Feasibility Study for the

[redacted]

56.0 MW Net Summer / 58.4 MW Net Winter

Biomass Plant

October 2012

Progress Energy

Transmission Planning, Florida

Michael Alexander, P.E.

Table of Contents

US[redacted] Biomass Plant Feasibility Study

Generation Description

- Biomass generating station with a 56.0 MW summer net output (58.4 MW winter net output)
- Commercial operation date: July 5, 2014

Interconnection Points Evaluated

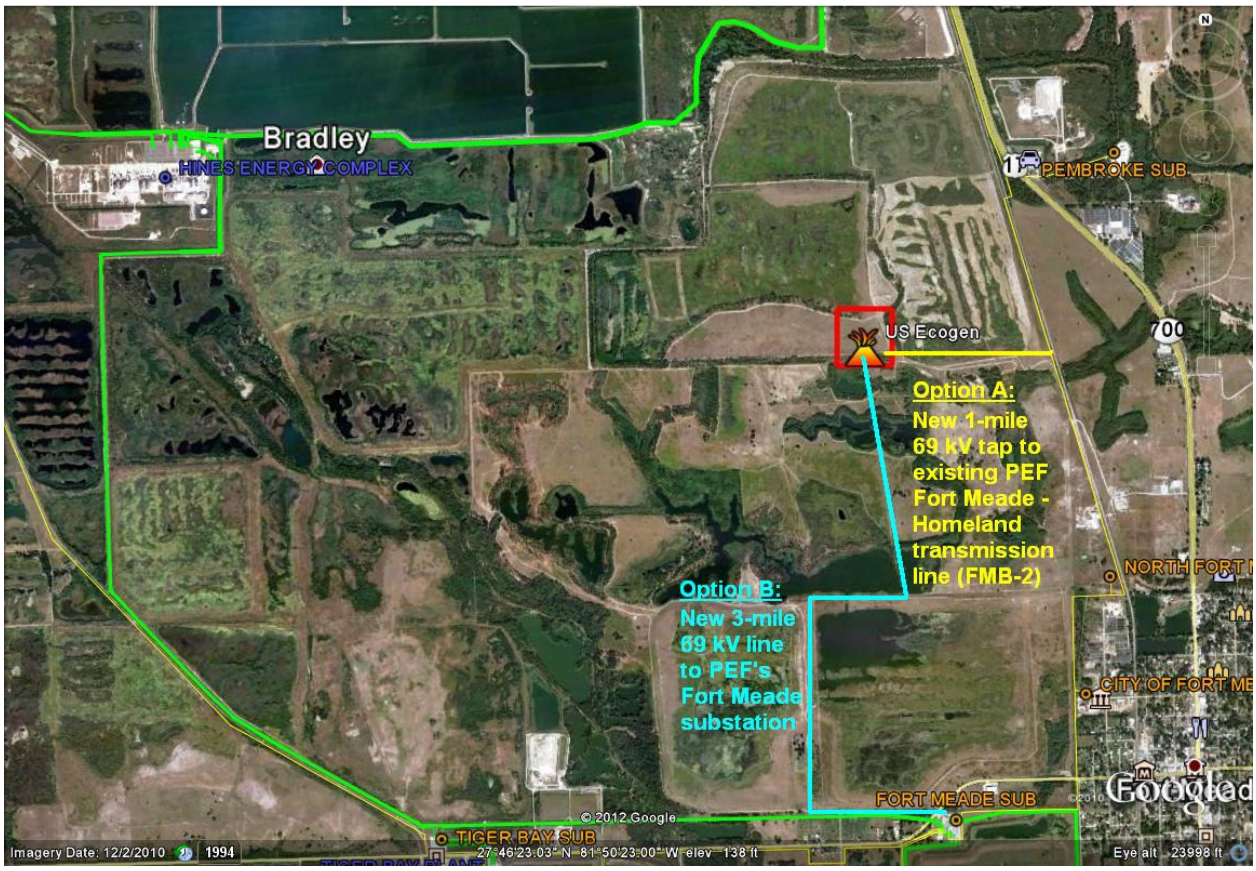
Point(s) of interconnection requested for study by interconnection customer:

- **Option A** – Connection to PEF's existing 69 kV transmission line at a tap point between PEF's Fort Meade and Homeland substations. The tap point will be approximately 0.85 miles south of the Pembroke Tap and 1.6 miles north of the City of Fort Meade Tap. From the tap point, a new transmission line approximately 1.0 mile in length will be built to the [redacted] generation site.

- **Option B** – Connection to PEF's Fort Meade substation via a new 69 kV transmission line, approximately 3.0 miles in length, built directly to the [redacted] generation site.

Alternative point(s) of interconnection considered by PEF:

- No other options were considered reasonable or necessary.



Click here to link to this location in Google Maps.

Criteria for Determining Transmission Impact

Progress Energy Florida's criteria for identifying transmission facilities impacted by the interconnection of new generation facilities are as follows:

Thermal Impact

- System-intact loading over 100% Rate A.
- Post-contingency loading over 100% Rate B.
- Minimum loading increase from Base Case to Interconnection Case of 3%.

Voltage Impact

- System-intact bus voltages lower than 0.95 p.u. or higher than 1.05 p.u.
- Post-contingency bus voltages lower than 0.90 p.u. or higher than 1.05 p.u.
- Minimum voltage change from Base Case to Interconnection Case of 0.01 p.u.

Short-circuit Impact

- Three-phase and single line-to-ground fault current over 100% breaker fault duty capability.
- Minimum fault current increase from Base Case to Interconnection Case of 3%.

Model Development

Power Flow Models

Power flow models were built using the Siemens PSS/E power system simulation program and were based on the FRCC 2012 series (Revision 1, September 2012) cases, which were the most recent models available at the time of the study. The model years studied for power flow impacts were 2014 summer and 2014/15 winter. The models that included the [redacted] plant interconnection utilized the base cases with the addition of the [redacted] generation and associated transmission for the interconnection.

Short Circuit Models

Short circuit models were built using the Siemens PSS/E power system simulation program and were based on the FRCC 2011 series (Revision 1c, March 2012) short circuit cases, which were the most recent models available at the time of the study. The model year studied for short circuit impacts was 2014.

Generator Interconnection Queue Considerations

Prior queued generation in the FRCC coordinated queue was reviewed, and it was determined that there are no relevant generator interconnection requests in the study area that were not already built into the FRCC cases.

Transmission Service Request Priority List Considerations

A review of transmission service requests in the FRCC coordinated priority list was performed, and it was determined that there are no relevant transmission service requests in the study area that were not already built into the FRCC cases.

Analyses Performed

Siemens PSS/MUST **power flow analyses** of base case and [redacted] cases were performed to determine the impact of interconnecting the [redacted] generation on the transmission system in the area. The base cases and each of the interconnection option cases were compared to determine if the interconnection option created thermal overloads or voltage violations, or exacerbated existing thermal overloads or voltage violations. All single element transmission contingencies (69 kV and above) in the FRCC region were analyzed in PSS/MUST. All branch flows and bus voltages were monitored (69 kV and above) in the FRCC region.

The FRCC reliability region is peninsular Florida east of the Apalachicola River. The State of Georgia and areas west of the Apalachicola River in the State of Florida are within the SERC reliability region.

Siemens PSS/E **short circuit analyses** were performed using PSS/E activity ASCC. Three phase and single line-to-ground faults were applied at the PEF Fort Meade and Homeland substations in both the base case and the [redacted] case to measure short circuit impacts. Fault analysis was performed with all nearby generation in service.

Screening Criteria

The following criteria were used for screening PSS/MUST **power flow thermal results**.

- GSU transformers were excluded from consideration.
- Transmission system elements operated at less than 69 kV nominal voltage were excluded.
- System-intact overloads must be greater than 90 percent of rate A.
- Post-contingency overloads must be greater than 90 percent of rate B.
- Post-contingency loadings must change by at least 5 MW.

The following criteria were used for screening PSS/MUST **power flow voltage results**.

- Transmission system buses operated at less than 69 kV nominal voltage were excluded.
- System-intact bus voltages must be outside the range 0.95–1.05 p.u.
- Post-contingency bus voltages must be outside the range 0.95–1.05 p.u.
- Post-contingency bus voltages must change by at least 0.01 p.u.

The following screening criteria were used for screening the PSS/E **short circuit results**.

- All results within two breakered transmission substations of the proposed interconnection points were examined.

Study Results for Option A

Required Upgrades

Thermal:
The feasibility analysis revealed that Option A would require a capacity upgrade of the existing PEF 69 kV line between the proposed [redacted] tap and the City of Fort Meade tap (approximately 1.6 miles of transmission line). This is based on a 41.6% increase in the contingency loading of this segment of the line, resulting in a 104.2% overload of its emergency rating (Rate B). It should also be noted that the segment between the City of Fort Meade tap and PEF's Fort Meade substation (approximately 1.18 miles) saw a similar 41.2% increase in loading under contingency, resulting in 95.9% of its emergency rating being utilized. While this does not exceed the 100% Rate B criteria, subsequent system impact studies may reveal this segment to be impacted as well. See Appendix A for a summary of thermal analysis results.

Voltage:
No adverse voltage impacts were noted as a result of the interconnection of the [redacted] generation under Option A.

Short Circuit:
Short circuit analyses revealed that the interconnection of the [redacted] facilities under Option A would cause impacts greater than 3% at both the Fort Meade and Homeland 69 kV buses. While these substations will be analyzed in greater detail in a future system impact study, the magnitude of the fault current revealed in the feasibility analysis does not appear to exceed the fault capability of existing components at these substations. See Apprendix B for a summary of short circuit analysis results.

Third Party Impacts:
No third party thermal or voltage impacts were identified as a result of interconnection the [redacted] facilities under Option A.

Costs:
Based on this Feasibility Study, the cost to interconnect the [redacted] facility between PEF's Fort Meade and Homeland 69 kV substations, at a tap point approximately 0.85 miles south of the Pembroke Tap and 1.6 miles north of the City of Fort Meade Tap, is estimated to be approximately $3.6M. This includes the cost of the new 1.0-mile 69 kV line, the tap to the Fort Meade – Homeland 69 kV line, and a 1.6-mile rebuild of the existing PEF 69 kV line between the new [redacted] tap and the City of Fort Meade tap.

If the System Impact Study were to reveal Rate B thermal overloading of the 1.18-mile line segment from the City of Fort Meade tap to PEF's Fort Meade substation, the additional cost to rebuild that segment would be approximately $2.0M, resulting in a total cost for Option A of approximately $5.6M.

Study Results for Option B

Required Upgrades

Thermal:
No adverse thermal impacts were noted as a result of the interconnection of the [redacted] generation under Option B. See Appendix A for a summary of thermal analysis results.

Voltage:
No adverse voltage impacts were noted as a result of the interconnection of the [redacted] generation under Option B.

Short Circuit:
Short circuit analyses revealed that the interconnection of the [redacted] facilities under Option B would cause impacts greater than 3% at the Fort Meade 69 kV bus. While this substation will be analyzed in greater detail in a future system impact study, the magnitude of the fault current revealed in the feasibility analysis does not appear to exceed the fault capability of existing components at the substation. See Apprendix B for a summary of short circuit analysis results.

Third Party Impacts:
No third party thermal or voltage impacts were identified as a result of interconnection the [redacted] facilities under Option B.

Costs:
Based on this Feasibility Study, the cost to interconnect the [redacted] facility at PEF's Fort Meade substation will cost approximately $1.0M, which covers the cost of the 69 kV terminal, breaker, and bus upgrades at PEF's Fort Meade substation.

Appendix A – Summary of Thermal Analysis Results

Summer 2014 (Rate B)

** From ** ** To **	Base Loading (%)	Option A Loading (%)	Option A Delta (%)	Option B Loading (%)	Option B Delta (%)	Contingency Description
City of Ft Meade Tap - US EcoGen Tap 69 kV	62.6	***104.2***	41.6	54.9	-7.7	NORTH BARTOW - ORANGE SW 69 kV
City of Ft Meade Tap - Ft Meade 69 kV	54.7	95.9	41.2	47.0	-7.7	NORTH BARTOW - ORANGE SW 69 kV

Winter 2014/15 (Rate B)

** From ** ** To **	Base Loading (%)	Option A Loading (%)	Option A Delta (%)	Option B Loading (%)	Option B Delta (%)	Contingency Description
City of Ft Meade Tap - US EcoGen Tap 69 kV	57.7	96.3	38.6	50.7	-7.0	NORTH BARTOW - ORANGE SW 69 kV

Appendix B – Summary of Short Circuit Analysis Results

		Base	Option A		Option B	
Substation	**Fault Type**	(Amps)	(Amps)	(Delta %)	(Amps)	(Delta %)
FT MEADE 230 kV	3-Phase to Ground	45146.5	45333.4	0.41%	45373.1	0.50%
	Single Line to Ground	43724.2	43916.7	0.44%	43993.2	0.62%
FT MEADE 69 kV	3-Phase to Ground	23201.5	24408.8	5.20%	24807.2	6.92%
	Single Line to Ground	18429.1	19725.2	7.03%	20602.3	11.79%
HOMELAND 69 kV	3-Phase to Ground	18380.5	19282.2	4.91%	18586.2	1.12%
	Single Line to Ground	12362.1	13276.9	7.40%	12478.6	0.94%
ORANGE SW 69 kV	3-Phase to Ground	17972.2	18423.6	2.51%	18061.6	0.50%
	Single Line to Ground	16419.1	16740	1.95%	16473.1	0.33%
MULBERRY 69 kV	3-Phase to Ground	23379.4	23705.8	1.40%	23542.5	0.70%
	Single Line to Ground	23226.6	23481.8	1.10%	23343.1	0.50%
BARCOLA 69 kV	3-Phase to Ground	23587.5	23842.3	1.08%	23794.3	0.88%
	Single Line to Ground	22144.5	22327.2	0.83%	22303.3	0.72%
FTGRNSPG SW 69 kV	3-Phase to Ground	13743.3	13766.9	0.17%	13772.3	0.21%
	Single Line to Ground	8823.9	8835.2	0.13%	8840.2	0.18%