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 #1A (McClung-Layland 69kV circuit) (N02_AEP139 to McClung/Quinwood)

Network Impact – McClung/Quinwood Station Connection

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 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 interconnection customer (IC) N09 project was studied as 90 MW gross capacity consistent with the interconnection application.** The results are summarized below.

Normal System

- Projected loading of the Meadow Bridge-Layland 69 kV line loading is up to 115% of its capability

- The Grassy Falls – McClung 138 kV circuit is overloaded to 109% of its normal rating (80 MVA). The project contributes approximately 74 MW to the normally overloaded facility.

Single Contingency

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

- Projected loading of the Rainelle-Layland 69 kV line loading is up to 197% of its capability

- Projected loading of the Layland-Bradley 69 kV circuit loading is up to 180% of its capability

Generator Deliverability

- The Grassy Falls – Nettie 138 kV circuit is overloaded to 111% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 67 MW to the contingency facility loading.

- The Crupperneck – Nettie 138 kV circuit is overloaded to 107% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 67 MW to the contingency facility loading.

Multiple Facility Contingency – Tower Line Outages
No problems identified

Short Circuit Analysis
No problems identified.

New System Reinforcements

AEP Service Territory

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 69 kV line from AEP's McClung Station to Rainelle Station will be necessary. The required transmission enhancements as identified by this study and associated budgetary cost estimates are listed below and shown as Figures 3:

- Construct a 69 kV line from McClung Station to Rainelle Station. The new McClung-Rainelle 69 kV circuit will consist of approximately 8 miles of 69 kV line construction.

  Estimated Cost* **$ 5,600,000**
  Right of Way* **$ 585,000**

- Rebuild 5 miles of 69 kV line from Layland Station to Meadow Bridge Station.

  Estimated Cost* **$ 1,974,000**

- McClung Station: Install a 69 kV circuit breaker with associated line relaying and controls for the Rainelle circuit.

  Estimated Cost* **$ 342,600**

- Rainelle Station: Add a 69 kV breaker with associated line relaying and controls for the McClung circuit.

  Estimated Cost* **$ 342,600**

- Meadow Bridge Station: Replace switch and bus conductor

  Estimated Cost* **$ 50,000**

- Layland Station: Replace switch and bus conductor

  Estimated Cost* **$ 50,000**

Total Estimated System Modification Cost* **$ 8,944,200**

- 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.

APS Service Territory

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**

1272 ACSR Conductor Ratings

	Amps	MVA
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 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)

Contribution to Previously Identified System Reinforcements

The N09 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 originally identified as required for project M24.

In general, PJM does not require system upgrade for delivery of the energy portion of any 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 N02_AEP139 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.

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the addition of the N02_AEP139 facility and permit it to operate at 200 MW for all conditions 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. See Figure #3

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**

- 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**

- McRoss Station: Replace switches and bus conductor
  Estimated Cost* **$ 100,000**

- Meadow Bridge Station: Replace switch and bus conductor
  Estimated Cost* **$ 50,000**

Total Estimated System Modification Cost* $27,451,100
(AEP Service territory)

* 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.

Alternative #1B (McClung-Layland 69kV circuit with new line between M24 & N02_AEP139)

Network Impact – McClung/Quinwood Station Connection

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 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 IC N09 project was studied as 90 MW gross capacity consistent with the interconnection application.** The results are summarized below.

Normal System
No identified problems.

Single Contingency

An outage of the Bradley-Beury Mt. 69 kV line results in the following facility to be loaded to levels well above their respective capabilities:

- Projected loading of the Layland-Prince 69 kV line loading is up to 157% of its capability.

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

- Projected loading of the Layland-Beury Mt 69 kV line loading is up to 111% of its capability.
- Projected loading of the Layland-Prince 69 kV line loading is up to 110% 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 Layland to Prince 69 kV line and rebuilding of the Layland to Beury Mt. 69 kV line would mitigate the thermal contingency loadings identified in this study. The required transmission enhancements as identified by this study and associated budgetary cost estimates are listed below and shown as Figures 6:

- Rebuild 8 miles of 69 kV line from Layland Station to Prince Station.
  Estimated Cost* $ 3,158,000

- Rebuild 4 miles of 69 kV line from Layland Station to Beury Mt. Station.
  Estimated Cost* $ 1,579,000

- Layland Station: Replace switch and bus conductor
  Estimated Cost* $ 100,000

Total Estimated System Modification Cost* $ 4,837,000

* 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.

APS Service Territory

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**

1272 ACSR Conductor Ratings

	Amps	MVA
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 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)

Contribution to Previously Identified System Reinforcements

The N09 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 originally identified as required for project M24.

In general, PJM does not require system upgrade for delivery of the energy portion of any 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 N02_AEP139 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.

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the addition of the N02_AEP139 facility and permit it to operate at 200 MW for all conditions 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**

- 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**

- McRoss Station: Replace switches and bus conductor

  Estimated Cost* **$ 100,000**

- Meadow Bridge Station: Replace switch and bus conductor

  Estimated Cost* **$ 50,000**

Total Estimated System Modification Cost* **$27,451,100**
(AEP Service territory)

* 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.

Alternative #2A Direct Connection to McClung (N02_AEP139 Connected to McClung

Network Impact – McClung/Quinwood Station Connection

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 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 IC N09 project was studied as 90 MW gross capacity consistent with the interconnection application.** The results are summarized below.

Normal System

- The Grassy Falls – McClung 138 kV circuit is overloaded to 109% of its normal rating (80 MVA). The project contributes approximately 74 MW to the normally overloaded facility.

Single Contingency

An outage of the McClung-McRoss 69 kV line results in the following facility to be loaded to level above its respective capability:

- Projected loading of the McClung-Brackens Creek 69 kV line loading is up to 100% of its capability

Generator Deliverability

- The Grassy Falls – McClung 138 kV circuit is overloaded to 109% of its normal rating (80 MVA). The project contributes approximately 74 MW to the normally overloaded facility.

- The Grassy Falls – Nettie 138 kV circuit is overloaded to 111% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 67 MW to the contingency facility loading.

- The Crupperneck – Nettie 138 kV circuit is overloaded to 107% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 67 MW to the contingency facility loading.

Multiple Facility Contingency – Tower Line Outages
No problems identified

Short Circuit Analysis
No problems identified.

New System Reinforcements

AEP Service Territory

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. Rebuilding of the 69 kV line from AEP's McClung Station to Brackens Creek Station will be necessary. The required transmission enhancements as identified by this study and associated budgetary cost estimates are listed below and shown as Figures 5:

- Rebuild 14 miles of 69 kV line from McClung Station to Brackens Creek Station.

Estimated Cost* $ 5,526,000

- Brackens Creek Station: Replace switch and bus conductor

Estimated Cost* $ 50,000

Total Estimated System Modification Cost* $ 5,576,000

* 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.

APS Service Territory

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**

1272 ACSR Conductor Ratings

	Amps	MVA
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 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)

Contribution to Previously Identified System Reinforcements

The N09 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 originally identified as required for project M24.

In general, PJM does not require system upgrade for delivery of the energy portion of any 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 N02_AEP139 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.

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the addition of the N02_AEP139 facility and permit it to operate at 200 MW for all conditions 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. See Figure #3

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

The N09 project might be responsible for an allocated portion of these upgrades.

- 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**

- 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 a138 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**

- McRoss Station: Replace switches and bus conductor

  Estimated Cost* **$ 100,000**

- Meadow Bridge Station: Replace switch and bus conductor

  Estimated Cost* **$ 50,000**

Total Estimated System Modification Cost* **$27,451,100**
(AEP Service territory)

*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.

Alternative #2B Direct Connection to McClung and new 138kV line between M 24 and N02_AEP139 Projects

Network Impact – McClung/Quinwood Station Connection

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 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 IC N09 project was studied as 90 MW gross capacity consistent with the interconnection application.** The results are summarized below.

Normal System

No identified problems.

Single Contingency

An outage of the Bradley-Beury Mt. 69 kV line results in the following facility to be loaded to levels well above their respective capabilities:

- Projected loading of the Layland-Prince 69 kV line loading is up to 125% of its capability.

An outage of the Bradley-Prince 69 kV line results in the following facility to be loaded to levels well above their respective capabilities:

- Projected loading of the Layland – Beury Mt 69 kV line loading is up to 123% of its capability.

Generator Deliverability

- The Grassy Falls – Nettie 138 kV circuit is overloaded to 114% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 69 MW to the contingency facility loading.

- The Crupperneck – Nettie 138 kV circuit is overloaded to 110% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 69 MW to the contingency facility loading.

- The Crupperneck-Powell Mountain 138kv circuit was identified as being overloaded by Allegheny Power

- The Crupperneck-Cowen 138kV circuit was identified as being overloaded by Allegheny Power.

Multiple Facility Contingency – Tower Line Outages
No problems identified

Short Circuit Analysis
No problems identified.

Required System Reinforcement

AEP Service Territory

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 Layland to Prince 69 kV line and rebuilding of the Layland to Beury Mt. 69 kV line would mitigate the thermal contingency loadings identified in this study. The required transmission enhancements as identified by this study and associated budgetary cost estimates are listed below and shown as Figures 5:

- Rebuild 8 miles of 69 kV line from Layland Station to Prince Station.
  Estimated Cost* $ 3,158,000

- Rebuild 4 miles of 69 kV line from Layland Station to Beury Mt. Station.
  Estimated Cost* $ 1,579,000

- Layland Station: Replace switch and bus conductor
  Estimated Cost* $ 100,000

Total Estimated System Modification Cost* $ 4,837,000

- 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.

APS Service Territory

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**
Crupperneck - Powell Mt. 138kV line	954 kcmil	13.2 miles	**$4,000,000**

Crupperneck - Cowen 138kV line - Raise 30 structures to eliminate derate **$1,200,000**

1272 ACSR Conductor Ratings

	Amps	MVA
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 - (1 terminals) **$ 75,000**

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)

Crupperneck - (Powell Mt. terminal) **$75,000**
Bus Side & Line Side Breaker Disc. - 600 Amp (Replace with 1200 Amp)
Breaker Riser Bus& Line Side - 500 kcmil cu.(Replace with 1024 ACAR)
Line Trap - 800 Amp (Replace with 1200 Amp)
Line Riser -- 556 ACSR (Replace with 954 ACSR)

Powell Mt. - (Crupperneck terminal) **$40,000**
Line Trap - 800 Amp (Replace with 1200 Amp)
Line Riser -- 556 ACSR (Replace with 954 ACSR)

Contribution to Previously Identified System Reinforcements

The N09 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 originally identified as required for project M24.

In general, PJM does not require system upgrade for delivery of the energy portion of any 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 N02_AEP139 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.

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the addition of the N02_AEP139 facility and permit it to operate at 200 MW for all conditions 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. See Figure #3

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

The N09 project might be responsible for an allocated portion of these upgrades.

- 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**

- 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 a138 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**

- McRoss Station: Replace switches and bus conductor
  Estimated Cost* **$ 100,000**

- Meadow Bridge Station: Replace switch and bus conductor
  Estimated Cost* **$ 50,000**

Total Estimated System Modification Cost* $27,451,100
(AEP Service territory)

*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.

Alternative #3A Connected to Grassy Falls (N02_AEP139 connected to McClung/Quinwood)

Network Impacts

The **#N09 project was studied as a total injection of 90 MW** into the Grassy Falls 138 kV substation. Project #N09 was evaluated for compliance with reliability criteria for summer peak conditions in 2008. Potential network impacts were as follows:

Normal System

No identified problems

Single Contingency

An outage of the McClung-McRoss 69 kV line results in the following facility to be loaded to level above its respective capability:

- Projected loading of the McClung-Brackens Creek 69 kV line loading is up to 100% of its capability

Generator Deliverability

- The Grassy Falls – Nettie 138 kV circuit is overloaded to 114% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 69 MW to the contingency facility loading.

- The Crupperneck – Nettie 138 kV circuit is overloaded to 110% of its emergency rating (103 MVA) for the outage of the Gilboa – Summerville – Grassy Falls 138 kV circuit. The N09 project contributes approximately 69 MW to the contingency facility loading.

Multiple Facility Contingency – Tower Line Outages
No problems identified

Multiple Facility Contingency – Tower Line Outages
No problems identified

Short Circuit Analysis
No problems identified.

Required System Reinforcement

APS Service Territory

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**

1272 ACSR Conductor Ratings

	Amps	MVA
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 - (1 terminals) **$ 75,000**

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)

Contribution to Previously Identified System Reinforcements

The N09 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 originally identified as required for project M24.

In general, PJM does not require system upgrade for delivery of the energy portion of any 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 N02_AEP139 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.

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the addition of the N02_AEP139 facility and permit it to operate at 200 MW for all conditions 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. See Figure #3

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

The N09 project might be responsible for an allocated portion of these upgrades.

- 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**

- 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 a138 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**

- McRoss Station: Replace switches and bus conductor

  Estimated Cost* **$ 100,000**

- Meadow Bridge Station: Replace switch and bus conductor

  Estimated Cost* **$ 50,000**

Total Estimated System Modification Cost* **$27,451,100**
(AEP Service territory)

*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.

Alternative 3B (Conneccted to Grassy Falls)

Network Impacts

Generator Deliverability

- The Grassy Falls - Nettie 138 kV circuit is overloaded to 119% of its emergency rating (103 MVA) for the outage of the Grassy Falls-Summersville-Gilboa 138 kV circuit. The #N09, with a Dfax of 79%, contributes approximately 71 MW to the contingency overloaded facility.

- The Crupperneck - Nettie 138 kV circuit is overloaded to 115% of its emergency rating (103 MVA) for the outage of the Grassy Falls-Summersville-Gilboa 138 kV circuit. The #N09, with a Dfax of 79%, contributes approximately 71 MW to the contingency overloaded facility.

Multiple Facility Contingency – Tower Line Outages

No problems identified

Required System Reinforcement

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**

1272 ACSR Conductor Ratings

	Amps	MVA
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 - (1 terminals) **$ 75,000**

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)

Contribution to Previously Identified System Reinforcements

The N09 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 originally identified as required for project M24.

In general, PJM does not require system upgrade for delivery of the energy portion of any 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 N02_AEP139 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.

To maintain appropriate levels of reliability to the McClung area, additional transmission capacity will be required to permit the addition of the N02_AEP139 facility and permit it to operate at 200 MW for all conditions 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. See Figure #3

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

The N09 project might be responsible for an allocated portion of these upgrades.

- 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**

- 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 a138 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**

- McRoss Station: Replace switches and bus conductor
  Estimated Cost* **$ 100,000**

- Meadow Bridge Station: Replace switch and bus conductor
  Estimated Cost* **$ 50,000**

Total Estimated System Modification Cost* $27,451,100
(AEP Service territory)

*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.