 kV breaker and one half with Line Traps, Line CCVT's. One line relay panel, and control panel. The line termination will be for the Bradley circuit.

Estimated Cost*	\$ 550,800
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- McRoss Station: Replace switches and bus conductor

Estimated Cost*	\$ 100,000
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- Meadow Bridge Station: Replace switch and bus conductor

Estimated Cost*	\$ 50,000
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Total Estimated System Modification Cost* (AEP Service territory)	\$27,451,100
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* The estimates are based in 2005 dollars and preliminary in nature, as they were determined without detailed engineering and design studies. Final estimates will require detailed engineering analysis, including on-site review and investigation. It will take a minimum of nine months after obtaining the authorization to design and construct the facilities as outlined above excluding any potential issues related to acquiring required right-of-way.

Interconnection Facilities (AP)

- Perform a protection coordination review of the AP System area surrounding Grassy Falls Substation to determine if relaying modifications or relay-setting changes are required.

Estimated Cost **\$5,000**

Optional Reinforcements to Alleviate Operational Concerns

Line reconductoring

Grassy Falls – Nettie Tap 138 kV	1272 ACSR	3.33 miles	\$1,000,000
Crupperneck – Nettie Tap 138 kV	1272 ACSR	4.63 miles	\$1,400,000
Grassy Falls – McClung 138 kV	1272 ACSR	10.28 miles	\$3,100,000
Grassy Falls – Summerville 138 kV	1272 ACSR	12.37 miles	\$3,750,000
Summersville – Enon 304 Jct	1272 ACSR	3.50 miles	\$1,050,000

1272 ACSR Conductor Ratings

	<u>Amps</u>	<u>MVA</u>
summer continuous	1211	289
summer 4 hour	1488	356
summer 1/4 hour	1711	409

Substation Upgrades:

Crupperneck reconductor 138 kV buses with 1272 ACSR **\$175,000**

Grassy Falls - (2 terminals) **\$150,000**

- Breaker Riser Bus & Line Side - 1024.5 ACAR (Replace with 1272)
- Line Trap - 1200 Amp (Replace with 2000 Amp)
- Line Riser -- 954 ACSR (Replace with 1272)
- Relay Circuitry - 800/5 (CT ratio and relay changes)
- RTU MW - 240 MVA (Replace with digital panel meter)
- RTU Amps - 1200 Amps (Replace with digital panel meter)

Crupperneck - (1 terminal) **\$150,000**

- Bus Side & Line Side Breaker Disc. - 600 Amp (Replace with 1200 Amp)
- Breaker Riser Bus & Line Side - 954 ACSR (Replace with 1272 ACSR)
- Disc. Leads - 954 ACSR (Replace with 1272 ACSR)

Line Trap - 400 Amp (Replace with 2000 Amp)
Line Riser -- 954 ACSR (Replace with 1272 ACSR)
Relay Circuitry - 800/5 (CT ratio and relay changes)
RTU MW - 240 MVA (Replace with digital panel meter)
RTU Amps - 1200 Amps (Replace with digital panel meter)

Total cost of upgrades **\$9,775,000**

Contribution to Previously Identified System Reinforcements

The N02_AEP139 project will be allocated a portion of the estimated **\$55,000** cost for the replacement of two 138kV switches and one wave trap on the Crupperneck terminal of the Grassy Falls-Crupperneck circuit.

Alternative #2 – Create a new line between Project M24 & N02 AEP139

Network Impacts

The transmission n system was evaluated with the #N02_AEP139 project as a total injection of 200 MW (40 MW of Capacity) into the McClung 138 kV substation with a connecting path at 138kV between the #N02_AEP139 and the #M24 projects. Project #N02_AEP139 was evaluated for compliance with reliability criteria for summer peak conditions in 2008. Potential network impacts were as follows:

Generator Deliverability

No problems identified

Multiple Facility Contingency – Tower Line Outages

No problem

New System Reinforcements

None

Short Circuit

No problem

Contribution to Previously Identified System Reinforcements

Normal System

This project contributes to the overload of two 138kV switches and one 138kV wave trap on the Crupperneck terminal of the Grassy Falls-Crupperneck circuit.

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 Grassy Falls – Nettie 138 kV circuit is overloaded to 288% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The project, with a distribution factor of 77%, contributes approximately 153 MW to the contingency overloaded facility.
2. The Crupperneck – Nettie 138 kV circuit is overloaded to 284% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The project, with a distribution factor of 77%, contributes approximately 153 MW to the contingency overloaded facility.
3. The M24 – N2AEP139 138 kV circuit is overloaded to 118% of its normal rating (80 MVA). The project, with a distribution factor of 52 %, contributes approximately 47 MW to the normally overloaded facility.

Network Impact – McClung/Quinwood Station Connection (Figure 5)

The impact of the proposed generation facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria requires that the McClung/Quinwood area meet Single Contingency performance criteria, which is consistent with the AEP FERC Form 715. Therefore, this criterion was used to assess the impact of this proposed facility on the AEP System. The Invenegy N02 project was studied at 200 MW gross output consistent with the interconnection application. The results are summarized below.

In general, PJM does not require system upgrade for delivery of the energy portion of the generation project since PJM is not relying on the energy portion of the generation project to meet the PJM load requirements. Operationally, reliability can be maintained because, for those facilities monitored by PJM Operations, the generation will be reduced (redispatch) to eliminate any overload. The following overloads were identified on the AEP system for the entire output (energy and capacity) of the generation project. These overloaded circuits are not monitored by PJM Operations. PJM will need to review these overloads during the Impact Study to determine if they will require upgrade based on the delivery of the energy and capacity output of the project.

Normal System

- Projected loading of the –McClung – McRoss 69 kV line loading is up to 125% of its capability

Single Contingency

An outage of the Quinwood – Grassy Falls 138 kV line results in the following three facilities to be loaded to levels well above their respective capabilities:

- Projected loading of the McClung- McRoss 69 kV line loading is up to 149 % of its capability
- Projected loading of the McRoss – Meadow Bridge 69 kV line loading is up to 120% of its capability
- Projected loading of the Meadow Bridge – Layland line loading is up to 112% of its capability

- Projected loading of the McClung – Brackens Creek 69 kV line loading is up to 111% of its capability

An outage of the McClung-McRoss 69kV line results in the following three facilities to be loaded to levels well above their respective capabilities:

- Projected loading of the McClung – Brackens Creek 69 kV line loading is up to 117% of its capability
- Projected loading of the Brackens Creek – Tower 117 69 kV line loading is up to 102% of its capability

Short Circuit Analysis

No problems identified.

Required System Reinforcement

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the integration of the proposed generating facility at this location. Rebuilding of the McClung to Layland 69 kV line and rebuilding of the McClung to Tower 117 69 kV line would mitigate the thermal contingency loadings identified in this study. As previously stated, the McClung Station cannot be expanded to permit the installation of a 138 kV line terminations and associated equipment and required metering facilities due to land limitations. The required transmission enhancements as identified by this study and associated budgetary cost estimates are listed below:

- Rebuild 20 miles of 69 kV line from McClung Station to Layland Station.

Estimated Cost* \$ 7,895,000

- Rebuild 18 miles of 69 kV line from McClung Station to Tower 117 Station.

Estimated Cost* \$ 7,105,000

- McRoss Station: Replace switches and bus conductor

Estimated Cost* \$ 100,000

- Meadow Bridge Station: Replace switches and bus conductor

Estimated Cost* \$ 100,000

- Brackens Creek Station: Replace switches and bus conductor

Estimated Cost* \$ 100,000

Total Estimated System Modification Cost* \$15,300,000

*The estimates are based in 2005 dollars and preliminary in nature, as they were determined without detailed engineering and design studies. Final estimates will require detailed engineering analysis, including on-site review and investigation. It will take a minimum of nine

months after obtaining the authorization to design and construct the facilities as outlined above excluding any potential issues related to acquiring required right-of-way and or station site.

Interconnection Facilities (AP)

- Perform a protection coordination review of the AP System area surrounding Grassy Falls Substation to determine if relaying modifications or relay-setting changes are required.

Estimated Cost **\$5,000**

Optional Reinforcements to Alleviate Operational Concerns

Line reconductoring

Grassy Falls – Nettie Tap 138 kV	1272 ACSR	3.33 miles	\$1,000,000
Crupperneck – Nettie Tap 138 kV	1272 ACSR	4.63 miles	\$1,400,000
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1272 ACSR Conductor Ratings

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summer 1/4 hour	1711	409

Substation Upgrades:

Crupperneck reconductor 138 kV buses with 1272 ACSR **\$175,000**

Grassy Falls – (2 terminals) **\$150,000**

- Breaker Riser Bus & Line Side – 1024.5 ACAR (Replace with 1272)
- Line Trap – 1200 Amp (Replace with 2000 Amp)
- Line Riser – 954 ACSR (Replace with 1272)
- Relay Circuitry – 800/5 (CT ratio and relay changes)
- RTU MW – 240 MVA (Replace with digital panel meter)
- RTU Amps – 1200 Amps (Replace with digital panel meter)

Crupperneck – (1 terminal) **\$150,000**

Bus Side & Line Side Breaker Disc. – 600 Amp (Replace with 1200 Amp)

Breaker Riser Bus& Line Side – 954 ACSR (Replace with 1272ACSR)
Disc. Leads – 954 ACSR (Replace with 1272 ACSR)
Line Trap – 400 Amp (Replace with 2000 Amp)
Line Riser – 954 ACSR (Replace with 1272 ACSR)
Relay Circuitry – 800/5 (CT ratio and relay changes)
RTU MW – 240 MVA (Replace with digital panel meter)
RTU Amps – 1200 Amps (Replace with digital panel meter)

Total cost of upgrades **\$9,775,000**

Contribution to Previously Identified System Reinforcements

The N02_AEP139 project will be allocated a portion of the estimated **\$55,000** cost for the replacement of two 138kV switches and one wave trap on the Crupperneck terminal of the Grassy Falls-Crupperneck circuit.