

#004 Camden - Richmond 640 MW
Generation Interconnection

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

Network Impacts - 640 MW Capacity Injection

The #004 project was studied as an injection of 640 MW into a tap of the Richmond to Camden 230 kV circuit. Project #004 was evaluated for compliance with reliability criteria for summer peak conditions in 2009. Potential network impacts were as follows:

Generator Deliverability

The Camden to O04 230 kV circuit is loaded to 106% of its emergency rating (874 MVA) for the outage of the Croydon—Burlington—Mt. Laurel—Cox’s Corner 230 kV circuit. The #004 project contributes approximately 157 MW to the contingency overloaded facility.

Multiple Facility Contingency – Tower Line Outages

No problems were identified

Short Circuit

See Attachment #1 for more detail. The following circuit breakers were found to be overdutied as a result of the Queue O04 interconnection:

Richmond 230 kV - #415 and #525

Waneeta 230 kV - #425, #285 and #85

Richmond 69 kV - #30, #50 and #130

Stability (MAAC Criteria IV)

Not required for Feasibility Study. Will be performed during the Queue O04 Impact Study. See Notes 1 and 2 below for additional information.

The following stability notes were from the former E21 Impact Study

Stability analysis was performed at light load conditions. The range of contingencies evaluated was limited to that necessary to demonstrate compliance with MAAC Reliability Criteria IV.

There were no identified problems except as described in Note 1 below. See Attachment #1 for the fault cases evaluated.

Note 1:

The Camden - Richmond 230 kV line does not presently have redundant high speed pilot line protection, and a simulated SLG fault at 80% of the O04 - Richmond 230 kV line with a zone 2 clearing time of 30

cycles created a fairly large (about 75 degrees) angular first swing on the O04 units. As a margin test, increasing the clearing time to 35 cycles resulted in the units going unstable.

In order to provide for adequate stability margin it will be required that the zone 2 total clearing time for the new E21 to Camden line protection, and E21 to Richmond line protection not exceed 25 cycles. This requirement can be waived if redundant high speed pilot line protection is used for each line segment.

Note 2:

While the stability analysis has been performed at extreme system conditions, there is a potential that evaluation at higher levels of generator output over a range of load levels would disclose unforeseen stability problems. The MAAC yearly reliability analysis to be performed to test all system changes will include this evaluation. Any problems uncovered will need to be resolved.

New System Reinforcements

Circuit breaker Replacements / Upgrades:

Richmond 230kV CBs #415 and #525; Richmond 69kV CBs #30, #50 and #130; and Waneeta 230kV #85, #285 and #425 can be upgraded / replaced at an estimated cost of **\$1,250,000** with a construction leadtime of approximately **14 months**.

Camden to O04 230kV circuit upgrade:

The Camden – Queue O04 230kV circuit can be upgraded to sufficient emergency rating by replacing the existing conductor with 1590 ACSS. The estimated cost is **\$2,500,000** and the construction leadtime is approximately **24 months**.

Contribution to Previously Identified System Reinforcements

To be determined. See Note 3 below.

Note 3:

There are ongoing studies to identify system reinforcements to accommodate the generator retirements in Eastern PJM. All of the system upgrades have not been identified at the time the Feasibility Study was completed for generation project O04. The network impacts for this project will be re-evaluated at the Impact Study when a more complete set of system reinforcements for Eastern MAAC will be available.

ATTACHMENT #1

New Upgrade Requirements due to Queue O04 Interconnection

Location	Voltage	Breaker	Rating (kA)	Fault Current (A) before Queue O4	Fault Current (A) after Queue O4	% of SC Rating	Reinforcement Requirement	Cost
Richmond	230 kV	415	40.5	36,309	42,156	104.1	Upgrade to 50 kA	\$ 105,000
Richmond	230 kV	525	40.5	36,987	42,835	105.8	Upgrade to 50 kA	\$ 105,000
Richmond	69 kV	30	29	28,997	29,390	101.3	Replace w/ 40kA	\$ 170,000
Richmond	69 kV	50	29	28,997	29,390	101.3	Replace w/ 40kA	\$ 170,000
Richmond	69 kV	130	29	28,722	29,112	100.4	Replace w/ 40kA	\$ 170,000
Waneeta	230 kV	425	42	39,836	43,666	104.0	Replace w/ 63kA	\$ 320,000
Waneeta	230 kV	85	45.2	41,743	45,508	100.7	Upgrade to 50 kA	\$ 105,000
Waneeta	230 kV	285	40.5	40,132	43,995	108.6	Upgrade to 50 kA	<u>\$ 105,000</u>
							Total	\$ 1,250,000