#U2-023 Printz 720 MW

Generator 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

Queue U3-023 was studied as a 720 MW capacity injection into the PECO system at the Printz 230 kV substation. U3-023 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

NETWORK IMPACTS

Generator Deliverability

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

1. The (**PECO-PECO**) Tunnel – Parrish 230 kV line loads from **86.51% to 110.75%** of its emergency rating (1395 MVA) for single line outage of line 220-70 (PE69). This project contributes approximately **338.27 MW** to cause this thermal violation.

2. The (**PECO-PECO**) Tunnel – Parrish 230 kV line loads from **80.43% to 102.02%** of its normal rating (1239 MVA) for non-contingency condition. This project contributes approximately **267.46 MW** to cause this thermal violation.

3. The (**PECO-PECO**) Master – North Philadelphia 230 kV line loads from **85.15% to 107.68%** of its emergency rating (882 MVA) for single line outage of line 220-70 (PE69). This project contributes approximately **198.75 MW** to cause this thermal violation.

4. The (**PECO-PECO**) Printz – Eddystone 4 230 kV line loads from **45.19% to 105.35%** of its emergency rating (1193 MVA) for single line outage of line 220-46 (PE46). This project contributes approximately **717.79 MW** to cause this thermal violation.

Multiple Facility Contingencies

(Double Circuit Tower Line contingencies only for the full energy output. Stuck Breaker and Bus Fault contingencies will be performed for the Impact Study)

No problems identified.

Contribution to Previously Identified Overloads

(This project contributes greater than the PJM cost allocation threshold loading to the following contingency overloads, i.e. "Network Impacts", identified for either (i) Earlier generation or transmission interconnection projects in the PJM Queue for upgrades >$5M, or (ii) Projects within the same PJM Queue for upgrades <$5M)

5. The (**PECO-PECO**) Elmwood8-Greysferry 93 230kV line (bus# 4665-4684) loads from **100.95%** to **119.51%** (DC power flow) of its emergency rating (1339 MVA) for single line outage of line #220-23 (PE23). This project contributes approximately **248.50MW** to the thermal violation.

Short Circuit

6. The following circuit breakers were found to exceed their interrupting rating as a result of (i) (>$5M / substation in upgrades - The addition of Queue U3-023 generation, and/or (ii) (<$5M / substation in upgrades) - The addition of all generation in this Queue and U3-023's contribution exceeds the required short circuit contribution threshold (3% of rating) for cost allocation.

Station	Volt (Kv)	CB #	Rating (KA)	Calculated Short Circuit Current					
				Before			After		
				Int Rating Amps	3-phase	Ph-Gnd	Int. Rating Amps	3-phase	Ph-Gnd
Grays Ferry	230	775	45.2	45110.6	45801.8	43116.9	46275.3	46972.7	43893.2
Eddystone	230	305	63	59492.6	53658.7	57685	63878	57568.6	62262
Eddystone	230	405	63	59492.6	53658.7	57685	63878	57568.6	62262
Eddystone	230	345	63	59018	53658.7	57685	63410	57568.6	62262
Chichester	230	195	50	49138.8	52848.7	46201.6	50242.3	53988.6	46868
Ply Meeting	230	475	56	55970.7	57991.1	51697.6	56191.2	58243.9	51835
Whitpain	230	105	40	62917.2	66069.6	62175.7	63087.5	66286.2	62305
Eddystone	230	365	50	49189.9	53658.7	57685	53545.4	57568.6	62262
Printz CT2	230	CT2	63	58348.6	52039.5	53793.1	65077.3	56218.1	59095
Printz CT1	230	CT1	63	58317.1	52039.5	53793.1	65042.1	56218.1	59095
Printz ST	230	ST	63	58319.2	52039.5	53793.1	64836.6	56218.1	59095

Stability Analysis

Will be performed for the Impact Study.

NETWORK UPGRADE REQUIREMENTS

(Queue U3-023 cost allocation for these upgrades will be determined for the Impact Study)

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

1. **Tunnel – Parrish 230 kV.** The total estimated cost of the upgrade is **$33,000,000.** The lead time required for construction is **48 months**.

   Upgrade description: The Tunnel – Parrish (220-27p-t) 230kV line currently has a normal rating of 1239 MVA and an emergency rating of 1395 MVA. This overload would require the construction of a second 230kV line (underground).

2. **See #1 above, this upgrade satisfies both impacts.**

3. **Master – North Philadelphia 230 kV.** The total estimated cost of the upgrade is **$14,000,000.** The lead time required for construction is **48 months**.

   Upgrade description: The Master – North Philadelphia (220-44) 230 kV line currently has a normal rating of 760 MVA. This overload would require the tear down and rebuild of this line to obtain a rating of 1243N/1410E MVA ($9.0M). The appropriate terminal equipment would also need to be replaced ($5.0M).

4. **Eddystone – Printz 230 kV.** The total estimated cost of the upgrade is **$6,000,000.** The lead time required for construction is **36 months**.

   Upgrade description: The Eddystone – Printz (220-78) 230 kV line currently has an emergency rating of 1193 MVA. This overload would require the appropriate terminal equipment to be replaced ($6.0M).

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

5. **Elmwood – Grays Ferry (220-37) 230kV line**:

   The total estimated cost of the upgrade is **$5,000,000.** The lead time required for construction is **30 months**. At this point in time this Queue's cost allocation is undetermined. If required, cost allocation will be performed for the Impact Study.

   Upgrade description: The Elmwood – Grays Ferry (220-37) 230 kV line currently

has an emergency rating of 1339 MVA. This overload would require the replacement of the appropriate terminal equipment.

Short Circuit Upgrades

6. The following circuit breakers were found to exceed their interrupting rating as a result of (i) The addition of Queue U3-023 generation (>$5M / substation in upgrades, and/or (ii) The addition of all generation in this Queue and U3-023's contribution exceeds the required threshold (<$5M / substation in upgrades).

Station	Volts (kV)	CB	Rating (kA)	Upgrade Cost	Time (mos.)	Upgrade
Grays Ferry	230	775	45.2	$100K	24	Upgrade to 50 kA
Eddystone	230	305	63	$300K	30	Replace to 80 kA
Eddystone	230	405	63	$300K	30	Replace to 80 kA
Eddystone	230	345	63	$300K	30	Replace to 80 kA
Chichester	230	195	50	$275K	30	Replace to 63 kA
Ply Meeting	230	475	56	$275K	30	Replace to 63 kA
Whitpain	230	105	40	$300K	30	Replace to 80 kA
Eddystone	230	365	50	$275K	30	Replace to 63 kA
Printz CT2	230	CT2	63	$300K	30	Replace to 80 kA
Printz CT1	230	CT1	63	$300K	30	Replace to 80 kA
Printz ST	230	ST	63	$300K	30	Replace to 80 kA