PJM Generator Interconnection Request
Queue #L17
Friedensburg (Rolling Hills) 69 kV
Feasibility/Impact Study Report

August 2004
275912

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner. The process for evaluating the interconnection of a generator to the PJM system is defined in the manuals posted on the PJM Generation Interconnection web page.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

Rockwood-Arnold (Casselman) 115 kV Feasibility/Impact Study

General

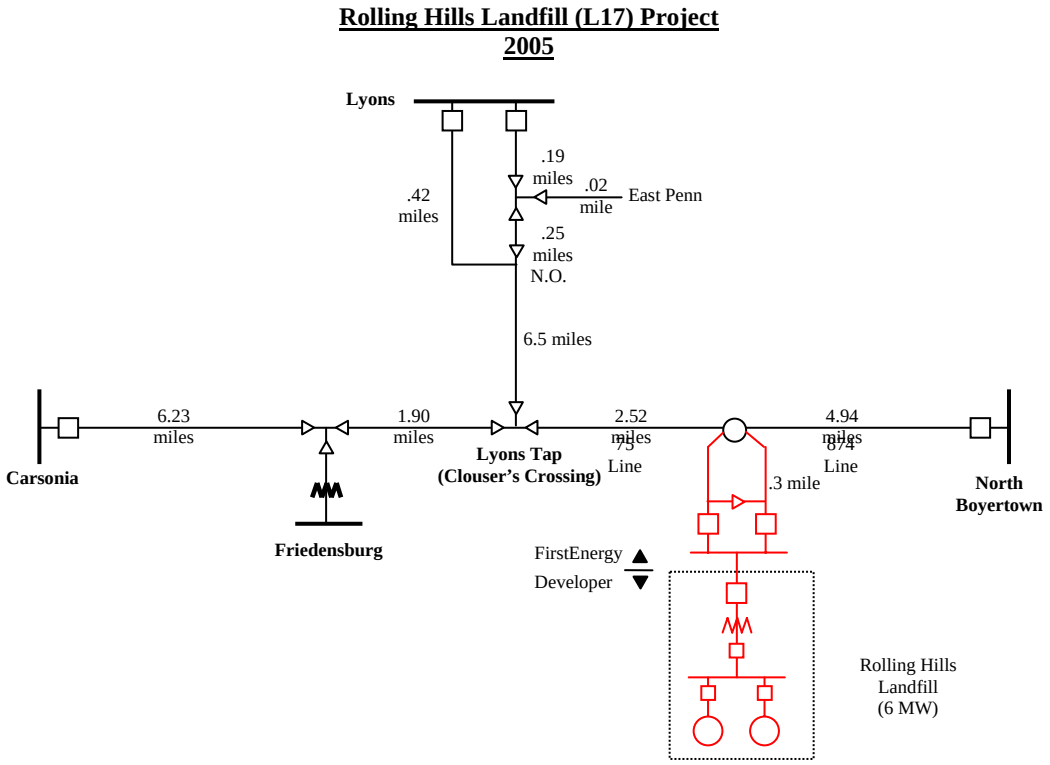
Rolling Hills Landfill Gas, L.L.C. has submitted a proposal for a 6 MW landfill gas generation project (queue position L17) consisting of 1 Solar simple cycle generator. The generators are to be installed at 583 Longview Road, Boyertown, Berks County, Pennsylvania. The proposed in-service date for the generation facility is December 1, 2004.

This project was last evaluated in the generation interconnection queue as project C15. At that time a Facilities Study report was issued and most of the work to interconnect the generation to the system was completed. This Feasibility Study will identify what work remains to be done to reliably connect the generation to the FirstEnergy 69kV system.

Direct Connection

The project will be connected to the Boyertown-Lyons-Carsonia 69kV transmission line in the section between Boyertown and Lyons Tap (Clousers Crossing). See Figure #1.

Figure #1



This project was originally proposed by the Benntech Group in 1999 and proceeded to the point of installing most, but not all, of the direct connection facilities required for its compliance with the PJM RTEP procedures before being withdrawn. Therefore, the analysis performed for the current project is focused on the three issues that need to be resolved in order to proceed with the attachment of the proposed generation project to the Met-Ed transmission system.

The first issue to be addressed is an identification of the status and acceptability of the facilities that have already installed for the project. The second issue is to identify what, if any, system upgrades beyond those previously defined must be installed to meet the transmission connection requirements. The final issue is to evaluate the system protection requirements for the project as defined in the original Facilities Study report issued in March 2002, copy attached as Appendix #1, to determine if any changes need to be implemented.

With regard to the current status of the project, the Met-Ed Regional staff has conducted a field inspection of the direct connection and system facilities that have already been installed for the Rolling Hills project. This review confirmed that the looped 69 kV line for the project attachment was completed as designed and that the Rolling Hills Landfill substation facilities were in place. However, the Regional staff expressed a significant concern that the circuit breakers and substation equipment provided by PEPCO Energy Services pose an unacceptable risk to the reliability of the local Met-Ed 69 kV network. The reason for his concern is that the 69 kV circuit breakers that were acquired and installed by the Project Developer at the Rolling Hills substation are all used equipment with a majority of their useful life already expended. The reliability concern is that the loss of either line breaker at Rolling Hills could sectionalize the Met-Ed 69 kV system and cause the potential for a loss of service to the East Penn Manufacturing facility and/or other customers in the area.

Given the state of the circuit breakers at the substation, as evaluated by Met-Ed, the probability of this occurrence is much higher than normal and will increase exponentially with time. Therefore, as good utility practice, the Met-Ed Region is requiring the installation of a by-pass (or reconnect) switch at or near the Rolling Hills substation with supervisory control. This will assure a continued reliability of service to the Met-Ed customers in the area by providing for the rapid restoration of the 69 kV system in the event that a line breaker failure occurs. The estimated cost for the purchase and installation of this switch is **$75,000** and it is anticipated that it will take 6 months to complete from the signing of an agreement.

As further information, it was also identified during the Region review that the system protection equipment required for the North Boyertown 69 kV substation was acquired, but not installed before the original project was withdrawn. It is estimated that the cost of the engineering and labor to complete its installation is **$50,000**. As a disclaimer, there may be other items not uncovered during the Met-Ed Regional review that will need to be addressed. These will also be a responsibility of the Project Developer.

The FirstEnergy Transmission and Substation Design group has also reviewed the adequacy of the project plan as defined in the March 2002 Facilities Study report. While no additional system facility requirements were defined from this assessment, it was identified that the RTU previously specified for the Rolling Hills Landfill substation no longer meets the FirstEnergy standards. For this reason, PEPCO Energy Services will be required to install a Harris D20 model RTU for compliance. The acquisition and installation of this device will be a responsibility of PEPCO Energy Services.

Based on the defined need for a bypass switch, the First Energy Planning & Protection group then performed a review of the system protection requirements for this project. Note that it was specified in the March 2002 Rolling Hills Project Facilities Study report that microprocessor relays were necessary at the North Boyertown 69 kV substation to provide an adequate protection of the Rolling Hills - North Boyertown (874) 69 kV line. These relays have multiple setting groups that can also be utilized with the installation of a bypass switch at the Rolling Hills Landfill substation. While the electromechanical relays at the Carsonia and Lyons 69 kV substations were deemed adequate without the bypass switch, they are no longer acceptable for the revised configuration. The reason is that they do not have the capability for multiple settings or remote control to make adjustments when changes to the system configuration occur. FirstEnergy is therefore requiring that the existing electromechanical relays at the Carsonia and Lyons 69 kV substations be replaced with an SEL 321 Phase Distance Relay and the Nxtphase Line Protection Relay. This provides a compatibility with the system protection installed at North Boyertown and assures a continuous service to the Met-Ed Regional customers in the area. The estimated cost for a purchase and installation of this equipment is **$129,000**. It is anticipated that it will take 6 months to complete the required work from the signing of an agreement.

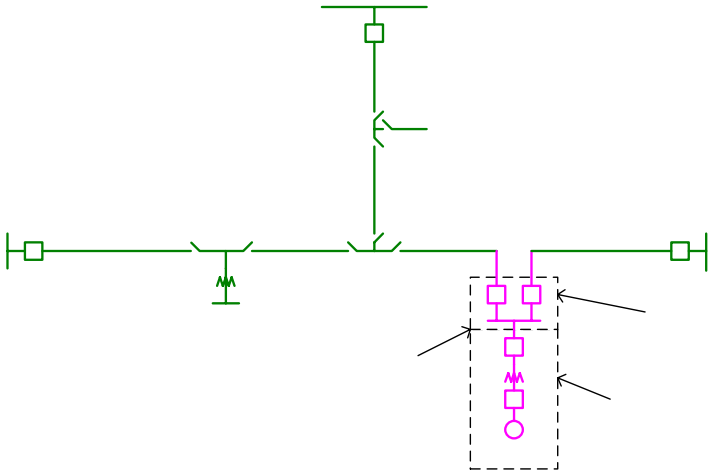
Rolling Hills Landfill Gas, LLC will also be required to fulfill all of the design requirements identified in the original Facilities Study for this project and those defined in the FirstEnergy "Requirements for Transmission Connected Facilities" document. In addition, the Project facilities will be subject to a verification inspection before an energization of the substation and providing for the generation connection. This includes a confirmation that a Harris D20 RTU is in-service to support EMS SCADA communications. The cost for the verification inspection is estimated to be **$3,000**. It is expected that the work to install all of the identified system facilities will take 6 months to complete from the execution of an interconnection service agreement.

In summary, the cost estimate for the additional facilities needed for the connection of the Rolling Hills Landfill project is **$257,000.**

Note that while this FirstEnergy review has been made based on the Rolling Hills substation facilities as they currently exist, an acceptable alternative to the switch installation and purchase and installation of new protective relays at Lyons and Carsonia, is for Rolling Hills Landfill Gas, LLC to install new 69 kV line breakers at the Rolling Hills substation

If Rolling Hills Landfill Gas, LLC chooses to replace the 69kV breakers, the installation of relays at North Boyertown substation, estimated cost **$50,000**, and verification of the new SCADA at the Rolling Hills substation, estimated cost **$3,000**, will still be required.

Figure #2



Network Impacts

The #L17 Friedensburg (Rolling Hills) project was studied as a total of 6 MW capacity injection into the Boyertown-Lyons-Carsonia 69kV circuit between Boyertown and Lyons Tap. Project # L17 was evaluated for compliance with reliability criteria for summer peak conditions in 2008. Potential network impacts were as follows:

Generator Deliverability

No identified problems.

Multiple Facility Contingency (MAAC Criteria IIC)

No identified problems

New System Reinforcements

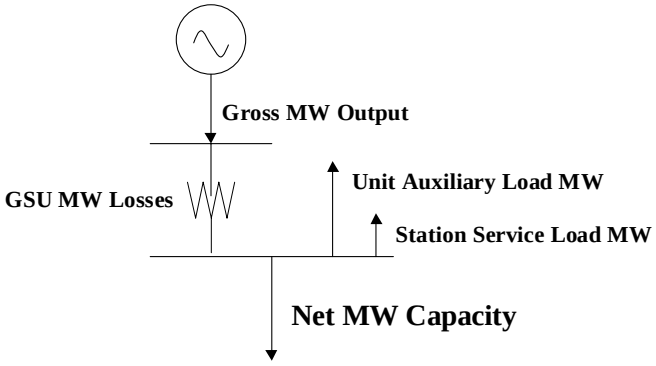
None

Contribution to Previously Identified System Reinforcements

None.

ATTACHMENT #1

Unit Capability Data



Net MW Capacity = (Gross MW Output - GSU MW Losses* – Unit Auxiliary Load MW - Station Service Load MW)

Queue Letter/Position/Unit ID: _____L17

Primary Fuel Type: _____ Landfill Gas

Maximum Summer (92º F ambient air temp.) Net MW Output**:_____ 5.6 MW

Maximum Summer (92º F ambient air temp.) Gross MW Output: _____ 5.6 MW

Minimum Summer (92º F ambient air temp.) Gross MW Output: _____

Maximum Winter (30º F ambient air temp.) Gross MW Output: _____

Minimum Winter (30º F ambient air temp.) Gross MW Output: _____

Gross Reactive Power Capability at Maximum Gross MW Output – Please include Reactive Capability Curve (Leading and Lagging):_____ +4.1 MVAR, -3.8 MVAR

Individual Unit Auxiliary Load at Maximum Summer MW Output (MW/MVAR): _____

Individual Unit Auxiliary Load at Minimum Summer MW Output (MW/MVAR): _____

Individual Unit Auxiliary Load at Maximum Winter MW Output (MW/MVAR): _____

Individual Unit Auxiliary Load at Minimum Winter MW Output (MW/MVAR): _____

Station Service Load (MW/MVAR):_____

* GSU losses are expected to be minimal.

** Your project's declared MW, as first submitted in Attachment N, and later confirmed or modified by the Impact Study Agreement, should be based on either the 92º F Ambient Air Temperature rating of the unit(s) or, if less, the declared Capacity rating of your project.

Unit Generator Dynamics Data

Queue Letter/Position/Unit ID: _____L17

MVA Base (upon which all reactances, resistance and inertia are calculated): ___7 MVA

Nominal Power Factor: _____ 0.8

Terminal Voltage (kV): _____ 13.8

Unsaturated Reactances (on MVA Base)

- Direct Axis Synchronous Reactance, $X_{d(i)}$: _____ 2.086
- Direct Axis Transient Reactance, X'd(i): _____ 0.317
- Direct Axis Sub-transient Reactance, X"d(i): _____ 0.165
- Quadrature Axis Synchronous Reactance, Xq(i): _____ 1.204
- Quadrature Axis Transient Reactance, X'q(i): _____ 1.204
- Quadrature Axis Sub-transient Reactance, X"q(i): _____ 0.178
- Stator Leakage Reactance, Xl: _____ N/A
- Negative Sequence Reactance, X2(i): _____ 0.146
- Zero Sequence Reactance, X0: _____ 0.075

Saturated Sub-transient Reactance, X"d(v) (on MVA Base): _____ 0.141

Armature Resistance, Ra (on MVA Base): _____ 0.00323

Time Constants (seconds)

- Direct Axis Transient Open Circuit, T'_{do}: _____ 5.78
- Direct Axis Sub-transient Open Circuit, $T"_{do}$: _____ 0.058
- Quadrature Axis Transient Open Circuit, T'_{qo}: _____ N/A
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- Inertia, H (kW-sec/kVA, on KVA Base): _____ 0.7395

Speed Damping, D: _____ N/A

Saturation Values at Per-Unit Voltage [S(1.0), S(1.2)]: _____ N/A

Units utilize a *Generator model*

Unit GSU Data

Queue Letter/Position/Unit ID: _____L17

Generator Step-up Transformer MVA Base:_____ 25

Generator Step-up Transformer Impedance (R+jX, or %, on transformer MVA Base): __7.25%

Generator Step-up Transformer Rating (MVA): _____ N/A

Generator Step-up Transformer Low-side Voltage (kV): _____ 13.8

Generator Step-up Transformer High-side Voltage (kV):_____ 69 KV

Generator Step-up Transformer Off-nominal Turns Ratio:_____ 1.0

Generator Step-up Transformer Number of Taps and Step Size: _____ N/A

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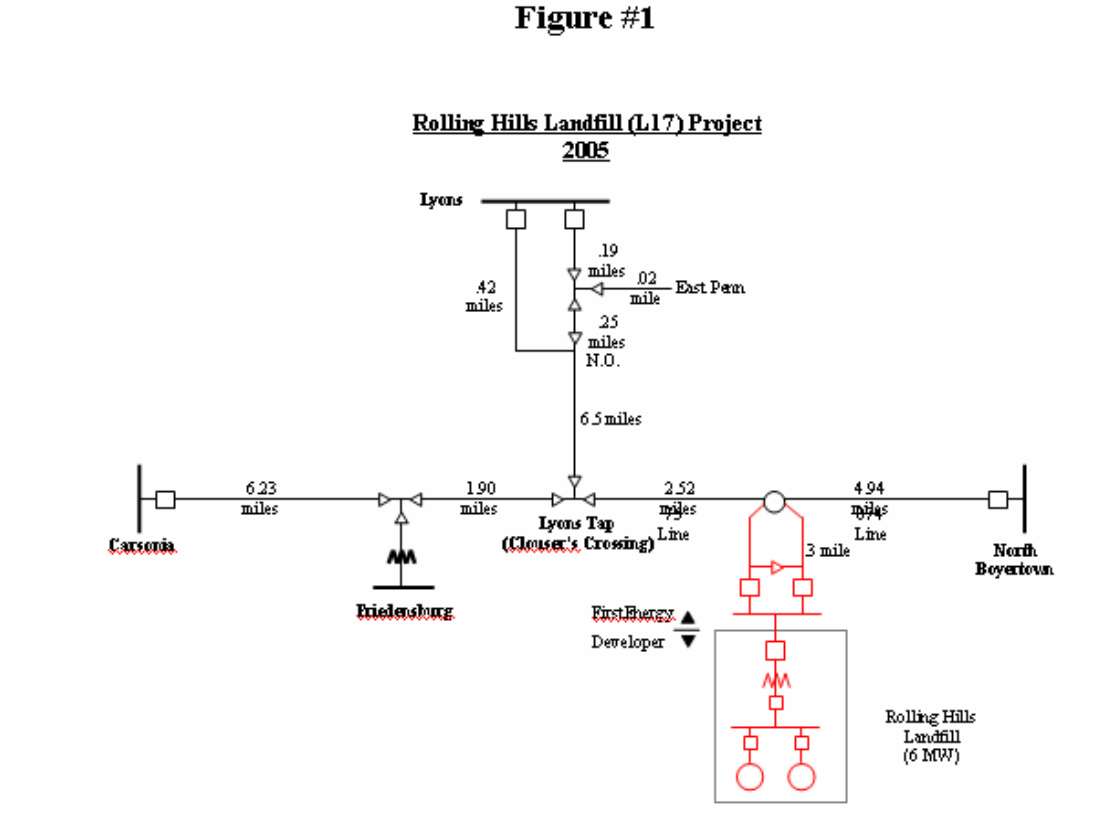

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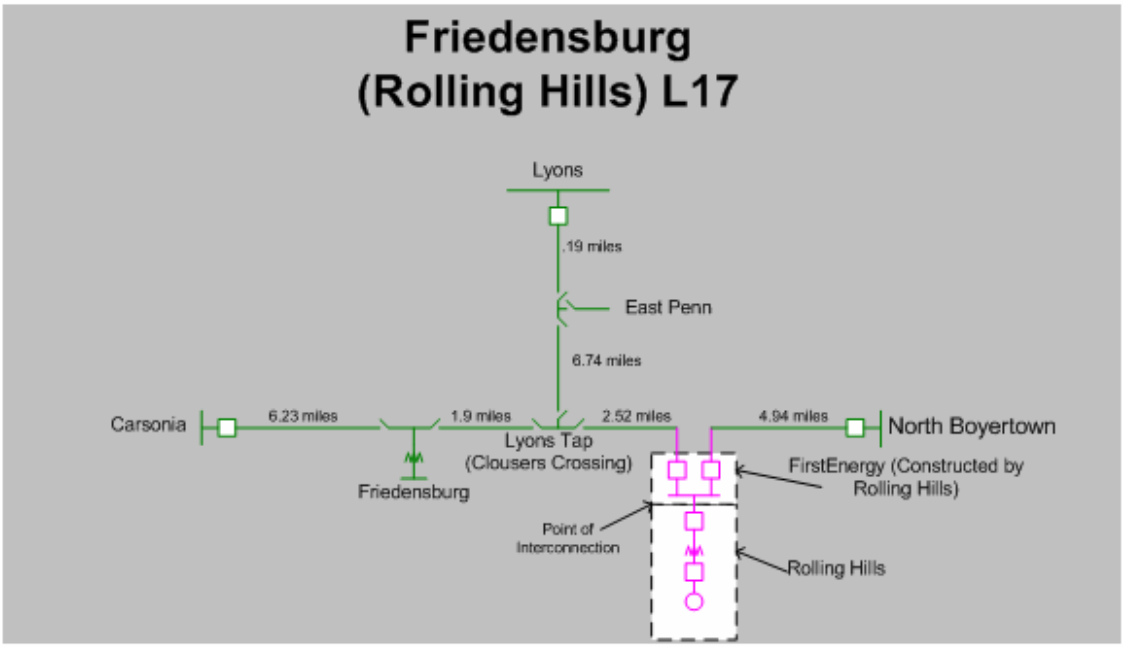

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Contribution to Previously Identified System Reinforcements

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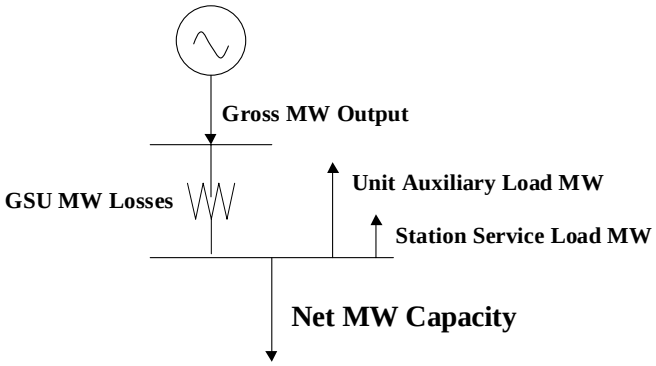
Unit Capability Data



Net MW Capacity = (Gross MW Output - GSU MW Losses* – Unit Auxiliary Load MW - Station Service Load MW)

Queue Letter/Position/Unit ID: _____L17

Primary Fuel Type: _____ Landfill Gas

Maximum Summer (92º F ambient air temp.) Net MW Output**:_____ 5.6 MW

Maximum Summer (92º F ambient air temp.) Gross MW Output: _____ 5.6 MW

Minimum Summer (92º F ambient air temp.) Gross MW Output: _____

Maximum Winter (30º F ambient air temp.) Gross MW Output: _____

Minimum Winter (30º F ambient air temp.) Gross MW Output: _____

Gross Reactive Power Capability at Maximum Gross MW Output – Please include Reactive Capability Curve (Leading and Lagging):_____ +4.1 MVAR, -3.8 MVAR

Individual Unit Auxiliary Load at Maximum Summer MW Output (MW/MVAR): _____

Individual Unit Auxiliary Load at Minimum Summer MW Output (MW/MVAR): _____

Individual Unit Auxiliary Load at Maximum Winter MW Output (MW/MVAR): _____

Individual Unit Auxiliary Load at Minimum Winter MW Output (MW/MVAR): _____

Station Service Load (MW/MVAR):_____

* GSU losses are expected to be minimal.

** Your project's declared MW, as first submitted in Attachment N, and later confirmed or modified by the Impact Study Agreement, should be based on either the 92º F Ambient Air Temperature rating of the unit(s) or, if less, the declared Capacity rating of your project.

Unit Generator Dynamics Data

Queue Letter/Position/Unit ID: _____L17

MVA Base (upon which all reactances, resistance and inertia are calculated): ___7 MVA

Nominal Power Factor: _____ 0.8

Terminal Voltage (kV): _____ 13.8

Unsaturated Reactances (on MVA Base)

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Time Constants (seconds)

- Direct Axis Transient Open Circuit, T'_{do}: _____ 5.78
- Direct Axis Sub-transient Open Circuit, $T"_{do}$: _____ 0.058
- Quadrature Axis Transient Open Circuit, T'_{qo}: _____ N/A
- Quadrature Axis Sub-transient Open Circuit, $T"_{qo}$: _____ N/A
- Inertia, H (kW-sec/kVA, on KVA Base): _____ 0.7395

Speed Damping, D: _____ N/A

Saturation Values at Per-Unit Voltage [S(1.0), S(1.2)]: _____ N/A

Units utilize a *Generator model*

Unit GSU Data

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Generator Step-up Transformer Impedance (R+jX, or %, on transformer MVA Base): __7.25%

Generator Step-up Transformer Rating (MVA): _____ N/A

Generator Step-up Transformer Low-side Voltage (kV): _____ 13.8

Generator Step-up Transformer High-side Voltage (kV):_____ 69 KV

Generator Step-up Transformer Off-nominal Turns Ratio:_____ 1.0

Generator Step-up Transformer Number of Taps and Step Size: _____ N/A