DISCUSSION OF [redacted] ("Customer") GENERATION SYSTEM IMPACT STUDY RESULTS FOR THE PROPOSED GENERATING FACILITY NEAR THE CITY OF HIGH POINT. TOTAL SUMMER PEAK OUTPUT IS EXPECTED TO BE 244 MW

REVISED 9-22-2009: FAULT DUTY STUDY RESULTS UPDATED TO REFLECT DUKE ENERGY SYSTEM CHANGES.

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Following are the results of the Generation System Impact Study for the installation of 244 MW of generating capacity in Guilford County, NC. The site is located near Jackson Lake Substation, the switching station for Duke's High Point City delivery 3, in proximity to the Archdale 100 kV lines (Linden Street to Pleasant Garden). The plant consists of four units of 61 MW each, with Commercial Operation dates of June 1, 2014, June 1, 2016, June 1, 2018 and June 1, 2020. The study evaluated the requested Network Resource Interconnection Service (NRIS).

A. Study Assumptions and Methodology

The power flow cases used in the study were developed from the Duke internal year 2017 summer peak case (there were no system topology changes identified past 2017). The results of Duke's annual screening were used as a baseline to identify the impact of the new generation. All cases were modified to include 244 MW of additional generation. The generation addition was evaluated interconnected to the Archdale 100 kV line. To determine the thermal impact on Duke's transmission system, the new generation was modeled with a single-circuit, direct connection to the 100 kV High Point City delivery 3 that is served from the Archdale 100 kV lines. The economic generation dispatch was also changed by adding the new generation and forcing it on prior to the dispatch of the remaining Duke Balancing Authority Area units. The study cases were re-dispatched, solved and saved for use.

The NRIS thermal study uses the results of Duke Power Delivery's annual internal screening as a baseline to determine the impact of the new generation. The annual internal screening identifies violations of the Duke Power Transmission System Planning Guidelines and this information is used to develop the transmission asset expansion plan. The annual screening provides branch loading for postulated transmission line or transformer contingencies under various generation dispatches. The thermal study results following the inclusion of the new generation were obtained by the same methods, and are therefore comparable to the annual screening. The results are compared to identify significant impacts to the Duke transmission system.

Stability studies are performed using a dynamic model composed of an updated Duke internal model inserted into the SERC dynamically reduced 2011 summer model with the appropriate generator and equipment parameters for the new units to most accurately represent the Duke control area in the study. The case was economically dispatched to turn off some units to offset the new generation. NERC Category B, Category C, and Category D faults were evaluated.

Fault studies are performed by modeling the new generator and previously queued generation ahead of the new generator in the interconnection queue. Any significant changes in fault duty resulting from the new generator's installation are identified. Various faults are placed on the system and their impact versus equipment rating is evaluated.

Reactive Capability is evaluated by modeling a facility's generators and step-up transformers at various taps and system voltage conditions. The reactive capability of the facility can be affected by many factors including generator capability limits, excitation limits, and bus voltage limits. The evaluation determines whether sufficient reactive support will be available at the Connection Point.

B. Thermal Study Results

No network upgrades were identified as being attributable to the studied generating facility.

Facility Name/Upgrade	Mileage	Estimated Cost	Lead Time (months)
Interconnection cost (new substation, assuming customer provides graded level pad)	n/a	$3.0M	12
Interconnection cost (fold-in of Archdale lines to new substation)	0.5	$1.1M	24
CUSTOMER TOTAL COST ESTIMATE		$4.1M	

C. Fault Duty Study Results

~~The following breakers will need to be replaced:~~

~~1. At Pleasant Garden, PCB 26 (230 kV), the breaker connecting the Pleasant Garden White line to the red bus.~~

~~Total estimated cost for breaker replacements: $250,000~~
No overdutied breakers were identified in the System Impact Study as attributable to the new facility.

D. Stability Study Results

The proposed High Point units folded into the existing 100 kV Archdale transmission lines between Linden Street Station and High Point City Station 3 are transiently stable and well damped for the majority of the possible significant contingency and fault scenarios.

The less severe, more typical NERC Category B scenarios could cause instability. If pilot tripping is assumed out of service or not installed, a fault on either of the Archdale West lines would result in High Point instability due to the delayed Zone 2 clearing of the remote end of the lines. The Zone 2 critical clearing time for the Archdale West Black and White lines is 12 cycles. A clearing time of 10 cycles would be ideal so that the 2 cycles of margin can be maintained for Category B contingencies. This indicates pilot tripping is more critical for this line. Redundant line protection with pilot communication for each (dual pilot tripping) is required because Category B contingencies must be stable per the NERC Standard. Should this protection not be available, High Point is more subject to instability.

The more severe NERC Category C scenarios could cause instability. If pilot tripping is assumed out of service or not installed, a multi-transmission line fault involving the combination of an Archdale West line and an Archdale East line would result in High Point instability. Again this indicates dual pilot tripping on the Archdale West lines is important. Should this protection not be available, High Point is more subject to instability. Implementing dual pilot tripping on these lines will resolve concerns with all NERC Category B and C scenarios studied.

The most severe NERC Category D scenarios could cause instability. If pilot tripping is assumed out of service or not installed and the Zone 2 clearing time is greater than 16 cycles, an Archdale West line breaker 3LG fault with normal clearing would result in High Point instability. If pilot tripping is assumed out of service or not installed and the breaker failure time delay is greater than 9 cycles, an Archdale West or East transmission line 3LG fault with delayed clearing would result in High Point instability. If direct transfer tripping is assumed out of service, not installed, or the direct transfer trip clearing time is greater than 16 cycles, a High Point Generation tap bus section 3LG fault with delayed clearing involving either Archdale West line breaker would result in High Point instability. Should this protection not be available, High Point is more subject to instability.

Circuit reclosing is not modeled in any of the scenarios studied.

The manufacturer proposed power system stabilizers (PSS) were not studied because there was sufficient damping without them. However, a PSS should be purchased along with each exciter and optionally placed in service. If problems arise in the future, then the facility can quickly implement a PSS solution.

The addition of the proposed High Point 244 MW combustion turbine plant does present some stability concerns. With the appropriate equipment and protective systems it may be possible to resolve the concerns. In that case, the units will not negatively impact the overall reliability of other generators and the interconnected transmission system.

E. Reactive Capability Study Results

With the proposed generating facility, the level of reactive support supplied by the units has been determined to be acceptable at this time. Evaluation of MVAR flow and voltages in the vicinity of the Connection Point indicates adequate reactive support exists in the region. Should future studies show the need for additional support, Duke Power integrated resource planning will evaluate solutions and make appropriate changes to the system.

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