PJM Generator Interconnection Request
Queue #Z2-042
Jackson Ferry-Peak Creek 138 kV
Feasibility Study Report

August 2014

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, 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 feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners,

General

The Interconnection Customer (IC) proposes to interconnect PJM Project #Z2-042, a 180 MW (23.3 MW Capacity) wind generating facility (78 – 2.3 MW wind turbines) to the American Electric Power (AEP) Transmission System. This project comprises of two (2) alternative interconnection points. The primary point of interconnection is located approximately 10 miles from the Jackson Ferry 138 kV substation on the Jackson Ferry – Peak Creek 138 kV circuit (Figures 1 & 2). The secondary point of interconnection is located east of the Wurno 138 kV substation on the Wurno – Claytor 138 kV section of the Peak Creek – Claytor 138 kV circuit (Figures 3 & 4). The location of the proposed wind project is in Pulaski County, Virginia (Figure 5).

The requested in-service date is December 31, 2017.

The objective of this Feasibility Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP Transmission System. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required to maintain the reliability of the AEP Transmission System. Stability analysis is not included as part of this study.

Attachment Facilities

Primary Point of Interconnection (Jackson Ferry – Peak Creek 138 kV line):

A new in-line switching station will be constructed 10 miles from the Jackson Ferry 138 kV substation between Jackson Ferry and Peak Creek 138 kV stations in Pulaski County, Virginia. This new station is to consist of three (3) 138 kV circuit breakers physically configured in a breaker and half bus arrangement, initially operated as a ring-bus (Figure 1). The interconnection station will be expandable to accommodate future projects in the area. The station will also include 138 kV metering, SCADA, and associated equipment. Protection relays in the surrounding area will need to be reset to accommodate the addition of the new station.

The IC is expected to obtain, at its cost, a station site for the AEP facilities. The IC shall obtain all necessary permits. Ownership of the in-line switching facility and associated equipment shall be transferred from The IC to AEP upon successful completion of the required work.

A 138 kV line extension is required to loop through the proposed station. The AEP switching station is assumed to be located immediately adjacent to the existing transmission lines. A supplemental line easement for the tap poles will be required. It is expected that The IC will obtain the supplemental easement when the station property is purchased.

The following work is required to connect Project Z2-042 to the Jackson Ferry – Peak Creek 138 kV line:

Station Cost:

- Construct a new three (3) breaker 138 kV switching station laid out in a breaker and half arrangement including associated disconnect switches, bus work, SCADA and 138 kV revenue metering.

- **Estimated Station Cost: $12,500,000**

Protection and Relaying Cost:

- Line protection and controls will need to be installed at the new 138 kV switching station. Estimated Cost: $600,000*

- Line protection and controls at the Jackson Ferry 138 kV Substation will need to be upgraded to coordinate with the new 138 kV switching station. Estimated Cost: $300,000*

- Line protection and controls at the Peak Creek 138 kV Substation will need to be upgraded to coordinate with the new 138 kV switching station. Estimated Cost: $300,000*

- **Estimated Protection and Relaying Cost: $1,200,000**

Secondary Point of Interconnection (Wurno – Claytor section of Peak Creek – Claytor 138 kV circuit):

A new in-line switching station will be constructed east of the Wurno 138 kV substation between Wurno and Claytor 138 kV stations in Pulaski County, Virginia. This new station is to consist of three (3) 138 kV circuit breakers physically configured in a breaker and half bus arrangement, initially operated as a ring-bus (Figure 3). The interconnection station will be expandable to accommodate future projects in the area. The station will also include 138 kV metering, SCADA, and associated equipment. Protection relays in the surrounding area will need to be reset to accommodate the addition of the new station.

The IC is expected to obtain, at its cost, a station site for the AEP facilities. The IC shall obtain all necessary permits. Ownership of the in-line switching facility and associated equipment shall be transferred from The IC to AEP upon successful completion of the required work.

A 138 kV line extension is required to loop through the proposed station. The AEP switching station is assumed to be located immediately adjacent to the existing transmission lines. A supplemental line easement for the tap poles will be required. It is expected that the IC will obtain the supplemental easement when the station property is purchased.

The following work is required to connect Project Z2-042 to the Wurno – Claytor 138 kV line section:

Station:

- Construct a new three (3) breaker 138 kV switching station laid out in a breaker and half arrangement including associated disconnect switches, bus work, SCADA and 138 kV revenue metering.

Protection and Relaying:

- Line protection and controls will need to be installed at the new 138 kV switching station.
- Line protection and controls at the Wurno 138 kV Substation will need to be upgraded to coordinate with the new 138 kV switching station.
- Line protection and controls at the Claytor 138 kV Substation will need to be upgraded to coordinate with the new 138 kV switching station.

It is understood that the IC is responsible for all these connection costs associated with interconnecting the PJM project Z2-042 to AEP transmission system. The costs above are reimbursable to AEP. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the IC's switching station are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Local and Network Impacts

The impact of the proposed wind generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance parameters prescribed in the AEP FERC Form 715[1] and Connection Requirements for AEP Transmission System[2]. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. PJM project Z2-042 was studied as a 180 MW (23.3 MW capacity) injection to AEP system consistent with the interconnection application. Project Z2-042 was evaluated for compliance with reliability criteria for summer peak conditions in 2018.

1 http://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/GuideLines/2014%20AEP%20PJM%20FERC%20715_Final_Part%204.pdf

2 http://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/Requirements/AEP_Interconnection_Requirements_Rev1.pdf

Primary Point of Interconnection Potential network impacts were as follows (Jackson Ferry – Peak Creek 138 kV):

Network Impacts

The Queue Project Z2-042 was studied as a 180.0 MW (Capacity 23.3 MW) injection as a tap of the Jacksons Ferry – Peak Creek 138 kV line in the AEP area. Project Z2-042 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project Z2-042 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2018

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

None

Multiple Facility Contingency
(Double Circuit Tower Line, Failed Breaker and Bus Fault contingencies for the full energy output)

None

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)

None

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

To be determined

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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

None

Light Load Analysis - 2018

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements

New System Reinforcements
(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

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 Impact Study)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Short Circuit
(Summary form of Cost allocation for breakers will be inserted here if any)

None

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

To be determined

Secondary Point of Interconnection Potential network impacts were as follows (Wurno – Claytor 138 kV):

Network Impacts

The Queue Project Z2-042 was studied as a 180.0 MW (Capacity 23.3 MW) injection as a tap of the Wurno – Claytor 138 kV line in the AEP area. Project Z2-042 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project Z2-042 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2018

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

None

Multiple Facility Contingency
(Double Circuit Tower Line, Failed Breaker and Bus Fault contingencies for the full energy output)

1. (AEP - AEP) The Z2-042 TAP-05CLYTR2 138 kV line (from bus 917310 to bus 242609 ckt 1) loads from 64.32% to 111.77% (**DC power flow**) of its emergency rating (251 MVA) for the line fault with failed breaker contingency outage of '2914_C2_05J.FERR 765-B2'. This project contributes approximately 119.08 MW to the thermal violation.

CONTINGENCY '2914_C2_05J.FERR 765-B2'
OPEN BRANCH FROM BUS 242512 TO BUS 242514 CKT 1 / 242512 05CLOVRD 765 242514 05J.FERR 765 1
OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1 / 242514 05J.FERR 765 242520 05J.FERR 500 1
OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1 / 242520 05J.FERR 500 306719 8ANTIOCH 500 1
END

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

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)

None

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

To be determined

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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

None

Light Load Analysis - 2018

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

System Reinforcements

None

New System Reinforcements
(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

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 Impact Study)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Short Circuit
(Summary form of Cost allocation for breakers will be inserted here if any)

None

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(AEP - AEP) The Z2-042 TAP-05CLYTR2 138 kV line (from bus 917310 to bus 242609 ckt 1) loads from 64.32% to 111.77% (**DC power flow**) of its emergency rating (251 MVA) for the line fault with failed breaker contingency outage of '2914_C2_05J.FERR 765-B2'. This project contributes approximately 119.08 MW to the thermal violation.

CONTINGENCY '2914_C2_05J.FERR 765-B2'
OPEN BRANCH FROM BUS 242512 TO BUS 242514 CKT 1 / 242512 05CLOVRD 765 242514 05J.FERR 765 1
OPEN BRANCH FROM BUS 242514 TO BUS 242520 CKT 1 / 242514 05J.FERR 765 242520 05J.FERR 500 1
OPEN BRANCH FROM BUS 242520 TO BUS 306719 CKT 1 / 242520 05J.FERR 500 306719 8ANTIOCH 500 1
END

Bus Number	Bus Name	Full Contribution
913031	Y1-006 C	0.56
913032	Y1-006 E	3.75
913201	Y1-049	0.2
917311	Z2-042 C OP2	15.41
917312	Z2-042 E OP2	103.67

Schedule

The Virginia siting process has several paths through the process. Depending on which path is required, it is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 24 to 36 months.

Conclusion

Based upon the results of this Feasibility Study, the construction of the The Interconnection Customer (IC) (PJM Project #Z2-042) Wind generation project will require additional interconnection charges.

Estimated Interconnection Cost: $12,500,000
Estimated Protection and Relaying Cost: $1,200,000

Total Estimated Cost for Project Z2-042: $13,700,000

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Primary POI for Project Z2-042

Jackson Ferry – Peak Creek 138 kV

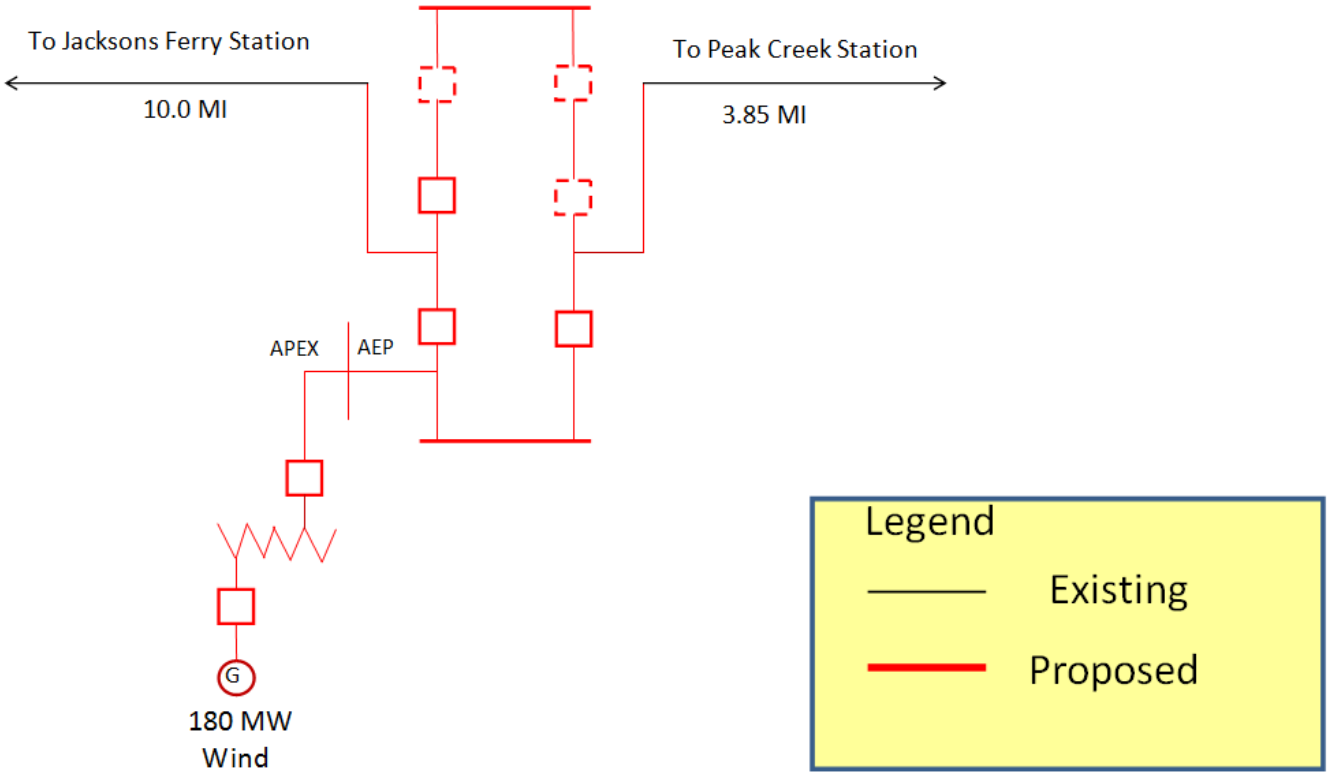

Figure 2: Primary POI for Project Z2-042

Jackson Ferry-Peak Creek 138 kV

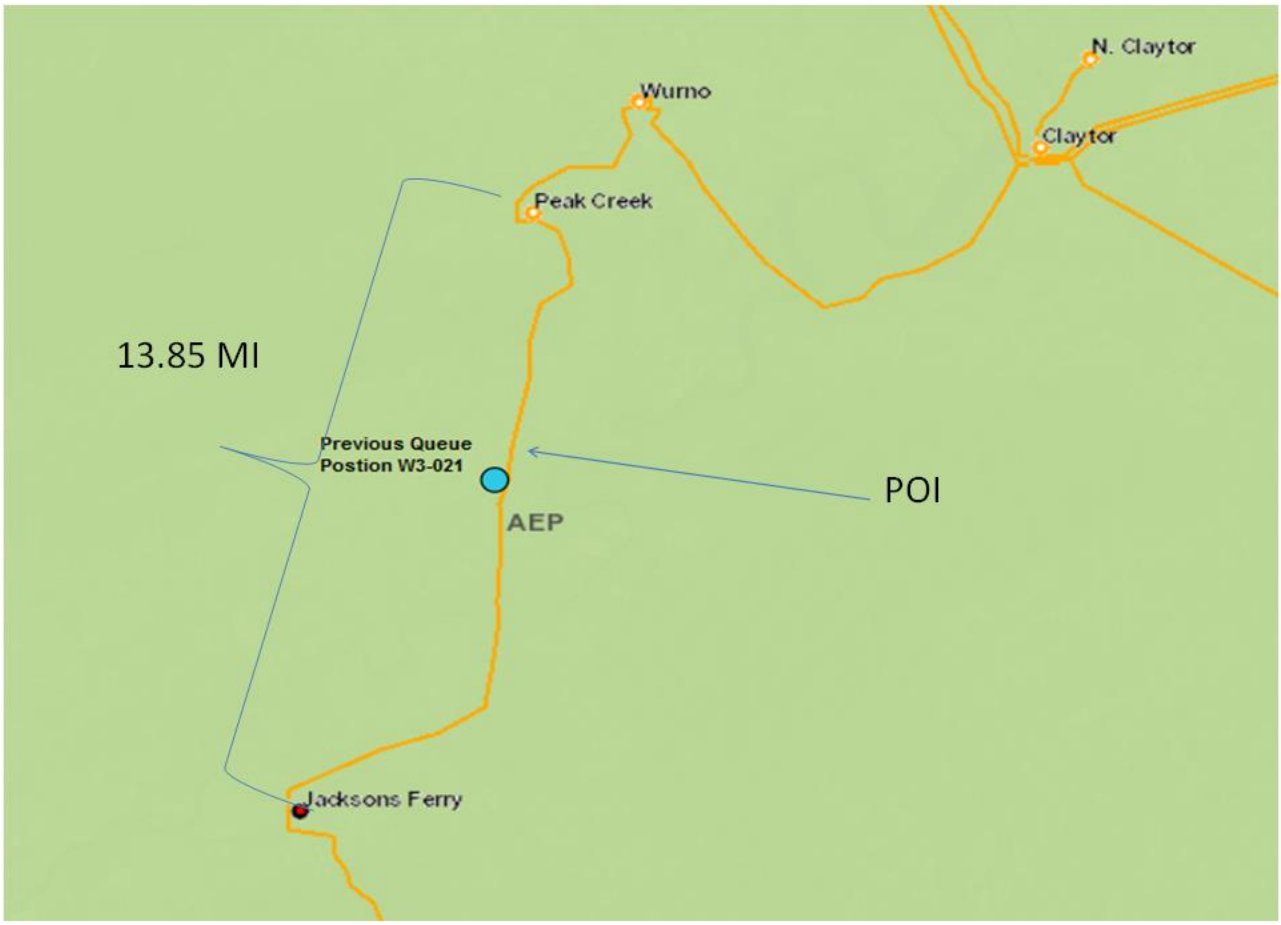

Figure 3: Secondary POI for Project Z2-042
Wurno – Claytor 138 kV

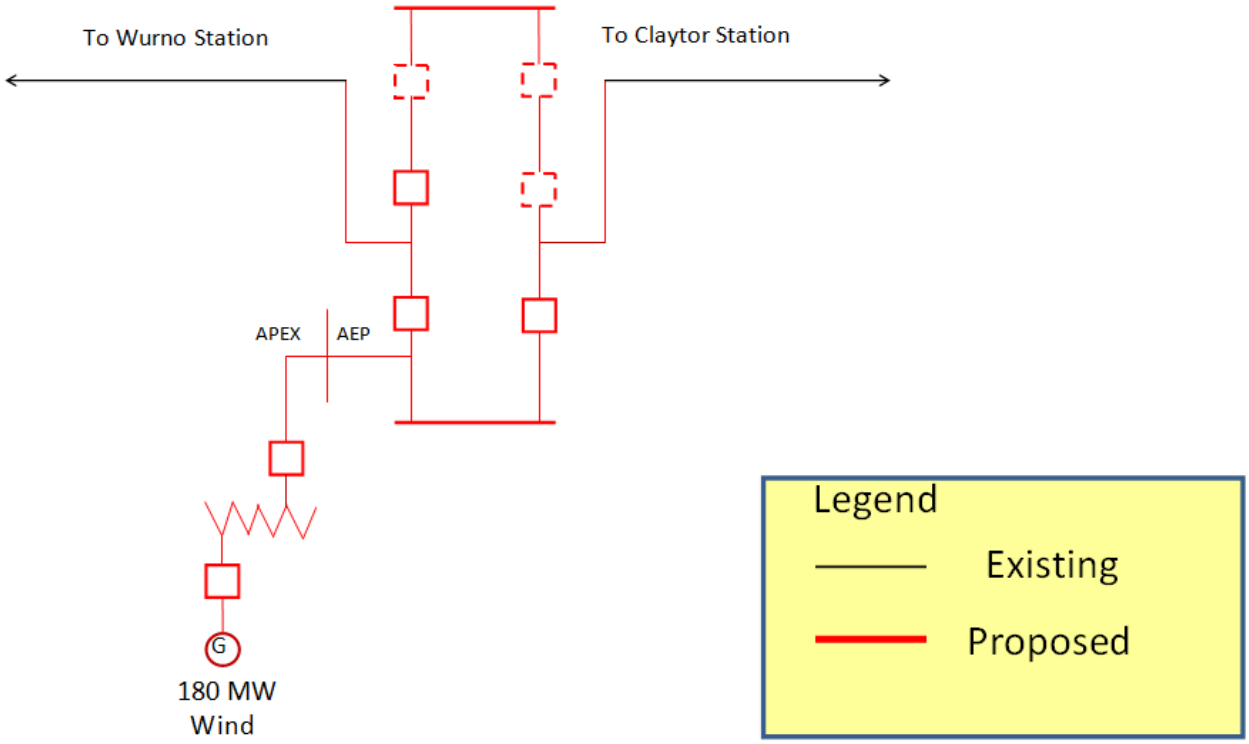

Figure 4: Secondary POI for Project Z2-042

Wurno - Claytor 138 kV

Figure 5: Project Site