System Impact Study Report
PID-273
19.9 MW
Oak Grove-Galion 115kV Tap
Transmission Interconnection

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0	August 31, 2011	Initial Review	JCA
A	Sept. 21, 2011	Approved for Release	MG

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. 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 System Impact Study is based on the request for interconnection of Entergy's transmission system between Oak Grove and Galion 115kV substations by PID-273. The objective of this study is to assess the impact of the proposed 19.9MW photovoltaic facility on reliability of the Entergy transmission.

The study is intended to determine whether the transmission system Planning Criteria is met when the facility is connected to Entergy's system. If not, appropriate system improvements will be identified.

The System Impact Study process required a load flow analysis to determine if the existing transmission lines are adequate to handle the full output from the proposed facility and maintain the system voltages within the acceptable limits. A short circuit analysis was performed to determine if the proposed facility would cause the available fault current to exceed the fault duty of existing equipment within the Entergy transmission system. A transient stability analysis was conducted to determine if the new facility would cause stability problems in the Entergy system. A flicker study was performed to ensure that there was no detrimental impact on the power quality due to the fluctuations of facility output. Finally, impact on the existing protection systems in the local area was investigated. If necessary, appropriate mitigation measures were identified.

This study was based on information provided by PID-273 and assumptions made by Entergy's Transmission Planning group. 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. Transmission System Analysis

1. SHORT CIRCUIT ANALYSIS/BREAKER RATING ANALYSIS

There were no problems identified for this part of the study that were a result of the proposed PID-273 facility.

2. LOAD FLOW ANALYSIS

There were no problems identified for this part of the study that were the result of the proposed PID-273 facility.

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

3. STABILITY ANALYSIS

A voltage sag analysis was performed using ASPEN OneLiner which monitored the voltage at the proposed generator terminals while simulating bus faults at buses around the point of interconnection. Any buses whose faults caused the

generator terminals to drop below 0.6 pu were noted. A stability analysis was then performed using the PSS™E stability software. PID-273 was modeled with and without the extended ride-through option using customer provided data.

The analysis shows that for a 6-cycle three-phase fault near the North Bastrop 115kV switching station followed by the loss of North Bastrop-Bastrop 115kV transmission line, the PID-273 facility will trip offline if not equipped with the extended ride-through option. Similarly, the facility also has the ability to trip for other faults on the 115kV system up to three stations away. Appendix A shows plots for reactive power, active power and voltage at the generator terminals for the North Bastrop fault with and without the extended ride-through option. Based on this stability assessment, installation of the extended ride-through option is recommended to enhance the facility's performance during voltage excursions.

4. HARMONIC REQUIREMENTS

IEEE 519 states the limits for current distortion for various voltage levels on the utility system. The values below, taken from IEEE 519-1992 Table 10.4, show the current distortion limits for facilities connected to the 115kV system. Total Demand Distortion (TDD) is the total root-sum-square harmonic current distortion as a percentage of maximum 60Hz current at the point of common coupling (PCC). PID-273 will be responsible for installing any harmonic filtering to remain within these limits. If these limits are violated, the PID-273 facility may be disconnected until proper remedies are taken.

Current Distortion Limits as % of Max 60Hz Current at PCC					
Individual Harmonic Order (Odd Harmonics)					
<11	11≤*h*<17	17≤*h*<23	23≤*h*<35	35≤*h*	TDD
2.0	1.0	0.75	0.3	0.15	2.5

5. FLICKER ANALYSIS

Entergy uses the General Electric Flicker Limit Curve as a guideline for allowable transmission system voltage fluctuations. The Entergy standard SL1904 "Voltage Fluctuations Operation Guideline" provides additional guidance on voltage fluctuation requirements. If the customer is unable to comply with the standard, additional voltage control measures must be taken to ensure voltage drop is mitigated.

The plant MW output was adjusted from 100% to 40% rating and the voltage at the POI was monitored for voltage swings. PID-273 generation does not produce significant voltage fluctuations when operated at unity power factor, and therefore should have no problem when operated at ±0.95 power factor.

6. RELAYING COORDINATION AND EQUIPMENT

Entergy will design and build a 3-breaker ring bus substation to interconnect the PID-273 facility to the Bastrop-North Bastrop-Oak Grove 115kV transmission line. The interconnection station will consist of the following equipment systems:

- Electrical (includes structures, breakers, switches, arrestors, etc.)
- Foundation & Site (includes site prep, roads, foundations, rock, ground grid, etc.)
- Relay (includes CCVTs, CTs, relay panels, batteries, metering, RTU, etc.)
- Telecom package (includes ADSS fiber, MUX, channel bank, etc.)

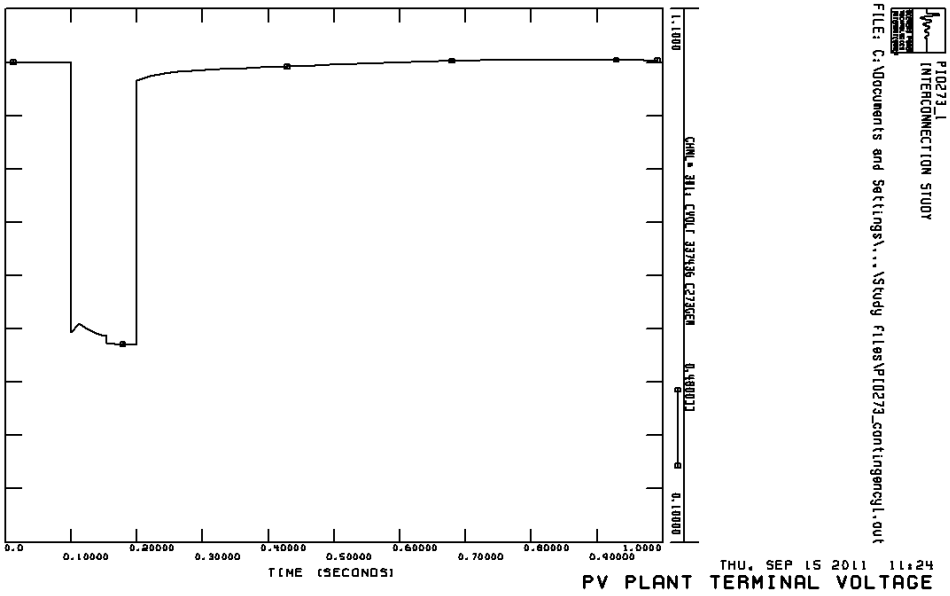
The total estimated cost of the interconnection facilities needed to connect the PID-273 generator to the Bastrop-North Bastrop-Oak Grove 115kV line is Five Million Three Hundred Thousand Dollars (**$5.3 MM)**. The estimate does not include any major transmission line work and assumes the interconnection facility will be sited adjacent to the Bastrop-North Bastrop-Oak Grove 115kV transmission line.

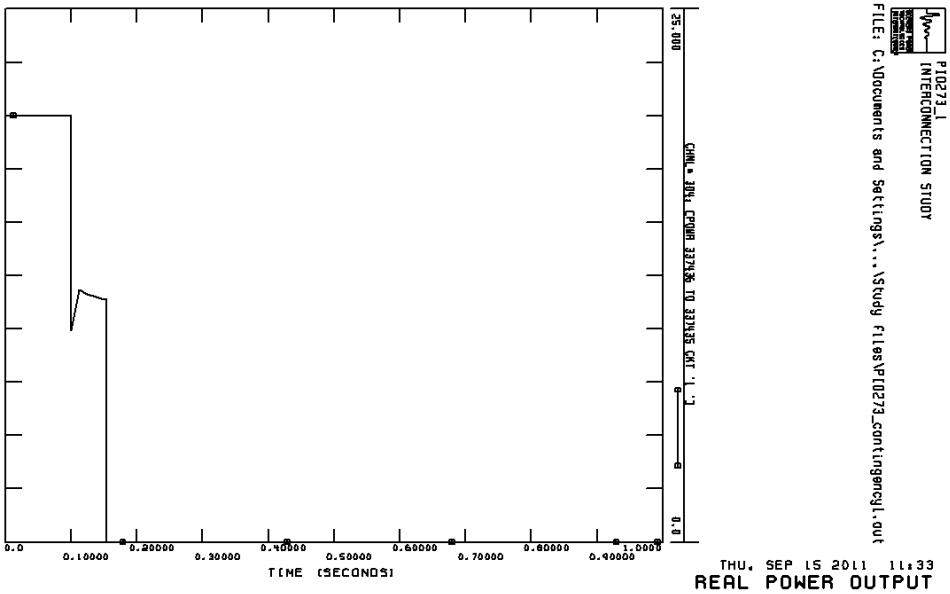
The estimated construction time for the Direct Connection facilities is 24 months after receipt receipt of a fully executed Small Generator Interconnection Agreement (SGIA).

A simplified relaying diagram for PID-273 is shown in Appendix B.

APPENDIX A: PLOTS FOR STABILITY SIMULATIONS

For a 6-cycle three-phase fault near North Bastrop 115kV switching station followed by the loss of North Bastrop-Bastrop 115kV transmission line and PID-273 without the extended ride-through option.





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0.40000
0.50000
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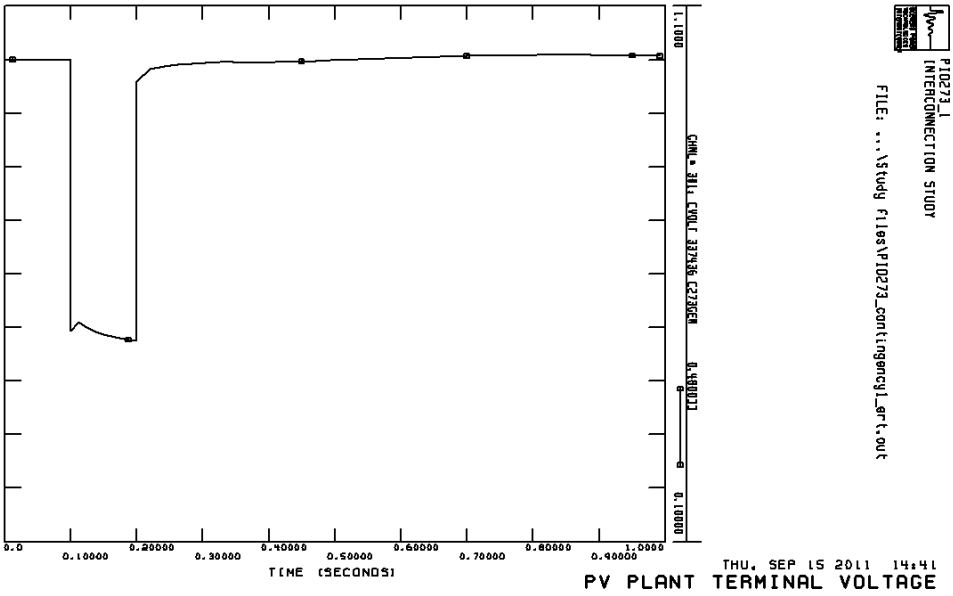
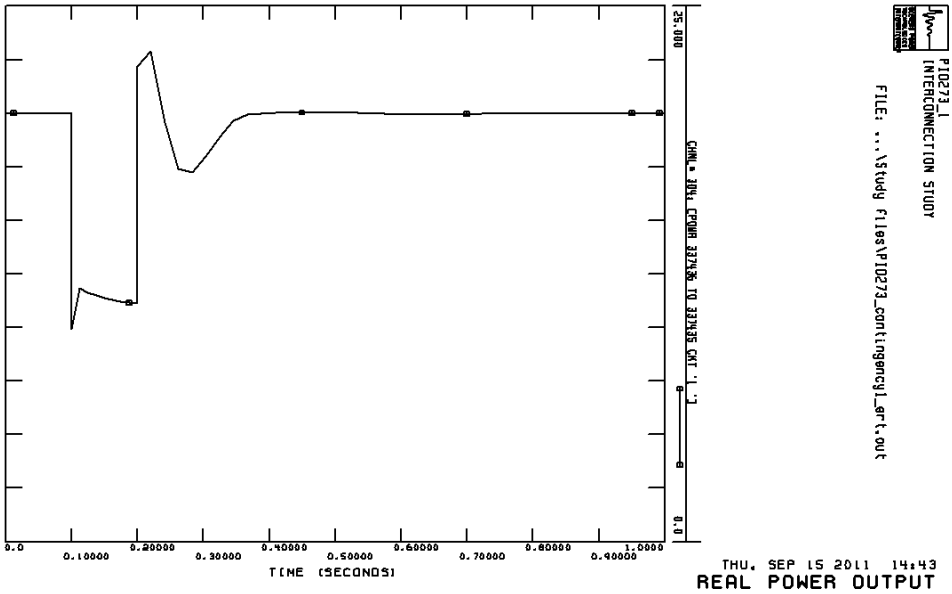
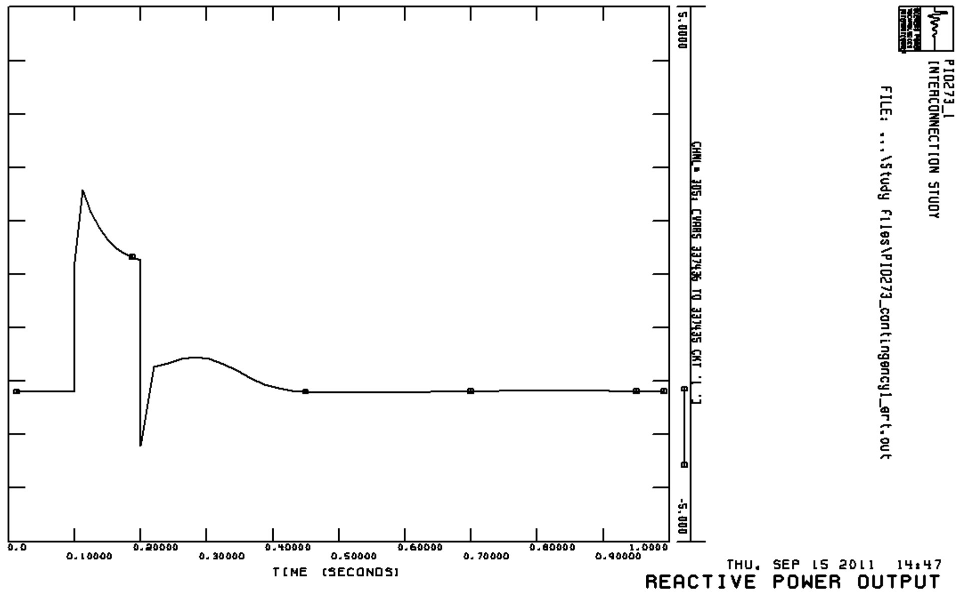
0.70000
0.80000
0.90000
1.0000
TIME (SECONDS)
THU, SEP 15 2011 11:35
REACTIVE POWER OUTPUT

For a 6-cycle three-phase fault near North Bastrop 115kV switching station followed by the loss of North Bastrop-Bastrop 115kV transmission line and PID-273 with the extended ride-through option.



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THU, SEP 15 2011 14:47
REACTIVE POWER OUTPUT

APPENDIX B: PID-273 RELAYING DIAGRAM