Generation Interconnections

This analysis was completed to assess the reliability impact for a new generator interconnecting to the PJM system as a capacity resource.

Network Impacts - 725 MW Injection

Network impacts for the injection of 725 MW into the Chichester - Claymont (220-39) and Chichester - Edgemoor (220-43) 230kV lines are as follows:

During normal operation, with all transmission facilities in-service, power flow simulation indicates that all voltages can be adjusted within an acceptable range but the following transmission line thermal overloads were found:

138 kV

- Eddystone - Llanerch (130-42 line); 218 MVA loading exceeds 215 MVA rating.

230 kV

- Master - N. Phila. (220-44 line); 611 MVA loading exceeds 472 MVA rating.
- N. Phila. - Waneeta (220-49 line); 612 MVA loading exceeds 517 MVA rating.
- Grays Ferry - Parrish (220-27 line); 847 MVA loading exceeds 752 MVA rating.
- Mickleton - Monroe; 387 MVA loading exceeds 339 MVA rating.
- Gloucester - Eagle Point; 817 MVA loading exceeds 653 MVA rating.

Single contingency and towerline outage analyses were also performed. The following transmission lines were found to exceed emergency ratings for single contingency outages:

138 kV

- A single contingency outage of Eddystone - Llanerch 138 kV (130-45 Line) increases the loading on the Eddystone - Llanerch 138 kV (130-42 Line) to 328 MVA which exceeds the 323 MVA 4-hour emergency rating of the overhead portion of 130-42 line and approaches the 335 MVA 4-hour rating of the underground cable portion of 130-42 line.

230 kV

- Master - N. Philadelphia (220-44 line), for the outage of Plymouth - Pulaski (220-41 line), loads to 722 MVA which exceeds the 624 MVA emergency rating.
- N. Philadelphia - Waneeta (220-49 line), for the outage of Whitpain - Jenkintown (220-17 line), loads to 765 MVA which exceeds the 701 MVA emergency rating.

- Grays Ferry - Parrish (220-27 line), for the outage of Concord - Lenape (220-70 line), loads to 980 MVA which exceeds the 891 MVA emergency rating.
- New Generation attachment point for #A19 in Queue A - Ridley Tap (existing section of 220-46 line), for the outage of Eddystone - Island Road (220-23 line), loads to 1282 MVA which exceeds the 1234 MVA emergency rating.
- Mickleton - Monroe, for the outage of Gloucester - Eagle Point 230 kV and Gloucester 230/26 kV transformer, loads to 706 MVA which exceeds the 444 MVA emergency rating.
- Gloucester - Eagle Point, for the outage of Richmond - Waneta 230 kV and Richmond 230/13.8 kV #3, loads to 901 MVA which exceeds the 752 MVA rating.

(Note: All normal operation and contingency overloads shown above are not solely due to the injection of 725 MW by this project. In some instances this project aggravates an overload which exists from injection of generation which was earlier in Queue A.)

The cost and construction time estimates for required network upgrades are as follows:

138 kV Upgrades

To relieve both the normal and emergency overloads of Eddystone - Llanerch 138 kV (130-42 line), a second underground cable can be installed in parallel with the existing underground cable and the aerial portion of the line can be upgraded to increase the acceptable conductor operating temperature from 140 to 180 degrees. It would be possible to accept temporary loss of strength for 130-42 line aerial conductor; however, the towers that currently hold the aerial portion of the line may need to be modified to accommodate the additional sag. The increase in acceptable operating temperature provides a significantly higher emergency rating of 404 MVA. The total cost estimate for Eddystone - Llanerch 138 kV (130-42 Line) upgrade is $17.5 Million. This includes 4 miles of new 138 kV underground cable ($16 Million), and the upgrade of towers on the existing aerial portion ($1.5 Million).

230 kV Upgrades

Grays Ferry - Parrish 230 kV (220-27 line); $10 Million
Master - N. Philadelphia 230 kV (220-44 line); $8 Million
N. Philadelphia - Waneeta 230 kV (220-49 line); $6 Million
Mickleton - Monroe; $6 Million
Gloucester - Eagle Point; $5 Million

Estimated time for construction of 230 kV upgrades is 18-24 months assuming that it is possible to concurrently perform all of the work and obtain the required outages to transmission facilities.

A short circuit screening analysis was performed to determine the impact to network circuit breakers as a result of increased short circuit current duty provided by the proposed injection of generation. Results indicate that there may be as many as fifteen 230 kV circuit breakers which would require replacement if this generation is installed along with all others which are previous to this project in Queue A. It is estimated that replacement of all 15 circuit breakers would cost approximately $5.3 Million and would take 18 to 24 months to complete. The short circuit screening analysis had not been

performed with sufficient detail to allow for determination of whether all of the circuit breaker overduties are solely due to this project. In addition to the fifteen 230 kV circuit breakers previously identified, 138 kV circuit breakers at Eddystone and Chichester substations, and 69 kV circuit breakers at Island Road substation may also be overdutied.