Georgia Transmission Corporation
Georgia Systems Operations Corporation

Reactive Power Requirements for Generating Facilities Interconnecting to the Georgia Integrated Transmission System with Georgia Transmission Corporation (Reference IA Appendix C-4A)

INTRODUCTION

Voltage must be controlled to protect the transmission system and move power where it is needed. This control tends to be local in nature, such as at transmission substations and in areas of lower voltage transmission nodes. Ensuring sufficient voltage control of the transmission system is important both for normal operations and for events impacting normal operations (i.e., disturbances). Generators provide critical reactive power (dynamic) that regulates local voltage and are necessary to maintain the reliability of the transmission system.

Georgia Transmission Corporation (GTC) has established the following reactive power requirement guideline based on consultation with the Georgia Integrated Transmission System ('ITS') Participants[1] and the Transmission System Operators[2]. This reactive power requirement guideline is, in general, consistent with industry practices and the regional requirements of the Transmission System Operators[3]. Reactive requirements for individual generating facilities are stipulated in the INTERCONNECTION AND OPERATION AND MAINTENANCE AGREEMENT BETWEEN *GENERATOR* AND GEORGIA TRANSMISSION CORPORATION (AN ELECTRIC MEMBERSHIP CORPORATION) FOR THE *GENERATOR* PLANT PROJECT ("Interconnection Agreement").

A. GENERATING FACILIITES INTERCONNECTED ABOVE 100kV

For generating facilities interconnecting to the transmission system above 100 kV, the reactive power capability policy is that the generator owners are required to design the generating facility to maintain a voltage schedule at the point of interconnection and a composite power delivery at "Continuous, Rated MW Output" at the Point of Interconnection at a power factor within the minimum range of 0.95 leading to 0.95 lagging at the high side of the generator substation.

Consistent with that practice, GTC has developed the following:

(i) procedures for analyzing the minimum acceptable reactive power capability; and

[1] ITS Participants are Georgia Power Company, MEAG Power, Dalton Utilities, and GTC
[2] Transmission Operators include Southern Transmission (SBA), Georgia Control Center, and Georgia System Operations Corporation http://www.oasis.oati.com/SOCO/SOCOdocs/Reactive-Power-Policy.pdf
[3] http://www.oasis.oati.com/SOCO/SOCOdocs/Reactive-Power-Policy.pdf
4 See **Appendix A** for definitions of "Continuous, Rated MW Output"

(ii) operating requirements for reactive power support;

for interconnecting generating facilities.

1. Procedures for Analyzing Minimum Acceptable Reactive Power Capability for Generators Connected to the Transmission System (100 kV and above)

At Continuous, Rated MW Output (for summer peak conditions), calculations performed by Georgia Transmission Corporation must show that the interconnecting generating facility shall have the capability of supplying at least 0.33 MVArs (dynamic VArs) into the transmission system for each MW supplied at the high side of the generator substation when the transmission system bus voltage at the interconnection point is at the specified test voltage. This corresponds to a maximum power factor of 0.95 lagging. The test is performed at the following interconnection point voltage levels:

From 100 kV through 161 kV connected units	- 1.00 pu
230 kV connected units	- 1.01 pu
500 kV connected units	- 1.02 pu

The generating facility shall also be capable (at Continuous, Rated MW Output) of absorbing 0.33 MVArs (dynamic VArs) from the transmission system for each MW supplied at the high side of the generator substation. This corresponds to a maximum power factor of 0.95 leading. The test is performed at the following interconnection point voltage levels:

From 100 kV through 161 kV connected units	- 1.03 pu
230 kV connected units	- 1.04 pu
500 kV connected units	- 1.05 pu

Peaking generation (e.g., simple cycle combustion turbines and other units that would typically be dispatched only during peak load periods) may be exempted from the MVAr absorption requirement on a case-by-case basis.

The calculations made to test the reactive capability requirements set forth above include the allowable range of generator bus voltages considering station service load if it is fed from the generator bus as well as the GSU (generator step up transformer) tap setting. The generating facility must meet both the VAr production and VAr absorption requirements on the selected GSU tap setting. For GSU's which do not have a test report available, the manufacturing tolerance for the impedance will be taken into account in the calculations.

If the reactive capability test shows that, after modeling the full range of the generator reactive power, the generator is not capable of meeting the reactive requirements, the generator owner must provide additional dynamic reactive

power compensation. GTC will consider static reactive power compensation only as an addition to the full range of generator reactive power and on a case-by-case basis.

2. Operating Requirements for Reactive Power Support for Generators Connected to the Transmission System (100 kV and above)

When a generating facility is delivering power to the Georgia Integrated Transmission System (100 kV and above), the generator owner shall operate its generators to meet its voltage schedule as determined by GTC. The voltage will be measured at the Point of Interconnection with the transmission system as defined in the Interconnection Agreement. If the generating facility does not maintain its scheduled voltage, the generator owner, upon the request of Georgia System Operations Corporation[5] must explain its inability to comply. Georgia System Operations Corporation will deem the generating facility to have been in compliance with the reactive power requirements if one of the following conditions is met:

(i) **Maintained voltage was below the required scheduled voltage**.
If system conditions occurred that prevented the generating facility from maintaining the voltage schedule and the generator owner demonstrated that the generating facility maximized its MVAr supply.

(ii) **Maintained voltage exceeded the required schedule voltage**.
If system conditions occurred that prevented the generator from maintaining voltage schedule and the generator owner demonstrated that the generating facility maximized its MVAr absorption.

(iii) **Georgia System Operations Corporation had requested a modified GSU tap setting**.
Georgia System Operations Corporation requested the generating facility to operate on a GSU tap which made the reactive requirement of the generating facility different from a production value of 0.33 times rated MW and an absorption value of 0.33 times rated MW. The generator owner must have demonstrated that the generating facility provided its maximum MVAr production or absorption in an effort to meet the required voltage schedule. When a modified GSU tap setting is requested, Georgia System Operations Corporation will determine the adjusted minimum requirements and provide them to the generator owner.

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[5] For purposes of this document, the term “Georgia System Operations Corporation” shall mean Georgia System Operations Corporation, Southern Companies, or Georgia Transmission Corporation’s transmission operator, transmission owner and transmission planner, as appropriate

If Georgia System Operations Corporation determines that the generating facility did not comply with these requirements, appropriate actions, in accordance with NERC Standards and/or the IA, may be taken.

When a generating facility is on-line, the full reactive capacity of the generator(s) is expected to be available to the transmission system whether it is generating at reduced MW or at its Continuous, Rated MW Output. If the generating facility is temporarily operating above Continuous, Rated MW Output, it must reduce to the Continuous, Rated MW Output when requested by Georgia System Operations Corporation if that is necessary for the generator(s) to produce the amount of MVARs required to meet the required voltage schedule. Generator owners which have their generating facility's reactive capability limited by an equipment failure or operating problem should advise Georgia System Operations Corporation and correct the situation as soon as possible.

An exception to the requirement of holding a scheduled voltage on the transmission grid may be given to co-generation facilities that have significant customer load served from the generator bus. These types of facilities will be evaluated on a case-by-case basis.

3. CONSEQUENCES OF NOT FULFILLING ABOVE REQUIREMENTS

In the event a generating facility subject to these procedures and requirements does not comply with the supply of reactive power support in accordance with the aforementioned requirements, such action will be considered a material breach of the interconnection agreement and appropriate action will be taken.

4. APPLICABILITY

All interconnection requests for new generators submitted to GTC on or after April 1, 2017 are subject to the terms and conditions of these reactive power procedures and requirements. Generators with an Interconnection Agreement with Georgia Transmission Corporation are subject to applicable reactive power procedures and requirements of the Interconnection Agreement.

B. GENERATING FACILITIES INTERCONNECTED TO SUB-TRANSMISSION (Greater than 40 kV and below 100 kV)

For generating facilities interconnecting to the sub-transmission system (greater than 40 kV and below 100 kV), reactive power capability policy is that the generator owners are required to design the generating facility to maintain a composite power delivery at "Continuous, Rated MW Output" at the high side of the generator substation at a scheduled power factor within the minimum range of 0.95 leading to 0.95 lagging (0.95 or less leading and 0.95 or less lagging).

1. Procedures for Analyzing Minimum Acceptable Reactive Power Capability for Generators Connected to the Sub-Transmission System (greater than 40 kV and below than 100 kV)

At Continuous, Rated MW Output (for summer peak conditions), calculations performed by Georgia Transmission Corporation must show that the interconnecting generating facility have the capability of supplying, into the sub-transmission system, at least 0.33 MVArs (dynamic VArs) for each MW supplied at the high side of the generator substation. This corresponds to a power factor 0.95 or less lagging.

The generating facility shall also be capable (at Continuous, Rated MW Output) of absorbing, from the sub-transmission system, 0.33 MVArs (dynamic VArs) for each MW supplied at the high side of the generator substation. This corresponds to a power factor 0.95 or less leading.

If the reactive capability test shows that, after modeling the full range of the generator reactive power, the generator is not capable of meeting the reactive requirements, the generator owner must provide additional dynamic reactive power compensation. GTC will consider static reactive power compensation only as an addition to the full range of generator reactive power capability and on a case-by-case basis.

2. Operating Requirements for Reactive Power Support for Generators Connected to the Sub-Transmission System (greater than 40 kV and below than 100 kV)

When a generating facility is delivering power to the Georgia Integrated Transmission System at the sub-transmission level (greater than 40 kV and below 100 kV), the generator owner shall operate its generators to meet its fixed power factor as determined by GTC.

The power factor will be measured at the Point of Interconnection with the sub-transmission system as defined in the Interconnection Agreement. If the generating facility does not maintain its fixed power factor as determined by GTC, the generator owner, upon the request of Georgia System Operations Corporation[6] must explain its inability to comply. Georgia System Operations Corporation will deem the generating facility to have been in compliance with the reactive power requirements if one of the following conditions is met:

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6 For purposes of this document, the term “Georgia System Operations Corporation” shall mean Georgia System Operations Corporation, Southern Companies, or Georgia Transmission Corporation’s transmission operator, transmission owner and transmission planner, as appropriate

(i) Maintained power factor lagging (VAr supply) exceeded the required scheduled power factor.
If system conditions occurred that prevented the generating facility from maintaining the power factor and the generator owner demonstrated that the generating facility maximized its MVAr supply.

(ii) Maintained power factor leading (VAr absorption) exceeded the required scheduled power factor. If system conditions occurred that prevented the generator from maintaining the power factor and the generator owner demonstrated that the generating facility maximized its MVAr absorption.

(iii) Georgia System Operations Corporation had requested a modified GSU tap setting. Georgia System Operations Corporation requested the generating facility to operate on a GSU tap which made the reactive requirement of the generating facility different from a production value of 0.33 times rated MW and an absorption value of 0.33 times rated MW. The generator owner must have demonstrated that the generating facility provided its maximum MVAr production or absorption in an effort to meet the required voltage schedule. When a modified GSU tap setting is requested, Georgia System Operations Corporation will determine the adjusted minimum requirements and provide them to the generator owner.

Appendix A

Definition of
Generator Continuous, Rated MW Output

The purpose of this appendix is to define the term "Continuous, Rated MW Output" for the various generator types. All resources connected to the Georgia Integrated Transmission System are required to comply with NERC and SERC schedules and criteria for demonstrating generator MW capability.

1. **Coal, nuclear, oil and gas facilities**: These electric generator types are turbine generators which have steam power as their prime mover. For these facilities the term "Continuous, Rated MW Output" shall mean the generating facility's full load MW capability expected to be available continuously on a daily basis under normal operating conditions during June - August, when all generators of this type residing at the plant are demonstrating concurrently.

2. **Combustion turbine and combined cycle facilities**: These electric generator types are turbine generators which have fuel/air mixtures expanded through combustion as the prime mover for the combustion turbine and, in the case of combined cycle facilities, exhaust heat recovery steam generation as a prime mover for the steam turbine. For these facilities the term "Continuous, Rated MW Output" shall mean the generating facility's full MW capability expected to be available continuously on a daily basis under normal operating conditions during June - August, when all generators of this type residing at the plant are demonstrating concurrently.

3. **Conventional and pumped storage hydro facilities**: These electric generator types are turbine generators which have water as their prime mover. For these facilities the term "Continuous, Rated MW Output" shall mean the generating facility's full load efficient gate MW capability expected to be available continuously for eight hours during five continuous weekdays of the June - August peak season, when all generators of this type residing at the plant are demonstrating concurrently. Simulated operation using an acceptable hydro production modeling program which utilizes at least thirty years of hydro flow data may be used in the demonstrated rating process.

4. **Solar and wind facilities:** These non-synchronous electric generator types are inverter-based generators which have variable non-dispatchable energy input. For these facilities the term "Continuous, Rated MW Output" shall mean the generating facility's peak load MW capability at the high-side of the generator substation expected to be available on a daily basis under normal operating conditions during June - August.