PJM Generator Interconnection Request
Queue #Z2-114
Olive West 12 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,

Transmission Portion of the Z2-114 Feasibility Study Report

General

The Interconnection Customer (IC) proposes to interconnect a 5 MW Solar Generation Plant to the Olive 12.47 kV substation or to the Olive West 12.47 kV circuit fed from this station. For purposes of the Transmission portion of the Z2-114 Feasibility Study documented in this report, the estimated costs and impacts of the primary and alternate Points of Interconnection are assumed to be identical. Therefore for illustration purposes the simpler station configuration is shown (Figure 1).

PJM applies a default 38% capacity factor to Photovoltaic (PV) solar facilities. However, the Interconnection Customer has requested a 50% capacity factor for this project. Therefore, the PJM #Z1-114 project was studied as a 5.0 MW (2.5 MW Capacity) injection at the Olive 12.47 kV substation. The PJM Resource Adequacy Planning Department will evaluate the 50% capacity factor request. If the data supplied does not support the higher capacity value, the project capacity component will be reduced to 38%.

The requested in service date is October 1, 2016.

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

Attachment facilities are described in the AEP Distribution portion of this report.

Local and Network Impacts

The impact of the proposed generating facility on the AEP Transmission 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 criterion were used to assess the impact of the proposed facility on the AEP System. PJM project # Z2-114 was studied as a 5.0 MW (2.5 MW capacity) increase at the Olive 12.47 kV substation consistent with the interconnection application. Project #Z1-114 was evaluated for compliance with reliability criteria for summer peak conditions in 2018.

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[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

Potential network impacts were as follows:

Normal System (2018 Summer Conditions Capacity Output)

- No problems identified

Single Contingency (2018 Summer Conditions Capacity Output)

- No problems identified

Multiple Contingency (2018 Summer Conditions Capacity Output)

- No problems identified

Contribution to Previously Identified Overloads (2018 Summer Conditions Capacity Output)

- No problems identified

Normal System (2018 Summer Conditions Full Output)

- No problems identified

Single Contingency (2018 Summer Conditions Full Output)

- No problems identified

Multiple Contingency (2018 Summer Conditions Full Output)

- No problems identified

Contribution to Previously Identified Overloads (2018 Summer Conditions Full Output)

- No problems identified

Short Circuit Analysis

- No Problem identified.

Stability Analysis

- Stability study to be performed during the System Impact Study stage.

Voltage Variations

- No problems identified.

Additional Limitations of Concern

- Other concerns, if any, shall be addressed by AEP Distribution.

Local/Network Upgrades

- No problems identified.

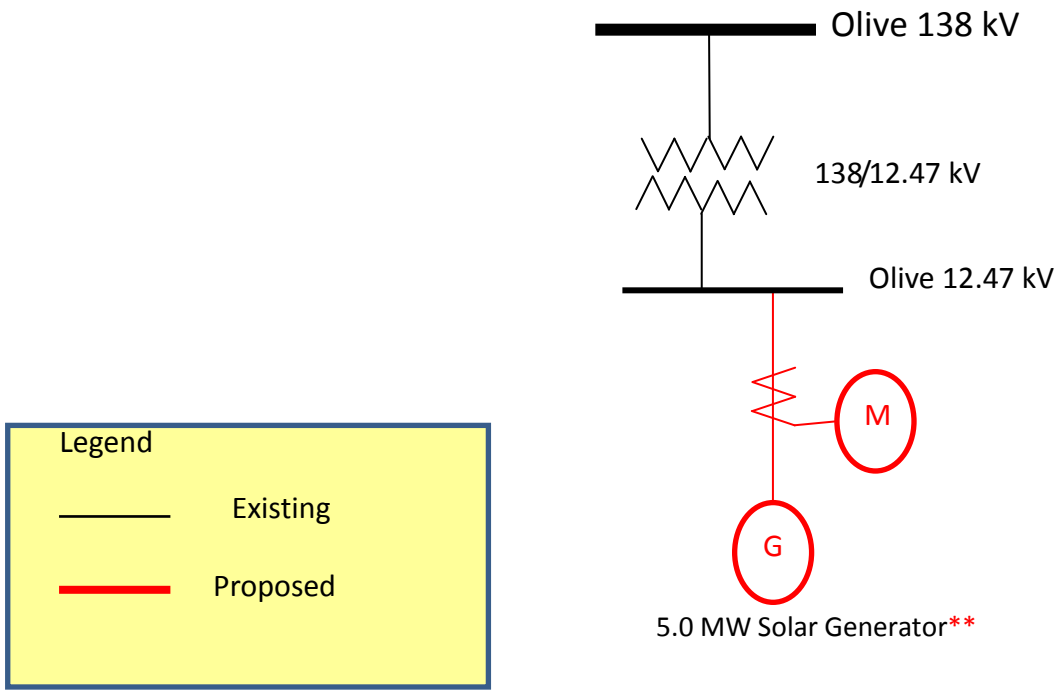
Conclusion

Based upon the results of this Feasibility Study, the injection of a 5.0 MW (2.5 MW Capacity) at the Olive 12.47 kV substation (PJM Project #Z2-114) will not require additional Transmission System Network upgrades.

Requirements and estimates for the project's attachment facilities will be provided by AEP Distribution in the AEP Distribution portion of this report.

Figure 1

Z2-114 Point of Interconnection
Olive 138/12.47 kV Substation*



* Olive 138/12.47 kV Substation is partially shown.

** 2.5 MW Capacity.

AEP Distribution Portion of the Z2-114 Feasibility Study Report

Disclaimer

The contents of this feasibility study apply only to the facility described in the feasibility study agreement. All modeling is based on the Distributed Generation (DG) location at Latitude: 41° 71'50''N, Longitude: 86° 48'80''W.

Modeling and Assumptions

The Olive solar power project will be served from AEP distribution system via 12.47 kV LL, 7.2 kV LG West circuit (0561-22) originating from Olive station. West circuit 0561-22 is a radial configuration, three-phase multi-grounded four wire system. The customer service Point of Common Coupling (PCC) is assumed to be near pole location JO0174000015. This will need a 12kV line extension to the solar field property.

The specs for the Solar Panels (SunEdison F330 Solar Module) and DC/AC Inverters (Sunny Central 500CP-US) were obtained from the applicant's one line diagram, e-mail, and manufacturer's documentation and web sites. The information submitted on the one line is preliminary. Detailed specifications will need to be provided if this project moves forward to an impact study.

It is expected the applicant understand and comply with IEEE 1547 concerning the DG installation and its requirements for interconnection with the utility grid.

CymDist Version 5.02 revision 10 was utilized to model the Distributed Generation's effect on the Distribution System. A high level analysis was performed to determine if there are any apparent steady state loading issues or excess fault current issues.

AEP Fault Values and Thevenin Impedances

The following are AEP symmetrical fault values and AEP Thevenin impedances calculated at the Solar field's assumed PCC (without the Distributed Generation connected). The nominal voltage can vary +/- 5%.

County Line Circuit

- LLL = 3778A LG = 3358A
- Z1 = Z2 = 1.9816 + j0.2758 ohms @ 12.47 kV
- Z0 = 2.7070 + j 0.5062 ohms @ 12.47/7.2 kV

Distribution Study Conclusion

The high level study did not reveal any steady state loading issues and did not reveal any issues due to the additional fault current contribution of the generators. During light load conditions, defined at 30% of peak load, there is a condition where the DG will be back feeding through the station bus regulators and Transformer #4, on to the 138kV. The regulator controls must be able to be set-up for bi-directional operation, and if necessary, replaced. This does not mean that additional issues will not be discovered

during a more complete impact study. AEP Protection and Control (P&C) Engineers will provide a more detailed evaluation of the P&C requirements during the System Impact Study phase of this project.

Conceptual Costs for Interconnection

The presumption based upon the documents submitted is that the developer will be extending a line to AEP's circuit and we will only need to provide a metering structure and the related facilities to permit interconnection.

12 kV metering at interconnection point	$50,000
SCADA communication and real time monitoring	$25,000
Regulator controls replacement (if necessary)	$15,000

Total estimated cost, **$ 75,000 or $90,000** is based on our high level analysis. When detailed engineering is performed the costs could be determined to be higher or lower. Also, an impact study may reveal additional work that might need to be done to AEP facilities in order to permit interconnection.

Timetable for Construction

Total time to complete this project is six months from the time that all required signed agreements are received. This time estimate is based upon the known work that is required as a result of this study. Additional work that might be indicated by an impact study would likely alter the required time.