PID275
Feasibility Study Report
9.33 MW Distribution Inter-Connection
Valentine Substation

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DISCLAIMER

This study has been prepared without the benefit of detailed engineering or study data. The solution set reflects the current understanding of the proposed project. **This study is intended to be used as a screening tool by the Customer**. There are many variables which are unknown at this time. These variables could significantly change the scope of work and estimated cost. In order to proceed with the project, a System Impact Study and Facility Study will need to be developed.

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I. Introduction

The following Feasibility Study is based on the request for inter-connection of Entergy's distribution system at Valentine substation. The objective of this study is to assess the impact of the new facility on the Entergy distribution and transmission system by identifying:

- Any system protection equipment short circuit capacity limits exceeded
- Thermal overload, frequency, or voltage limitations
- Grounding requirements and coordination

The study is intended to determine whether the distribution and transmission system planning criteria are met when the facility is connected to Entergy's system. If not, appropriate system improvements will be identified.

The Feasibility Study process required a load flow analysis to determine if the existing distribution and transmission lines are adequate to handle the full output from the proposed generation facility. A short circuit analysis is performed to determine if the generation would cause the available fault current to surpass the fault duty of existing equipment within the Entergy distribution and transmission system.

This study was based on information provided by PID275 and assumptions made by Entergy's Distribution and Transmission Planning groups. If the actual equipment installed is different from the supplied information or the assumptions made, the results outlined in this report are subject to change.

II. Distribution System Analysis

1. SHORT CIRCUIT ANALYSIS/BREAKER RATING ANALYSIS

A. MODEL INFORMATION

The short circuit analysis was performed on the Entergy system using SynerGEE software. This model includes all proposed generators and transformers interconnected to the Entergy system, and any approved future distribution projects.

B. SHORT CIRCUIT ANALYSIS

The method used to determine if any short circuit problems would be caused by the addition of the PID275 generation is as follows:

Three phase and single phase to ground faults were simulated on the Entergy system. Facility generators and transformers were modeled to generate a revised short circuit model. The base short circuit results were then compared with the results from the revised model to identify any breakers that were under-rated as a result of additional short circuit contribution from PID275 generation.

Any breakers identified to be upgraded through this process are mandatory upgrades.

C. ANALYSIS RESULTS

Initially, the results of the short circuit analysis indicate that the additional PID275 generation causes no increase in short circuit currents such that they exceed the fault interrupting capability of the circuit breakers within the vicinity of the proposed generation site. A more detailed analysis can be performed once specific nameplate data of the transformer is provided.

D. PROBLEM RESOLUTION

As a result of the short circuit analysis findings, currently no resolution is required.

2. LOAD FLOW ANALYSIS

A. MODEL INFORMATION

The load flow analysis was performed using a 2010 summer peak model in conjunction with summer peak data, historic Pegasus load data from the past 15 months, proposed future loads, and an area growth rate based on historic peak loading. In addition, the load flow analysis was projected out over five growth years. The transformers, generators (including future considerations), and interconnecting lines were modeled according to the information provided by PID275.

B. LOAD FLOW ANALYSIS

i) Circuit Loading Criteria

As per Distribution Planning Guidelines, the maximum safe, continuous ampacity rating for bare conductor is limited by the effect of high temperature on the mechanical properties of the conductor material. The conductor's 90°C rating is used to determine the maximum operating capacity.

ii) Power Factor Criteria

As per Distribution Planning Guidelines, the target power factor during summer peak for the low voltage bus of substation transformers is 98% lagging. While it is not possible or practical to operate all substation transformers at a 98% lagging power factor, an attempt should be made to maintain that as a system average by load area. In the event that, under normal operating conditions, the customer facility does not meet the prescribed power factor requirements at the point of interconnection,

the customer shall take necessary steps, such as the installation of reactive power compensating devices, to achieve the desired power factor.

C. ANALYSIS RESULTS

Noted issues to the Valentine X3513 34.5kV system due to the proposed inter-connection of PID275 generation are as follows:

- Feeder power factor *without* the proposed generator meets our system requirements. With generation, additional reactive compensation on feeder X3513 does not appear to be needed based on high leading and lagging generator power factor assumptions made for this study. A System Impact study is needed to verify that the generator will actually be able operate within the needed parameters. If not, reactive compensation may be required. Appropriate charges apply in the event that Entergy must install compensating devices rather than PID275 installing them.
- Controls for the existing pole mounted distribution capacitor banks may need to be replaced with a different type. The dynamic operation will be studied in the System Impact study.
- Valentine T1 LTC control is not designed for Co-generation.

D. PROBLEM RESOLUTION

As a result of the load flow analysis findings, the following resolutions would be required:

- Replace 7 distribution line capacitor controls
- Install a new LTC control

Estimated Cost to Implement Identified Upgrades:

Install 7 capacitor control systems……..……$ 16,000
Install a new T1 LTC control …….. $ 10,000
Total estimated cost of listed work to be performed…….. $ 26,000*

Not including any transfer trip system if noted elsewhere.

III. Transmission System Analysis

1. SHORT CIRCUIT ANALYSIS/BREAKER RATING ANALYSIS

A. MODEL INFORMATION

The short circuit analysis was performed on the Entergy system using ASPEN software. This model includes all generators interconnected to the Entergy system or interconnected to an adjacent system and having an impact on this interconnection request, IPP's with signed IOAs, and approved future transmission projects on the Entergy transmission system. Proposed generators were, conservatively, modeled at a Valentine 34.5kV bus.

B. ANALYSIS RESULTS

The evaluation projected an increase of less than 225 Amps at the Valentine 115kV bus. The present interrupting duty of four breakers installed at Valentine 115kV have adequate margin to accommodate the projected increase in the short circuit current. Increase in short circuit current has minimal impact on existing transmission breakers.

C. PROBLEM RESOLUTION

There were no problems identified for this part of the study that were a result of the additional PID275 generation.

2. LOAD FLOW ANALYSIS

A. LOAD FLOW ANALYSIS

The maximum power that the customer plans to export at the distribution level is approximately 9.3MW. The minimum load presently connected at Valentine 34.5kV is in excess of 14MW, therefore, a 9.3MW injection at the distribution level will not impact Entergy's transmission facilities.

B. PROBLEM RESOLUTION

There were no problems identified for this part of the study that were a result of PID275's generator.

The load flow results are for information only. This interconnection does not in and of itself convey any transmission service.

IV. Grounding

1. GROUNDING INFORMATION

Information provided indicates that the 13.8 kV Brush DG 150-04 generator will be a wye with high impedance neutral grounding and the transformer secondary side connection will be 3 phase, 13,800 volts, delta. The transformer primary side will connect 3 phase, voltage 34,500 V, wye solidly grounded, to the Entergy 34.5kV line. A system diagram indicates an 8400 to 240 VAC transformer with 4.82 Ohm resistor on the low side, connected to the generator as a high impedance sensing and grounding system.

The PID275 transformer is noted to be 3 phase, 9000 kVA base, with an assumed 8% impedance. Information provided indicates a Siemens SDV6 (or equal) 1200 Amp, 20 kA interrupting,13.8 kV, 5 cycle vacuum circuit breaker between the generator and the 9000 kVA transformer and Schweitzer relaying.

The transformer tying the generation to the Company's distribution system should be configured for the Customer to monitor the Company's distribution system and react based upon specifications in Entergy Standard DR07-01 titled "Connecting Large Electric Generators to the Entergy Distribution System (500kVA to 20MVA)". Grounded Wye to Grounded or Ungrounded Wye transformers are preferred with no delta connections between the generator and Entergy. A connection with a Delta may be sometimes used if the Customer monitoring equipment detects a line to ground fault, other faults, a loss of power or abnormal conditions on the Company's distribution system and isolates their equipment. It is noted that the provided one line shows PT's, CT's and a line protection relay at the 34.5kV Point of Interconnection.

The configuration between the Customer's generators and Entergy will be studied in more detail in a System Impact study. The following will be studied:

- Detection and response to various faults on the Company's distribution system per the Company's Interconnection Standard.
- Susceptibility to failure from overload since the Delta will attempt to balance the Company's distribution system load per phase even under grounded phase conditions.
- Whether or not a transfer trip is needed.

The Customer's grounding, transformer, relaying and generator system shall be designed to handle the normal imbalance on the distribution system. Entergy's normal voltage imbalance can be as much as 3% at an unloaded point of service.

V. Coordination

1. COORDINATION INFORMATION

As per the Protection/Interface Requirements section of Entergy Standard DR07-01 titled "Connecting Large Electric Generators to the Entergy Distribution System (500kVA to 20MVA)", protecting both the Customer's facilities and the Entergy facilities are of

great importance. Proper protective systems shall be established in the design phase and confirmed prior to start-up of the Customer's generation facilities. An inter-connection between Entergy and the Customer will not be allowed prior to proper coordination of protective devices.

As per the Specifying Protective Equipment section of Entergy Standard DR07-01 titled "Connecting Large Electric Generators to the Entergy Distribution System (500kVA to 20MVA)", Entergy will have the right to specify certain protective devices, including relays and circuit breakers that the customer must install.

Previous studies for generators connected to the Distribution System have identified a need to install Transfer Trip schemes with fiber communications between the generator and Entergy's Substation. A System Impact and/or Facility Study will be required to determine if Transfer Trip Schemes will be required for this project. The cost to implement a Transfer Trip Scheme on a prior project was approximately $450,000.

It should also be noted PID275 site Larose has another 34.5kV source to the plant from Valentine T2 34.5 kV feeder X3523. In the event that the X3513 source is not available the generator would probably not be allowed to operate but the plant would be allowed to operate as it did before the generation was installed. Feeder X3513 has a crossing under Bayou Lafourche at Valentine substation and over the Intracoastal Waterway. Certain failures of either crossing would take days rather than hours to repair.