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 Grays Ferry - Island Road (220-75) 230kV line are shown below.

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:

69 kV
· Richmond - Westmoreland (6607 line); 113 MVA loading exceeds 105 MVA rating.
138 kV
· Eddystone - Llanerch (130-42 line); 232 MVA loading exceeds 215 MVA rating.
230 kV
· Master - N. Phila. (220-44 line); 792 MVA loading exceeds 472 MVA rating.
· N. Phila. - Waneeta (220-49 line); 761MVA loading exceeds 517 MVA rating.

· Grays Ferry - Parrish (220-27 line); 1123 MVA loading exceeds 752 MVA rating.
· Master - Parrish (220-45 line); 956 MVA loading exceeds 752 MVA rating.
· Mickleton - Monroe (2304 line); 432 MVA loading exceeds 339 MVA rating.
· Gloucester - Eagle Point (P2242 line); 863 MVA loading exceeds 653 MVA rating.

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

69 kV
· Richmond - Westmoreland (6607 line), for the outage of Waneeta 230kV-138kV Transformer #8, loads to 142 MVA which exceeds the 124 MVA emergency rating.
· Island Road - Packer (6641 line), for the outage of Grays Ferry - Parrish (220-27 line), loads to 139 MVA which exceeds the 124 MVA emergency rating.
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 343 MVA which exceeds the 323 MVA 4-hour emergency rating of the overhead portion of 130-42 line and the 335 MVA 4-hour rating of the underground cable portion of 130-42 line.
· Eddystone - Master (130-43 line), for the outage of Grays Ferry - Parrish (220-27 line), loads to 331 MVA which exceeds the 323 MVA emergency rating.
· Llanerch - Bryn Mawr (130-36 line), for the outage of outage of Grays Ferry - Parrish (220-27 line), loads to 232 MVA which exceeds the 229 MVA emergency rating.
230 kV
· Master - N. Philadelphia (220-44 line), for the outage of Plymouth - Pulaski (220-41 line), loads to 903 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 919 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 1281 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 this generation developer's (#A 27) new substation to Grays Ferry line section (formerly 220-75 line), loads to 1486 MVA which exceeds the 1234 MVA emergency rating.
· This generation developer's (#A 27) new substation to Grays Ferry line section (formerly 220-75 line), for the outage of the line section of New Generation attachment point for #A19 in Queue A - MacDade (formerly 220-46 line), loads to 1513 MVA which exceeds the 1374 MVA emergency rating.
· Nottingham - Peach Bottom (220-08 line), for the outage of Peach Bottom - Conastone (5012 line), loads to 650 MVA which exceeds the 637 MVA emergency rating.
· Mickleton - Monroe, for the outage of Gloucester - Eagle Point 230 kV and Gloucester 230/26 kV transformer, loads to 793 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 959 MVA which exceeds the 752 MVA rating.
· Island Road 230-69kV Transformer, for the outage of the 220-75 line section from the generation developer's new 230 kV substation to Grays Ferry, loads to 248 MVA which exceeds the 222 MVA emergency 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:

69 kV Upgrades
· Richmond - Westmoreland (6607 line); $5.8 Million to install a 2nd Richmond - Westmoreland underground cable circuit.
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
· Master - Parrish (220-45 line); $4 Million
· New Generation attachment point for #A19 in Queue A - Ridley Tap (existing section of 220-46 line); $1.5 Million
· This generation developer's (#A 27) new substation to Grays Ferry line section (existing 220-75 line); $1 Million
· Mickleton - Monroe; $6 Million
· Gloucester - Eagle Point; $5 Million
· Island Road 230-69 kV Transformer; $4 Million to replace the existing 150 MVA transformer with a new 300 MVA transformer

Estimated time for construction of 230 kV upgrades is 24-36 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 twenty eight 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 28 circuit breakers would cost approximately $10 Million and would take 24 to 36 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 twenty eight 230 kV circuit breakers previously identified, there may be a significant number of 138 kV and 69 kV circuit breakers also overdutied.