DISCUSSION OF [redacted] ("Customer") GENERATION SYSTEM IMPACT STUDY RESULTS FOR THE PROPOSED GENERATING FACILITY AT GASTONIA TECHNOLOGY PARK. TOTAL SUMMER PEAK OUTPUT IS EXPECTED TO BE 244 MW

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Following are the results of the Generation System Impact Study for the installation of 244 MW of generating capacity in Gaston County, NC. The site is located at Gastonia Technology Park, adjacent to the Sampson 230 kV lines (Riverbend to Ripp). 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. 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 Sampson 230 kV lines. To determine the thermal impact on Duke's transmission system, the new generation was modeled with a single-circuit, direct connection to a new 230 kV bus and the Sampson 230 kV double circuit line was folded into the new bus approximately 13.94 miles from Riverbend Switching Station. 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 the SERC dynamically reduced 2011 summer model for the non-Duke control areas in the study. The Duke internal 2019 summer model was updated with the latest planned system upgrades. The updated Duke internal model was inserted into the SERC dynamically reduced 2011 summer model to most accurately represent the Duke control area in the study. The dynamics model has been updated with the appropriate generator and equipment parameters for the new units. The case was also modified to turn off some units to offset the new generation. No transmission system improvements were identified for the addition of these units during the power flow portion of the interconnection request. 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	$8.0M	36
Interconnection cost (fold-in of Sampson lines to new substation)	n/a	$2M	18
CUSTOMER TOTAL COST ESTIMATE		$10M	

C. Fault Duty Study Results

The fault duty does not increase significantly enough to require equipment upgrades.

D. Stability Study Results

All of the tested NERC Category A, B, and C contingencies meet stability criteria. All generators remain stable and oscillations are well damped. All NERC Category D contingencies except D2 also met criteria.

The Gastonia generators were unstable for all tested NERC Category D2 contingencies (three-phase faults with delayed clearing) which impacted two sections of the Sampson 230 kV lines. In the simulations, the unstable Gastonia generators were tripped off-line and all other generators remained stable. This is acceptable performance for NERC Category D.

The assumed total breaker failure clearing time for the D2 faults was 18 cycles. The critical clearing time required to make these faults stable is 9 or 10 cycles, depending on the specific NERC D2 fault. Reducing the clearing time to 9 or 10 cycles can be investigated to see if it is feasible, but again this is not required for NERC Category D. However, Duke Energy requires out-of-step protection on generators that have gone unstable in any of the simulations, so this protection must be added to all Gastonia units.

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 Gastonia 244 MW combustion turbine plant does present some stability concerns for NERC Category D2 contingencies. However, these are low probability events for which stability is not required. The conclusion of this study is that the proposed [redacted] Gastonia Peaking Plant 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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