

Generator Interconnection Feasibility Study Report

**Cumberland County, NC
30.0 MW Solar Farm
Queue #386**



**February 15, 2017
Duke Energy Progress
Transmission Department**

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1 PURPOSE

The purpose of this Feasibility Study is to assess the impacts of the generator interconnection requests on the reliability of the Duke Energy Progress (DEP) transmission system with respect to power flow and short circuit. Estimates of the cost and time required to interconnect the generation as well as to resolve the impacts as determined in this analysis are also included. The DEP internal system analysis consists of an evaluation of the internal DEP transmission system utilizing documented transmission planning criteria. The requests are described in Table 1 below. The customer requested primary and alternate points of interconnection (POI).

Table 1: Interconnection Requests

DEP Generator Interconnection Queue No.	MW	Requested In-Service Date	County	Interconnection Facility
386	30.0	7/1/2018	Sumter County, NC	Erwin-Fayetteville 115 kV Line (primary) or Fayetteville-Fayetteville East 230 kV Line (alternate)

2 ASSUMPTIONS

The following Impact Study results are from the DEP internal power-flow models that reflect specific conditions of the DEP system at points in time consistent with the generator interconnection requests being evaluated. The cases include the most recent information for load, generation, transmission, interchange, and other pertinent data necessary for analysis. Future years may include transmission, generation, and interchange modifications that are not budgeted and for which no firm commitments have been made. Further, DEP retains the right to make modifications to modeling cases as needed if additional information is available or if specific scenarios necessitate changes. For the systems surrounding DEP, data is based on the ERAG MMWG model. The suitability of the model for use by others is the sole responsibility of the user. Prior queued generator interconnection requests were considered in this analysis.

The results of this analysis are based on Interconnection Customer's queue requests including generation equipment data provided. If the facility technical data or interconnection points to the transmission system change, the results of this analysis may need to be reevaluated.

This study was based on the following assumptions:

- CUSTOMER would construct, own and operate the electrical infrastructure that would connect their generation to DEP's facilities, including any step up transformers and lines from the generators, but excluding the circuit breaker in the new breaker station where applicable.

3 RESULTS

3.1 Power-flow Analysis Results

Facilities that may require upgrade within the first three to five years following the in-service date are identified. Based on projected load growth on the DEP transmission system, facilities of concern are those with post-contingency loadings of 95% or greater of their thermal rating and low voltage of 92% and below, for the requested in-service year or the in-service year of a higher queued request. The identification of these facilities is crucial due to the construction lead times necessary for certain system upgrades. This process will ensure that appropriate focus is given to these problem areas to investigate whether construction of upgrade projects is achievable to accommodate the requested interconnection service.

All queue requests, as well as nearby existing and prior-queued generation, were modeled and assumed to be operating at full output.

Contingency analysis study results show that interconnection of these generation facilities **DOES** result in potential thermal overloads on the DEP system. The following facilities will need to be upgraded to accommodate the proposed generation:

Primary POI: Erwin-Fayetteville 115 kV Line

Facility	Upgrade
Erwin – Fayetteville 115 kV Line	Reconductor 2 sections of the line, approximately 9 miles in order to increase rating
Erwin - Fayetteville East 230 kV Line	Raise or replace structures over 18.86 miles in order to increase rating

Alternate POI: Fayetteville-Fayetteville East 230 kV Line

Facility	Upgrade
Erwin - Fayetteville East 230 kV Line	Raise or replace structures over 18.86 miles in order to increase rating

These results are dependent on assumptions regarding prior-queued interconnection requests. If any prior-queued requests drop out of the queue, these results may change.

Estimate of Resolutions for Power Flow Impacts

Primary POI: Erwin-Fayetteville 115 kV Line

Fayetteville – Fayetteville DuPont 115 kV SW STA Line

Potential Solution: Two sections of the Fayetteville – Fayetteville DuPont 115 kV SW STA Line will have to be reconductored/rebuilt. A project of this nature would take 2 years or more to complete.

Estimated Cost: \$13.5 million

Estimated Schedule: 1/1/2019

Erwin – Fayetteville East 230 kV Line

Potential Solution: The Erwin - Fayetteville East 230 kV line will have to be rebuilt. A project of this nature would take 2 years or more to complete.

Estimated Cost: \$12 million

Estimated Schedule: 1/1/2019

Total Power Flow Cost Estimate: \$25,500,000

Alternate POI: Fayetteville-Fayetteville East 230 kV Line

Erwin – Fayetteville East 230 kV Line

Potential Solution: The Erwin - Fayetteville East 230 kV line will have to be rebuilt. A project of this nature would take 2 years or more to complete.

Estimated Cost: \$12 million

Estimated Schedule: 1/1/2019

Total Power Flow Cost Estimate: \$12,000,000

3.2 Stability Analysis Results

Not part of the feasibility study.

3.3 Power Factor Requirements

Not part of the feasibility study.

3.4 Short Circuit Analysis Results

To be performed at a later date.

3.5 Harmonics Assessment

There is potential interaction of harmonic current injections from the Customer's proposed generation and certain capacitor banks on the DEP system. Testing may be necessary after the actual in-service date of this generation and the Customer will be responsible for mitigation of any detrimental impacts to the system.

3.6 Interconnection of Customer's Generation

The point of interconnection for Queue #386 is a new 115 kV breaker station connected to the Erwin-Fayetteville 115 kV Line near structure 53 or a new 230 kV breaker station connected to the Fayetteville-Fayetteville East 230 kV Line. The breaker station one-lines are provided as Figure 1 and 2. The customer should verify that the MVA ratings of their connecting lines are sufficient to accommodate delivering the total MVA output to the point of interconnection at the required 0.95 power factor.

3.7 Estimate of Interconnection Cost

Q386

The estimate includes the assumption that DEP will acquire and use a portion of the property that the Customer will secure for the addition of the facility. The costs below are typical values. Specific projects may cost outside this range. A detailed estimate will be developed at project kick-off.

Tap Line

Description: DEP will tap the Erwin-Fayetteville 115 or Fayetteville-Fayetteville East 230 kV Line kV Line and Construct a short tap line to New Breaker Station adjacent to DEP ROW. Manual switches will be installed on each side of the Tap.

Estimated Cost: \$950,000

New Breaker Station

Description: Construct new 1-230 kV breaker station at generation new connection point. Assumes a control building with cable trench, line trap, CCVTs, surge arrestors, power pot, 230 kV breaker with air break switches, metering PTs and CTs.

Estimated Cost: \$2,200,000

Install Transfer Trip Scheme at New Breaker Station and Transmission Substations

Description: It will be necessary to separate this generation facility from the DEP system for faults on the Erwin-Fayetteville 115 or Fayetteville-Fayetteville East 230 kV Line kV Line. Install protection system and transfer trip for coordination between the above listed transmission line and proposed generation facility.

Estimated Cost: \$300,000

Taxes

Description: NC utility tax of 7%

Estimated Cost: \$241,500

Total Interconnection Cost Estimate: \$3,691,500

4 SUMMARY

This Generator Interconnection Impact Study assesses the impact of interconnecting a new generation facility with a requested summer/winter rating of 30.0 MW. The approved MW injection will be determined after all analysis has been performed. Power flow analysis found multiple overloading issues. Interconnection upgrades to the DEP Transmission System are necessary to accommodate Q386.

DEP will require at least 24 months minimum after a firm written agreement to proceed is obtained from the customer.

The additional cost for telecommunications and metering can be estimated as a monthly charge of \$3,000/month per interconnection.

Primary POI: Erwin-Fayetteville 115 kV Line

Power-flow	\$25,500,000
Stability	\$0
Short Circuit	\$0
<u>Interconnection</u>	<u>\$3,691,500</u>
Total Estimate	\$29,191,500

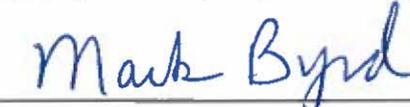
Alternate POI: Fayetteville-Fayetteville East 230 kV Line

Power-flow	\$12,000,000
Stability	\$0
Short Circuit	\$0
<u>Interconnection</u>	<u>\$3,691,500</u>
Total Estimate	\$15,691,500

Study Completed by:

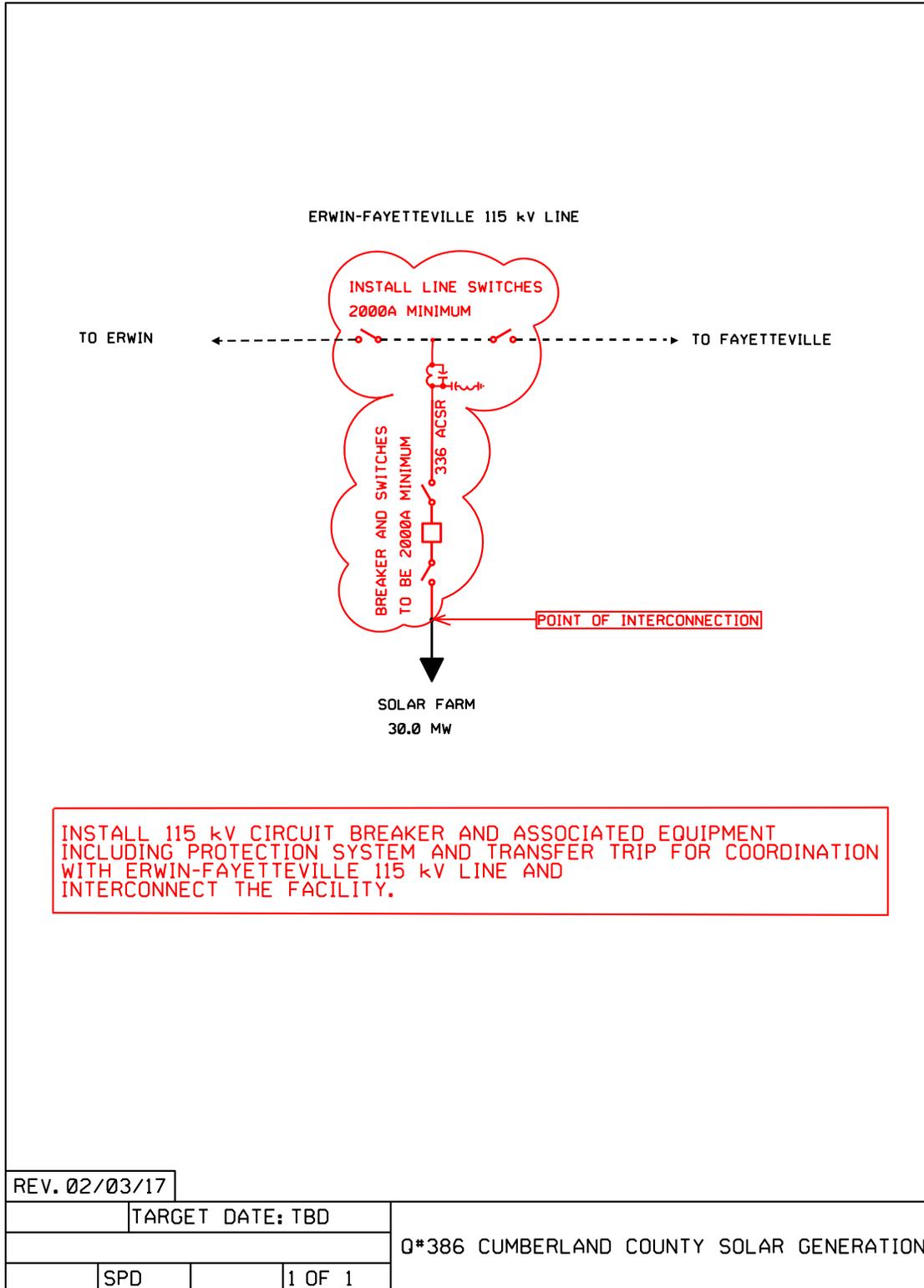

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APPENDIX I : FIGURES

-Figure 1-



-Figure 2-

