PJM Generator Interconnection Request
Queue X1-027
Hanging Rock (Haverhill 3) 138kV
Feasibility Study Report

February 2012
#684935

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, the costs may be included in the study.

X1-027 Hanging Rock (Haverhill 3) 138kV Feasibility Study

General

The interconnection customer (IC) proposes to install PJM Project #X1-027, a 200 MW industrial waste heat generating facility, consisting of 3 – 67 MW generators, connecting to the American Electric Power (AEP) Hanging Rock 138 kV Station near Ironton, Ohio. The proposed location of the generating facilities and switching station is near Franklin Furnace, Lawrence County, Ohio, approximately 3-5 miles from Hanging Rock Station (See Exhibit 1). The projected back feed date is scheduled for June 2014. The in-service date is October 1, 2014.

PJM Project #U2-080 was assumed to be in service during the evaluation of PJM project X1-027.

Direct Connection

Presently, Hanging Rock station's 138 kV facilities consist of a 138/69 kV 56 MVA transformer and the ground switch/MOAB protection scheme for the transformer. Hanging Rock station is at the end of a radial tap connected to the Bellefonte-East Wheelersburg 138 kV circuit (see Exhibit 2). The connection proposal is to expand Hanging Rock station to accommodate the generation. Since breakers will be required, a second line will be strung from Hanging Rock station to the Bellefonte-East Wheelersburg 138 kV line by utilizing the vacant side of the existing towers on the Hanging Rock extension. The Hanging Rock connection would then be reconfigured into a breaker-and-a-half arrangement with 5 circuit breakers.(see Exhibit 3). Relay equipment upgrades will also be required at East Wheelersburg and Bellefonte stations.

It is expected that any costs associated with right-of-way for line extensions or property expansion requirements will be borne by the IC. Note that the IC facilities and any facilities outside the expanded Hanging Rock station were not included in the cost estimate. These are assumed to be the IC's responsibility.

The AEP construction scope includes:

- Expand Hanging Rock station, adding five (5) 138 kV circuit breakers in a breaker-and-a-half bus arrangement, disconnect switches, relays, 138 kV metering, SCADA, and associated equipment.
  Estimated Cost: **$3,600,000**

- Replace relaying and install CCVTs, trap, and line tuner at East Wheelersburg 138 kV station.
  Estimated Cost: **$300,000**

- String second circuit on the existing 4.3 mile long Hanging Rock 138 kV extension utilizing vacant side of existing towers.
  Estimated Cost: **$900,000**

- Upgrade remote relaying at Bellefonte station.
  Estimated Cost: **$300,000**

Total Estimated Attachment Facilities Cost: **$5,100,000**

These upgrades will take approx. 16-30 months to complete from the time an ISA is executed.

Local Network Impacts

The impact of the proposed generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet single contingency performance criteria in accordance with the AEP FERC Form 715. Therefore, this criterion was used to assess the impact of the proposed facility on the AEP System. The AEPSC project was studied as a 200 MW net capacity consistent with the interconnection application. The results are summarized below.

Normal System (2014 Summer Conditions)

- No problems identified.

Single Contingency (2014 Summer Conditions)

- Outage of the Hanging Rock-East Wheelersburg 138 kV circuit , when existing IC 75 MVA generator (bus #243827) connected to North Haverhill is
  - at full output,
    - The Hanging Rock 138/69 kV transformer is overloaded to 106% of its capability.
  - off line,
    - The Hanging Rock 138/69 kV transformer is overloaded to 130% of it's capability.
    - The North Haverhill-E. Wheelersburg-Hanging Rock 69 kV circuit (Ironton-Portsmouth 69 kV line) is overloaded to 112% of its capability.

- Outage of the Hanging Rock-Bellefonte 138 kV circuit, when existing IC 75 MVA generator (bus #243827) connected to North Haverhill is
  - off line,
    - The Hanging Rock 138/69 kV transformer is overloaded to 120% of its capability.

        - The North Haverhill-E. Wheelersburg-Hanging Rock 69 kV circuit (Ironton-Portsmouth 69 kV line) is loaded to 95% of its capability.

- Outage of the North Haverhill-E. Wheelersburg-Hanging Rock 69 kV circuit (Ironton-Portsmouth 69 kV line), when existing IC 75 MVA generator (bus #243827) connected to North Haverhill is
    - off line,
        - The North Haverhill-Dow Chemical-Hanging Rock 69 kV circuit (North Haverhill-Hanging Rock 69 kV line) is overloaded to 118% of its capability.

- Outage of the North Haverhill-Dow Chemical-Hanging Rock 69 kV circuit (North Haverhill-Hanging Rock 69 kV line), when existing IC 75 MVA generator (bus #243827) connected to North Haverhill is
    - at full output,
        - The North Haverhill-E. Wheelersburg-Hanging Rock 69 kV circuit (Ironton-Portsmouth 69 kV line) is overloaded to 103% of its capability

    - off line,
        - The North Haverhill-E. Wheelersburg-Hanging Rock 69 kV circuit (Ironton-Portsmouth 69 kV line) is overloaded to 178% of its capability

Double Contingency (2014 Summer Conditions)

- No problems identified.
    - Attachment facilities as proposed (See Exhibit 3) prevent X1-027 from connecting to 69 kV facilities without at least one 138 kV outlet remaining under any double contingency.

Short Circuit Analysis

- No problems identified.

Stability Analysis

- Stability studies were not performed as part of this Feasibility Study and are not normally performed as part of a Feasibility Study effort. The stability assessments are part of the System Impact Study. Based upon the results of this future System Impact Study, the extent of system upgrades could change and the associated costs could be significantly different.

Local/Network Upgrades

To facilitate the #X1-027 generation, upgrades are required to the Hanging Rock 138/69 kV transformer and associated protective equipment, two 69 kV lines and remote relaying.

The AEP construction scope includes:

- Replace existing Hanging Rock transformer with 138/69 kV 130 MVA unit. Upgrade 69 kV transformer breaker and relaying for various 69 kV breakers. Estimated Cost: **$1,600,000**

- Rebuild Approx. 1.0 miles of 69 kV Ironton-Portsmouth 69 kV line between Hanging Rock and North Haverhill. Estimated Cost: **$1,000,000**

- Rebuild Approx. 2.1 miles of 69 kV Hanging Rock-North Haverhill 69 kV line between Hanging Rock and North Haverhill. Estimated Cost: **$2,100,000**

- Install fiber extension to Dow Chemical station and install new 69 kV relaying packages at Dow Chemical and North Haverhill stations. Estimated Cost: **$1,100,000**

- Upgrade 69 kV protection / relaying at East Haverhill station. Estimated Cost: **$300,000**

Total Estimated Local Network Upgrade Cost: **$6,100,000**

Network Impacts

Queue project X1-027 was studied as a(n) 200.0 MW (200.0 MW of which was Capacity) injection into AEP's system at the Hanging Rock 138.0 kV substation. Project X1-027 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Generator Deliverability

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

1. (AEP) The Hanging Rock-East Haverhill 69 kV line (from bus 244959 to bus 243165 ckt 1) loads from 76.36% to 103.86% (DC power flow) of its emergency rating (40 MVA) for the single contingency '6251_B1_N12 69.0-1'. This project contributes approximately 11.00 MW to the thermal violation.

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

No problems identified

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

No problems identified

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue.)

2. (AEP) The Franklin Furnace-K.O.T. Coal Co. 69 kV line (from bus 243167 to bus 243171 ckt 1) loads from 158.62% to 162.21% (DC power flow) of its emergency rating (40 MVA) for the single contingency '5892_B2_TOR612_U2-080B'. This project contributes approximately 8.90 MW to the thermal violation.

3. (AEP) The K.O.T. Coal Co.-Wheelersburg 69 kV line (from bus 243171 to bus 243183 ckt 1) loads from 155.62% to 159.21% (DC power flow) of its emergency rating (40 MVA) for the single contingency '5892_B2_TOR612_U2-080B'. This project contributes approximately 8.90 MW to the thermal violation.

4. (AEP) The Wheelersburg-Scioto Trail 69 kV line (from bus 243183 to bus 243181 ckt 1) loads from 142.59% to 146.19% (DC power flow) of its emergency rating (40 MVA) for the single contingency '5892_B2_TOR612_U2-080B'. This project contributes approximately 8.90 MW to the thermal violation.

System Reinforcements

1. We will need to install a second 138 kV circuit on the 4.3 mile 138 kV tap to Hanging Rock 138 kV and install a 4 breaker ring bus at Hanging Rock.
Hanging Rock ring bus & 2nd ckt on 138 kV tap ==> $6,600,000. This solution alone still leaves an N-1 loading of 95.6 MVA or 111.7% on the Hanging Rock 138/69 kV transformer so we will also need to upgrade the 138/69 kV transformer, upgrade the 69 kV transformer breaker, and replace the 138 kV MOAB & ground switch with 138 kV breaker.
Hanging Rock transformer / protection upgrade ==> **$1,800,000**

Contribution to Previously Identified Reinforcements

2,3,4. To avoid extensive 69kV upgrades to the AEP system due to an outage of the Millbrook Park-U2-080 line, AEP is proposing the construction of an additional 0.75 miles of 138kV line from the new interconnection station to Millbrook Park station($800,000), an additional breaker at the new interconnection station ($750,000), and an Ohio River crossing permit will be required for this new line. This solution will alleviate the 69kV overloads and satisfy the stability concern. Estimated cost **$2,915,000**.

Exhibit #1

Exhibit 2

Exhibit 3