Generator Interconnection Impact Study Report

Power Flow Only

Sumter County, SC
100.0 MW Solar Farm
Queue #385

February 15, 2017
Duke Energy Progress
Transmission Department

Table of Contents

1 PURPOSE 3
2 ASSUMPTIONS 3
3 RESULTS 4
3.1 Power-flow Analysis Results 4
3.2 Stability Analysis Results 5
3.3 Power Factor Requirements 5
3.4 Short Circuit Analysis Results 5
3.5 Harmonics Assessment 5
3.6 Interconnection of Customer's Generation 6
3.7 Estimate of Interconnection Cost 6
4 SUMMARY 7
APPENDIX I : FIGURES 8

1 PURPOSE

The purpose of this Impact 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, power factor, stability, and short circuit. This interim report presents only the power flow results. 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.

Table 1: Interconnection Requests

DEP Generator Interconnection Queue No.	MW	Requested In-Service Date	County	Interconnection Facility
385	100.0	7/1/2018	Sumter County, NC	Robinson Plant-Sumter 230 kV Line

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. <u>If the facility technical data or interconnection points to the transmission system change, the results of this analysis may need to be reevaluated</u>.

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:

Facility	Upgrade
Fayetteville – Fayetteville DuPont 115 kV SW STA Line	Reconductor 2 sections of the line, approximately 8 miles in order to increase rating
Cape Fear Plant – West End 230 kV Line	Reconductor 3 sections of the line, approximately 27 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

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: $12 million
Estimated Schedule: 6/1/2019

Cape Fear Plant – West End 230 kV Line

Potential Solution: *Three sections of the* Cape Fear Plant – West End 230 kV Line will have to be reconductored/rebuilt. A project of this nature would take 3 years or more to complete.

Estimated Cost: $40.5 million
Estimated Schedule: 6/1/2020

Total Power Flow Cost Estimate: $52,500,000

3.2 Stability Analysis Results

To be performed at a later date.

3.3 Power Factor Requirements

To be performed at a later date.

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 #385 is a new 230 kV breaker station connected to the Robinson Plant-Sumter 230 kV Line near structure 207. The breaker station one-line is provided as Figure 1. 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

Q385

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 Cumberland-Whiteville 230 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 Cumberland-Whiteville 230 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: State utility tax

Estimated Cost: $0

Total Interconnection Cost Estimate: $3,450,000

4 SUMMARY

This Generator Interconnection Impact Study assesses the impact of interconnecting a new generation facility with a requested summer/winter rating of 100.0 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 Q385.

DEP will require at least 36 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.

Power-flow	$52,500,000
Stability	$0
Short Circuit	$0
Interconnection	$3,450,000
Total Estimate	$55,950,000

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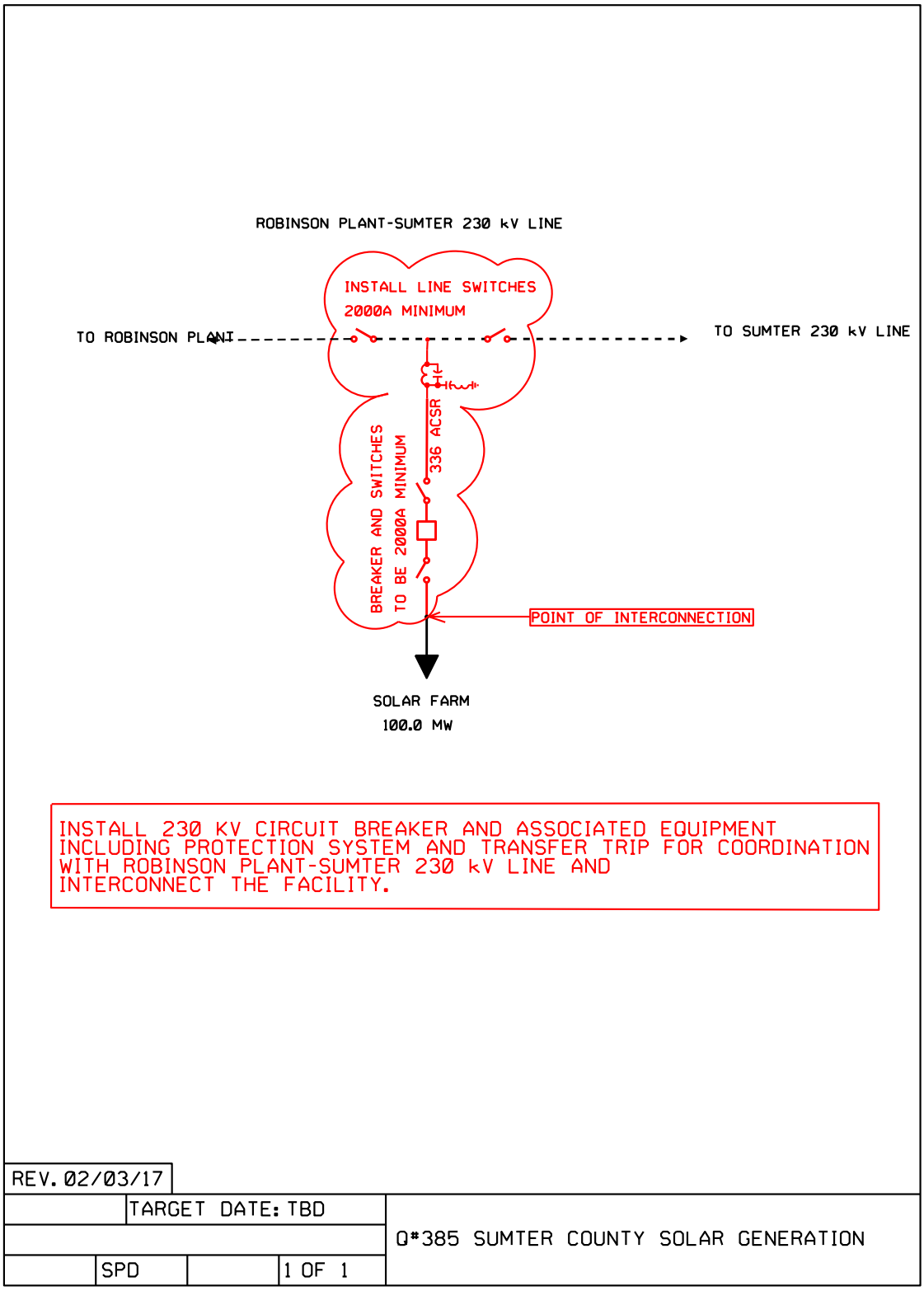
APPENDIX I : FIGURES

-Figure 1-