



**Gainesville Regional Utilities**

**Facility Connection Requirements**

**Latest Revision 04/01/09**

### Revisions (R3)

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# GRU Facility Connection Requirements

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This document has been prepared to identify the technical requirements for connecting new facilities to the Gainesville Regional Utilities' (GRU) transmission system. It applies to new connections or substantial modifications of existing generating units or transmission interconnections as well as existing and new end user delivery points. Rather than give detailed technical specifications this document provides a general overview of the functional objectives and requirements to be met in the design of facility connections. These requirements are written to establish a basis for maintaining reliability, power quality, and a safe environment for the general public, power consumers, maintenance personnel and the equipment. The requirements and guidelines found in this document are consistent with those used by GRU when installing new GRU facilities or modifying existing GRU facilities. This document is also written to comply with NERC Reliability Standard FAC-001-0 which requires entities responsible for the reliability of the interconnected transmission systems to document maintain and publish a Facility Connections Requirements document. This standard also requires those entities seeking to add facilities or connect to the interconnected transmission system to comply with the Facility Connection Requirements document. The NERC Reliability Standards are posted on NERC's web site ([www.nerc.com/standards](http://www.nerc.com/standards)). This Facility Connection Requirements document is revised from time to time to reflect changes or clarifications in planning, operating, or interconnection policies.

**Nothing in this documents is intended to supersede FERC's Standard Large Generation Interconnection Procedures or Agreement and if there is a conflict, FERC's Standard Large Generation Interconnection Procedures or Agreement will control.**

**I. COMMON REQUIREMENTS**

This section addresses the technical requirements that are common to the connection of generation, transmission and delivery point (end-users) facilities to the GRU transmission system. General overviews of functional requirements are given in this section. This document is not intended to be a design specification. Final design of facility connections to the GRU transmission system will be subject to GRU review and approval on a case-by-case basis. In the event of either GRU or an Independent Power Producer (IPP) developing and requesting a new facility to be added to GRU's Generation Transmission System, GRU' Strategic Planning Department will notify the Assistant General Manager (AGM) of Energy Supply, the Area Control Manager, and the AGM of Energy Delivery of the proposed change. In the event the change is granted permission to be instituted, the notification of the above personnel will be made as to the project's estimated completion date. When the Area Control Manager is notified of the additions to the Generation and Transmission System, he will notify the Florida Reliability Coordinating Council, Inc.

## **I. A. Responsibilities**

It is the responsibility of the facility owner to provide all devices necessary to protect the customer's equipment from damage by abnormal conditions and operations that might occur on the interconnected power system. The facility owner shall protect its generator and associated equipment from overvoltage, undervoltage, overload, short circuits (including ground fault conditions), open circuits, phase unbalance, phase reversal, surges from switching and lightning, over and under frequency conditions, and other injurious electrical conditions that may arise on the interconnected system.

It is the responsibility of the generation, transmission, and end-user facility owners to provide for the orderly re-energization and synchronizing of their high voltage equipment to other parts of the electric system. Appropriate operating procedures and equipment designs are needed to guard against out of synch closure or uncontrolled energization. Each owner is responsible to know and follow all applicable regulations, industry guidelines, safety requirements, and accepted practice for the design, operation and maintenance of the facility.

## **I. B. Site Access**

There are situations where some equipment that is owned by GRU is located within the Customer's facility. This is often required for data acquisition or metering. In these cases, installed equipment owned by GRU will be clearly identified as such on the appropriate station drawings, on the reference documents and at the site. Site access is to be provided to GRU employees where GRU equipment is located within the Customer's facility.

## **I. C. Safety**

Safety is of utmost importance. Strict adherence to established switching, lockout, tagging and grounding procedures is required at all times for the safety of personnel. Any work carried out within a facility shall be performed in accordance with all applicable laws, rules, and regulations and in compliance with Occupational Safety and Health Administration (OSHA), National Electric Safety Code (NESC), National Electric Code (NEC) and good utility practice. Automatic and manual disconnect devices are to be provided as a means of removing all sources of current to any particular element of the power system. Only trained operators are to perform switching functions within a facility under the direction of the responsible dispatcher or designated person as outlined in the National Electric Safety Code.

## **I. D. Operations**

Operational procedures are to be established in accordance with NESC, OSHA, Florida Reliability Coordinating Council (FRCC) and NERC requirements. Each party shall designate

operating representatives to address: communications, maintenance coordination, actions to be taken after de-energization of interconnected facilities, and other required operating policies. All parties are to be provided with current station operating diagrams. Common, agreed upon nomenclature is to be used for naming stations, lines and switches. Updated diagrams are to be provided when changes occur to interconnected facilities.

The operator of facilities interconnecting to the GRU transmission system must not perform any switching that energizes or de-energizes portions of the GRU transmission system or that may adversely affect the GRU transmission system without prior approval of the GRU System Operator. Operators of facilities interconnecting to the GRU transmission system must notify the GRU System Operator before performing any switching that would significantly affect voltages, power flows or reliability in the GRU transmission system.

### **I. E. Control Areas**

All loads, generation, and transmission facilities must be part of a control area. At least six months before Trial Operation, the facility owner shall notify GRU in writing of the control area in which it will be located. If the Customer elects to be located in a control area other than the control area in which GRU is located or change control areas, all necessary agreements shall be executed and technical and equipment requirements implemented prior to the placement of the facility in the other control area.

Facilities owners shall follow good utility practice to avoid creating oversupply imbalances or undersupply imbalances. The facility owner shall contract for or have available to it resources within its control area that are capable of supplying in real time any deviations between power schedules and the actual power interchange with the GRU Transmission System by the facility.

### **I. F. Responsibilities during Emergency Conditions**

All control areas within the FRCC region are responsible for maintaining voltage and frequencies within agreed upon limits. All operators of facilities (generation, transmission and end-users) interconnected to the GRU transmission systems in the FRCC Region are required to communicate and coordinate with their control area operator. During emergency conditions, the facility operator shall raise or lower generation, adjust reactive power, switch facilities in or out, or reduce end user load as directed by the control area operator. Within the FRCC Region, the Reliability Coordinator has overall responsibility for the secure operation of the interconnected transmission systems. All control area operators must communicate and coordinate with and follow the directions of the Reliability Coordinator. All facility owners are expected to follow the procedures and guides contained in the FRCC Operating Handbook. The FRCC's Operating Committee Handbook and Reliability Coordinator documents are posted electronically at "www.frcc.com."

## **I. G. Maintenance of Facilities**

The maintenance of facilities is the responsibility of the owner of those facilities. This maintenance includes the periodical inspection of all existing facilities and the initial inspection of newly installed facilities. Adjoining facilities on the interconnected power system are to be maintained in accordance with accepted industry practices and procedures. Each party is to have a documented maintenance program ensuring the proper operation of equipment. GRU will have the right to review maintenance reports and calibration records of equipment that could impact the GRU system if not properly maintained. GRU is to be notified as soon as practicable about any out of service equipment that might effect the protection, monitoring, or operation of interconnected facilities.

Maintenance of facilities interconnected to the GRU transmission system shall be done in a manner that does not place the reliability and capability of the GRU transmission system at risk. Planned maintenance must be coordinated and scheduled with the GRU System Operator.

## **I. H. Point of Interconnection**

The point of interconnection is to be clearly described. GRU will demark the metering point for the new installation. Usually the change of facility ownership and the point of interconnection are the same point.

An interconnection junction box may be required to connect control circuits and signals between the parties at a point of demarcation. Fiber optics is the preferred means of interconnection of control circuits. Metallic control cables will present problems if the distances are great, ground potential rise during faults can cause failures when these signals are needed the most. Long cable voltage drops can make control systems unreliable or produce inaccurate signal levels and therefore are to be avoided. GRU reserves the right to specify the type of lines and cables to be used.

Metering equipment should be provided as close to the interconnection point as practicable. The interconnecting facility must be connected to the GRU system through a transmission voltage interrupting device.

Facilities interconnecting to the GRU transmission system that are not solely operated and controlled by the GRU System Operator must have an isolating device installed at the point of interconnection. This isolating device, typically a disconnect switch, must be capable of physically and visibly isolating the facilities from the GRU transmission system. This isolating device must be lockable in the open position by GRU and must be under the ultimate control of the GRU System Operator.

## **I. I. Transmission Line Configurations**

Three source terminal interconnection configurations are to be avoided within the GRU transmission system. This is due to problems associated with protective relay coverage from in-feed, sequential fault clearing, out-feed or weak source conditions, reduced load flow, and automatic reclosing complications. Extensive studies are necessary to evaluate all possible implications when considering three terminal line applications. These studies will be totally funded by the requesting party.

Some new connections to the GRU transmission system may require one or more GRU transmission circuits to be looped through the new facility. The design and ratings of the new facilities and the transmission loop into them shall not restrict the capability of the transmission circuits or impair GRU's contractual transmission service obligations.

Long taps to feed connected load directly tied to a transmission line are to be avoided. This presents coverage problems to the protective relay system due to in-feed. Power line carrier signals will not be allowed.

Any interconnection configuration should not restrain GRU from taking a GRU transmission line out of service for just cause. GRU shall not be forced to open a transmission line for an adjacent interconnected generator or transmission line to obtain an outage. Manual switching or clearing electrical faults within the non-GRU facility shall not curtail the ability of GRU to transmit power or serve its customers.

Reliable station and breaker arrangements will be used when there are new or substantial modifications to existing GRU switching stations affecting transmission lines rated at or above 138kV. In general, GRU transmission switching stations are configured such that line and transformer, bus and circuit breaker maintenance can be performed without degrading transmission connectivity. This generally implies a breaker and a half or double breaker, double bus configuration. A ring bus may be used when a limited number of transmission lines are involved.

## **I. J. Grounding**

Each interconnection substation must have a ground grid that solidly grounds all metallic structures and other non-energized metallic equipment. This grid and grounding system shall be designed to meet the requirements of ANSI/IEEE 80, IEEE Guide for Safety in AC Substation Grounding and ANSI/IEEE C2, National Electrical Safety Code. The transmission line overhead ground wire (OHGW) shall be connected to the substation ground grid.

If the interconnection substation is close to another substation, the two grids may be isolated or connected. Connected grids are preferred, since they are easier to connect than to isolate. If the ground grids are to be isolated, there may be no metallic ground connections between the two substation ground grids. There must also be sufficient physical separation to limit soil

conduction. If the ground grids are to be interconnected, the interconnecting cables must have sufficient capacity to handle the fault currents, duration, and duty. GRU must approve any connection to a GRU substation ground grid.

All transmission line structures must be adequately bonded and grounded to control step and touch potential in compliance with the NESC, and to provide adequate lightning performance. All transmission lines should have a continuous ground wire, not relying on earth as the primary conductor, to transfer fault current between structures and to substations and plant switchyards. Any exceptions to a continuous ground wire shall be verified with a system study. All ground wires and bond wires must be adequately sized to handle anticipated maximum fault currents and duty without damage.

Transmission interconnections may substantially increase fault current levels at nearby substations and transmission lines. Modifications to the ground grids of existing substations and OHGWs of existing lines may be necessary. The interconnection studies will determine if modifications are required and the scope and cost of the modifications. These studies will be totally funded by the requesting party.

### **I. K. Insulation Coordination**

Insulation coordination is the selection of insulation strength. Insulation coordination must be done properly to ensure electrical system reliability and personnel safety. Basic Surge Level (BSLs), surge arrester, conductor spacing and gap application, substation and transmission line insulation strength, protection, and shielding shall be documented and submitted for evaluation as part of the interconnection plan.

GRU's standard is to shield generation, substations and transmission lines from direct lightning strokes and to provide line entrance arresters at transmission line terminals including delivery point for end-users. Surge arresters are also applied at major components and subsystems.

Interconnection facilities to be constructed in areas with salt spray contamination or other type of contamination shall be properly designed to meet or exceed the performance of facilities not in a contamination area with regard to contamination caused outages.

### **I. L. Structures**

Transmission and substation structures for facilities connected to the GRU transmission system shall be designed to meet the National Electrical Safety Code (NESC). Substation bus systems shall be designed to comply with ANSI/IEEE Standard 605, IEEE Guide for the Design of Substation Rigid-Bus Structures. All GRU structures are currently designed to meet extreme wind loading requirements from American Society of Civil Engineers (ASCE) 7-93<sup>1</sup>. Structures

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<sup>1</sup> ASCE 7-93, Category IV, I=1, Exposure C (D for coastal areas) with drag coefficients from adequately documented Industry Standard sources.

connected to the GRU transmission system shall be designed to meet ASCE 7-93 when the outage of these structures would interrupt power flow through the GRU transmission system or interrupt service to GRU customers.

### **I. M. Ratings**

There may be cases where adding generation will increase the available fault current above the present interrupting ratings of the existing breakers at a substation or stations. When this occurs, breaker upgrades are to be considered as part of the interconnection project. For non-fault facility and equipment ratings, reference the GRU Facility Rating Methodology document dated November 21, 2005. This document is available upon request. Interconnection facility ratings shall be compatible with those of connected GRU facilities.

AC high voltage circuit breakers and their duty requirements are specified by operating voltage, continuous current, interrupting current, and operating time in accordance with ANSI/IEEE Standards C37 series, "Symmetrical Current Basis." These ratings are displayed on the individual Circuit Breaker nameplate. Breakers are scheduled for replacement when they exceed 100% of ANSI C37 Guidelines.

All circuit breakers and other fault interrupting devices shall be capable of safely interrupting fault currents for any fault they may be required to interrupt.

### **I. N. Reliability and System Security**

GRU designs and operates its transmission system to meet FRCC and NERC Planning and Operating Standards. The planned transmission system with its expected loads and transfers must be stable and within applicable ratings for all category A, B, and C contingency scenarios<sup>2</sup>. The effect of category D contingencies on system stability is evaluated when changes are planned in the transmission system. The design of new transmission connections should take into account and minimize, to the extent practical, the adverse consequences of category D contingencies.

Higher probability category D contingencies, when they occur in combination with forecasted demand levels and firm interchange transactions, must not result in uncontrolled, cascading interruptions. While controlled interruption of load and/or opening of transmission circuits may be needed, the system shall be within its emergency limits and capable of rapid restoration after operation of automatic controls. Based on operating experience, GRU considers loss of all generators at a plant (NERC category D10) to be higher probability category D contingencies.

System and generator stability is to be maintained for normal clearing of all three phase faults. A normally cleared fault is assumed to last five cycles (0.1 seconds) for circuit elements protected by three cycle breakers. This provides approximately one cycle margin for slower than expected

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<sup>2</sup> NERC Planning Standards, Table 1

fault clearing. For circuit elements protected by two cycle breakers, a normally cleared fault is assumed to last four cycles.

The power system must be stable for single line to ground faults with the failure of a protection system component to operate. This includes clearing of a system fault with the simultaneous failure of a current transformer, protective relay, breaker, or communication channel. Three phase faults with the failure of a protection system component to operate are to be considered in all design alternatives with adverse consequences to system stability minimized.

GRU transmission circuits are protected with primary system relays that provide no intentional time delay when clearing faults for 100% of a line. A second high-speed relay system with communications and no intentional time delay is required if a failure of the primary system can result in instability when a fault is cleared by time delay backup protection. This can be the case for an end of line fault on a short line combined with a failed relay. Likewise, two independent high-speed protection systems may be required for bus protection if backup clearing results in instability.

## **I. O. Protective Relaying**

Utility grade, transmission level protective relays and fault clearing systems are to be provided on the interconnected power system. All protective relays should meet or exceed ANSI/IEEE Standard C37.90. Adjoining power systems may share a common zone of protection between two parties. Compatible relaying equipment must be used on each side of the point of ownership within a given zone of protection. The design must provide coordination for speed and sensitivity in order to maintain power system security and reliability.

All bulk transmission power systems are to have primary protective relaying that operates with no intentional time delay for 100% of the specified zone of coverage. On transmission circuits, this is accomplished through the use of a communication channel. A second high-speed protection system is required on a line and may be required on a bus.

Backup protective systems should provide additional coverage for breaker and relay failure outside the primary zone. Specific breaker failure protection schemes must always be applied at the bulk transmission level. Specific relay failure backup must also be provided. Backup systems should operate for failures on either side of an interconnection point. Time and sensitivity coordination must be maintained to prevent misoperations.

A power source for tripping and control must be provided at substations by a DC storage battery system. The battery system is to be sized with enough capacity to operate all tripping devices after eight hours without a charger. An undervoltage alarm must be provided for remote monitoring by the facilities owners who shall take immediate action to restore power to the protective equipment. The referenced battery charger shall be DC grounded providing filtered power to the DC storage battery system. A separate alarm shall monitor the proper operation of the battery charger.

Mechanical and electrical logic and interlocking mechanisms are required between interconnected facilities to ensure safe and reliable operation. These include, but are not limited to, breaker and switch auxiliary contacts, undervoltage and synch-check relays, and physical locking devices.

A transfer trip is required for many installations. It is used for backup protection and islanding schemes. Fiber optics is the preferred means of communication

Entities connecting to the GRU transmission system shall investigate and keep a log of all protective relay actions and misoperations as required by the FRCC in compliance with NERC Planning Standards. The most current requirements for analysis and reporting of protection misoperations are available from FRCC staff.

Entities connecting to the GRU transmission system must have a maintenance program for their protection systems. Documentation of the protection maintenance program shall be supplied to GRU, the FRCC, and NERC on request. Test reports as outlined in the maintenance program are to be made available for review by GRU and the FRCC. At intervals described in the documented maintenance program and following any apparent malfunction of the protection equipment, the entity shall perform both calibration and functional trip tests of its protection equipment at their own expense.

Any protective relaying performance issues that occur over time must be corrected to the satisfaction of GRU's Relay Protection Department and at the expense of the interconnected party.

## **I. P. Transmission Reclosing**

It is GRU's practice to automatically and manually test its transmission lines following breaker operations for system faults. This is required to minimize customer outage time and maintain system stability. On 230 kV lines and below, automatic reclosing occurs at 10 seconds after fault clearing. Interconnected facilities must not interfere with GRU's ability to quickly restore transmission lines following temporary or permanent system faults.

Automatic reclosing on lines originating at GRU generation sites is usually accomplished by hot line synch-check permissive. Any party wishing to interconnect with GRU must consider the implications of automatic reclosing in their design.

## **I. Q. Metering**

Each installation needs to be evaluated separately for metering requirements because of the many possible contractual agreements and interconnection configurations. In general, however, the following quantities are to be provided for each supply point. Megawatt-hours received, Megawatt-hours delivered, MegaVar-hours received, MegaVar-hours delivered, Three Phase Voltage, Three Phase Current, +/- Megawatts, and +/- Megavars. These quantities may need to be provided to various parties through various information/communication systems. Specific designs will be developed to meet those requirements. All metering devices are to be pre-approved by GRU prior to installation. Revenue meters are to have an accuracy class of 0.3% or better. Three element meters are to be used on all effectively grounded power systems. Both primary and backup revenue meters are to be provided. Backup current transformers (CTs) and potential transformers (PT's) are not required.

Instrument transformers are to have an accuracy class of 0.3% or better with 0.15% being preferred. Metering accuracy CTs and PTs are to be installed as close to the delivery point as practical. CT ratios are to be selected just above the expected full load. Using multi-ratio CT's are not advisable since accuracy is lost when using lower taps. Metering CT's and PT's should not be used to feed non-metering equipment such as protective relays. Metering CT's are not to be connected in parallel. Auxiliary CT's are not to be used in metering circuits. When more than one point is to be monitored, individual metering is to be used. The impedance of the CT and PT cable leads is to be kept low and not impose burdens above that of the instrument transformer rating.

At locations where ferroresonance can be a problem, metering accuracy capacitor coupled voltage transformers (CCVT) may be used if an alternate design configuration cannot be used. Designs that use ferroresonance dampening resistors connected to metering PT secondary circuits are not allowed.

When the metering location is different from the delivery point, compensation for losses is required for transformer losses and transmission line losses. Compensation should be performed internally by the installed metering equipment rather than by after-the-fact calculations.

Revenue meters are to remain sealed during operation and following maintenance or calibration testing. All parties are to be notified prior to removing seals. Calibration testing is to be performed annually and is to include all associated parties. Test equipment must be certified and traceable to the National Bureau of Standards.

## **I. R. Supervisory Control and Data Acquisition (SCADA)**

Each installation needs to be evaluated separately for SCADA requirements because of the many possible contractual agreements and interconnection configurations. Generally, the following quantities are to be provided. Megawatt-hours received, Megawatt-hours delivered, Voltage,

Current, +/- Megawatts, and +/- Megavars, breaker and switch positions, and equipment trouble alarms. These quantities may need to be provided to various parties through various information/communication systems. Specific designs will be developed to meet those requirements. Dual ported remote terminal units (RTUs) accessed by both parties may be used, provided the appropriate security levels are implemented. Equipment control of breakers, switches and other devices via SCADA is to be provided to only one responsible party.

Power for SCADA or metering communication equipment, if needed, is to be provided by the station battery. Office power systems and switching networks are not acceptable.

### **I. S. Ferroresonance**

Ferroresonance occurs on the power system under certain system configurations that may damage high voltage equipment. This phenomenon is usually caused when PT's are tied to a bus or line stub that may be energized through breakers having capacitors in parallel with the main contacts. Since interconnection facilities may contain shared equipment, such as metering PT's and high voltage breakers, care should be used to avoid configurations that could cause ferroresonance.

### **I. T. Future Modifications**

Any changes that affect an interconnection must be reviewed in advance. These include modifications to the metering or protection scheme as well as associated settings after the interconnection project has been completed. Information about expected increased load flows or higher fault currents levels due to system changes must be provided in a timely manner.

## **II. GENERATION**

This section addresses the technical requirements for connecting new generation to the GRU transmission system or substantially modifying existing generating facilities connected to the GRU transmission system. General overviews of functional requirements are described in this section. Detailed, project specific requirements will be developed as part of an Interconnection Feasibility Study or a Facilities Study, or are referenced in other documents such as the NERC Planning Standards, the NERC Operating Standards, or the National Electrical Safety Code. Florida Public Service Commission Rule 25-17.087 shall apply for Qualifying Facilities wishing to interconnect and operate in parallel with GRU's system.

### **II. A. Applicability**

This section applies to all interconnections with the GRU system made at 138 kV or 230 kV where generation is installed behind the interconnection point and is capable of operating in continuous parallel with the GRU transmission system. It also applies to incremental additions

of generation intended to serve GRU native load. GRU generators, cogenerators, qualifying facilities, merchant plants, and non-utility generators are covered under this section. The MW and MVAR capacity shall normally be limited to 200 MW and 100 MVAR respectively. Any greater capacity shall require extensive consideration involving a consultant service selected by GRU and totally paid for by the applicant. This section also covers utility-to-utility interconnections as specifically noted in Section III.

## **II. B. Configuration**

Generating plants connected to the GRU transmission system are designed to minimize the impacts of the maintenance or unplanned outages of a generator, line, transformer, circuit breaker or bus. The potential adverse effects of maintenance and equipment outages must be considered in the design of the generating plant and its connection to the GRU transmission system.

## **II. C. Operations**

Operators of generating facilities must notify the GRU System Operator and obtain approval before synchronizing the facility to or disconnecting the facility from the GRU transmission system. Disconnection without prior approval is permitted only when necessary to prevent injury to personnel or damage to equipment. Generators must not energize a de-energized GRU transmission circuit unless such actions are directed by the GRU System Operator or are provided for in the interconnection agreement.

Each generating facility shall provide a point of contact to the GRU System Operator. This contact person shall have the authority and capability to operate the facility according to the instructions of the GRU System Operator to ensure that the reliability of the transmission system is maintained. A point of contact shall be reachable and available through telephone or other agreed upon means of communication at all times when the Facility is energized or in operation.

Generating facilities connected to the Peninsular Florida Transmission Systems must follow all applicable FRCC and NERC Operating Standards. A number of constrained transmission interfaces have been identified within the Peninsular Florida Transmission Systems. Power transactions may need to be curtailed when a threat to one of these interfaces is identified by the FRCC's Reliability Coordinator.

In order to maintain the reliability of the GRU transmission system and meet FERC requirements for posting of Available Transmission Capability (ATC), planned outages of plant and transmission equipment must be coordinated. Notification of preliminary plans for overhauls and maintenance outages of generators must be submitted to the GRU generation coordinator by July 31<sup>st</sup> for the upcoming year's outages. The plans must specify the start date of the outage, the return to service date of the unit, and the generation capacity affected. For forced outages the length of time of the outage and the expected return to service date shall be reported as soon as the information is known. Changes in schedules either accelerating or delaying the forecasted

return to service date of generation shall be reported as soon as they are known. Permission to synchronize to the interconnected system must be requested of GRU system operator following any overhaul, unit trip or islanding.

When restoring interconnected generation facilities, it is GRU's practice to energize in the direction from the GRU system toward the de-energized generation facility, except as designated for blackstart units. Synchronization of a generator to the energized GRU system is accomplished within the generation facility using the appropriate synch breaker. The design at generation sites must consider the speed at which the GRU transmission system is restored through auto-restoration following system faults. The generation facility owner must protect their generators from out of synch closures under such conditions.

## **II. D. Islanding**

It is the responsibility of the electric power system owner to ensure **system protection**, safety and **quality of service** within its boundaries. GRU ensures this through equipment design, operating procedures, protective relay settings and a variety of automatic and manual processes. Under an island condition, a portion of load becomes separated from the rest of the Peninsular Florida transmission systems and is served by a local area generation site. It is the responsibility of GRU to ensure that even under an island condition, **power quality** is maintained to its customers. Therefore, GRU does not allow generation to island with GRU load where GRU does not have control over the generator voltage, frequency, protective relays, and operating procedures. Thus, when an island situation occurs, the generation must be separated from the GRU load except under temporary and controlled conditions. This ensures the quality of service and orderly restoration to GRU customers. Without such provisions the resynchronization between two separated power systems becomes uncontrolled.

An island scenario must be considered when the local area generation and associated area load is interconnected to the Peninsular Florida transmission systems with less than three effective transmission lines, and the generation is greater than 30% of the local area minimum load. For these situations, a special protective isolation scheme is required. Removal of the generation is accomplished through a combination of relays and/or remote communication devices. If the generation is less than 30% of the area load, then the generators are to be fast tripped from the GRU load, should the local area become separated from the rest of the Peninsular Florida transmission systems. This is normally done by a combination of over/under voltage and frequency relaying.

The tap connection of generators to GRU transmission system in which the capacitive susceptance (line charging) of the circuit is greater than the MVA rating of the generator is to be avoided. These types of connections may be subject to overvoltage and require special study.

## **II. E. Generator Protection Requirements**

Generators connecting to the GRU transmission system are responsible for protecting those facilities from electrical faults and other hazardous conditions. Generator interconnections must be equipped with circuit breakers to protect those facilities. The generator owner must provide and own the primary circuit breaker or other interrupting device that protects the facility and disconnects it from the GRU transmission system. The primary purpose of this interrupting device is to protect the generating plant facility. A joint use circuit breaker that protects both generating unit and transmission circuit facilities as its primary function is highly discouraged.

Synchronous generators connected to the GRU transmission system must be able to withstand certain temporary excursions in voltage, frequency, reactive and real power output without tripping. This is required to support the grid and avoid cascading events in the Florida peninsula.

As established by the NERC in conjunction with Regional Reliability Standard PRC-024-FRCC-01 synchronous generators with a nameplate rating greater than 20.0 MVA shall have the generator’s protection set such that it does not result in tripping of the generator for the following conditions;

- 1) Frequency that persist for times shorter than specified in Table 1.

**Table 1**

<b>Frequency Range</b>	<b>Minimum Time Delay</b>
60.5 < Frequency < 61.8	10 seconds
59.5 ≤ Frequency ≤ 60.5	No automatic tripping (continuous operation)
58.5 ≤ Frequency < 59.5	60 seconds
58.0 ≤ Frequency < 58.5	10 seconds
57.5 ≤ Frequency < 58.0	1 second

- 2) Generator terminal voltages that are within 5 % of the rated nominal design voltage.
- 3) Generator terminal voltage deviations that exceed 5% but are within 10% of the rated nominal design voltage and persist for less 10.0 seconds.
- 4) Generator volts per hertz conditions that are less than 116% (of generator nominal voltage) that last for less than 1.5 seconds.
- 5) Generator overexcited stator currents (or generator apparent impedance) less than 150% of nameplate rating persisting for less than 5.0 seconds.
- 6) Generator MVA less than 150% of nameplate at rated power factor when applying generator backup phase distance relays.

Documentation of the generator protection and controls that could respond to these conditions by tripping the generator shall be provided to GRU and the FRCC’s Operating Committee (“OC”). In the event the generating equipment owner can not correct or mitigate these potential generator trip conditions, a request for a waiver may be made to the OC. A waiver may be justified in certain special circumstances such as low adverse reliability consequences from generator tripping.

Generators must be designed to remain on line for normal clearing system faults within the close proximity to the plant switchyard. Voltage may approach zero at the switchyard bus for five cycles for some types of faults. Control systems, contactors, motors and auxiliary loads that are critical to the operation of the plant must not drop out under these conditions. Critical 480 volt supply contactors must be provided with ride-through capability where required. Additionally, generator protection systems such as the Load Drop Anticipator, Early Valve Actuator or Power Load Unbalance should not be designed to trip a generator for normal clearing external faults or stable swings.

## **II. F. Support of the Grid**

1. All synchronous generators connected to the GRU transmission system are to be equipped with automatic voltage regulators (AVR)<sup>3</sup>. Generators must operate with their excitation system in the automatic voltage control mode unless otherwise approved by the GRU system operator. Generating equipment owners shall maintain a log which records the date, time, duration and reason for not being in the automatic voltage control mode when operating in parallel with the GRU system. Generating equipment owners shall make this log available to GRU on request. Appendix B has additional details for reporting of AVR status and voltage schedule deviations.
2. All synchronous generators connected to the GRU transmission system must maintain a network voltage or reactive power output as specified by the GRU system operator within the reactive power capability of the generating equipment. Generating equipment owners shall maintain a log which records the date, time, duration, and reason for not meeting the network voltage schedule or desired reactive power output when operating in parallel with the GRU system. Generating equipment owners shall make this log available to GRU on request.
3. The generator step-up and auxiliary transformer tap settings shall be coordinated with GRU transmission systems voltage requirements. Generating equipment owners shall provide GRU with generator step-up and auxiliary transformer tap settings and available ranges.
4. The AVR's control and limiting functions must coordinate with the generator's short time capabilities and protective relay settings. The generating equipment owner shall provide GRU with the AVR's control and limiter settings as well as the protection settings which coordinate with AVR control and limiting functions.
5. Poorly damped power oscillations have occurred in the Florida transmission systems and can be a major concern if not properly addressed. The installation of new generating plants has the potential to aggravate existing modes of oscillation or create new modes. All new

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<sup>3</sup> Items G1, G2, G3, and G4 are requirements of NERC Planning Standards, section III. C.

synchronous generators connected to the GRU transmission system with a nameplate rating greater than 100 MVA shall be equipped with a power system stabilizer. Technical evaluations of oscillatory stability will be conducted for the interconnection of new generating plants. New generators that cause a decrease in the damping of an existing mode of oscillation or cause a poorly damped mode of oscillation will be required to operate with the power system stabilizer in service. The determination of the power system stabilizer's control settings will be coordinated with GRU. Typically this coordination would be to provide GRU with preliminary power system stabilizer settings prior to the stabilizer's field commissioning tests with the final settings provided after the field commissioning tests.

Where stabilizing equipment is installed on generating equipment for the purpose of maintaining generator or transmission system stability, the generating equipment owner is responsible for maintaining the stabilizing equipment in good working order and promptly reporting to the GRU System Operator any problems interfering with its proper operation.

6. All new synchronous generators connected to the GRU transmission system with a nameplate rating greater than 20 MVA shall be equipped with a speed/load governing control that has a speed droop characteristic in the 3 to 6% range. The preferred droop characteristic setting is 5% as this is the typical setting for generators in peninsular Florida. Notification of changes in the status of the speed/load governing controls must be provided to the GRU System Operator as detailed in Appendix 1.

## **II. G. Generator Testing**

1. Prior to commercial operation, the generating equipment owner shall provide GRU with open circuit, step-in voltage test results. Recording of generator terminal voltage and field voltages shall be clearly labeled so that initial and final values can be identified in physical units<sup>4</sup>.
2. Generating equipment owners shall annually test the gross and net dependable summer and winter capability of their units. These test results shall be provided to GRU.
3. Generating equipment owners shall test the gross and net reactive capability of their units at least every five years. These test results shall be provided to GRU.

Generating equipment owners shall inspect and test the AVR control and limit functions of their units at least every five years. An initial test result shall be provided to GRU prior to commercial operation and every five years thereafter. The initial test results shall include documentation of the settings AVR control and limit functions. Typical AVR limit functions are; maximum and minimum excitation limiters and volts per hertz limiters. Documentation of the generator protection that coordinates with these limit functions shall also be provided.

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<sup>4</sup> Sections H1, H2, H3, and H4 are required by NERC Planning Standards, section II. B.

Typical generator protection of this type includes overexcitation protection, loss of field protection.

## **II. H. Power Factor**

For synchronous generators the facilities shall be designed, operated and controlled to provide reactive power requirements from 0.9 lagging to 0.95 leading power factor measured at the high side of the generator step-up transformer when the facility is operating at its maximum summer rating. Induction generators shall have static capacitors that provide at least 85% of the magnetizing current requirements of the induction generator field. Qualifying Facilities shall meet the power factor requirements established in Florida Public Service Commission Rule 25-17.087.

## **II. I. Interrupting Ratings**

There may be cases where adding generation will increase the available fault current above the present interrupting ratings of the existing breakers at a substation or stations. When this occurs, breaker upgrades are to be considered as part of the interconnection project. Similarly, the connection of new generators to the transmission system may increase fault current to a level which exceeds the short time rating of overhead ground wires. The rating of overhead ground wires is discussed further in *GRU's Transmission Facility Rating Methodology* document. If equipment ratings will be exceeded, the appropriate modifications must be performed prior to the new generation coming on line.

## **II. J Source System Grounding**

When various switching devices are opened on an energized circuit, its ground reference may be lost if all sources are not effectively grounded. This situation may cause overvoltage that can affect personnel safety and damage equipment. This is especially true when one phase becomes short circuited to ground. Therefore, the interconnected transmission power system is to be effectively grounded from all sources. This is defined as  $X_0/X_1 \leq 3$  and  $R_0/X_1 \leq 1$ . Interconnected generators should provide for effective system grounding of the high side transmission equipment by means of a grounded high voltage transformer.

An alternative design only for sites with less than 10 MVA is available in some limited cases but requires a special Electromagnetic Transients Program (EMTP) system study to determine applicability. Under this non-preferred option the system is not grounded at the source. However, the transmission system equipment insulation level in the area must be rated to withstand the amplitude and duration of all overvoltage caused by neutral displacement. Also the source must be removed rapidly when any overvoltage condition occurs. This includes isolation of the ungrounded source for system faults simultaneously with other relaying systems within the protected zone. Since the source provides no ground fault current, relay protection

devices must operate for zero current. Some switching operations may cause the loss of all remote ground sources by islanding a part of the system even under non-fault conditions. The protection scheme must also be able to quickly remove the generation under this situation before any adverse effects occur. Some form of communication with remote transmission stations is usually required in order to accomplish this.

## **II. K Generator Telemetry**

All generating plants connected to the GRU transmission system must provide real time telemetered data for individual generators to the GRU system control center. The required data includes generator MW, MVAR, terminal voltage and switchyard high side voltages. MW and MVAR data should be Net output values as measured at the low side of the generator step up transformer less any auxiliary load directly fed from the generator. These generator output quantities shall be telemetered at a two second scan rate. In addition, the status of individual generator circuit breakers and the status of the generators' automatic voltage regulator must be made available to the GRU control center.

Individual generator output data values may be aggregated when the generator is rated less than 20 MVA. Other metering requirements are addressed in section I.O.

## **III. TRANSMISSION**

This section addresses the technical requirements for connecting new transmission lines to the GRU transmission system as well as for new and existing delivery points. The GRU planning process is designed to ensure that GRU's transmission system will have sufficient capability for GRU to meet the expected loads at distribution substations/delivery points, and to fulfill GRU's contractual obligations with other entities to receive and deliver power. A utility/customer may elect to connect to GRU through a "delivery point" connection or an "interconnection point" connection.

A "delivery point" is a point of connection between GRU's transmission system and another entity's system or facilities which ultimately delivers the power to individual customers' loads. Two characteristics may be generally used to distinguish delivery points from interconnections: i) the protective schemes of the integrated transmission system are designed to either entirely or partially suspend service to a delivery point by disconnecting a transmission facility that serves such delivery point from the transmission system; ii) power normally flows only in one direction across the delivery point (i.e., from the transmission system to the delivery point), and thus the protective schemes at the delivery point may be designed taking into account this characteristic.

An "interconnection point", in contrast, is a point of connection between two entities' respective transmission systems. Interconnection points are normally operated in parallel with the transmission systems such that it is possible for power to flow in either direction. Protection

systems for interconnection points are designed to prevent and/or minimize the possibility of an event within one of the systems affecting or cascading into the other system.

### **III. A. Applicability**

This section applies to all interconnections with the GRU system made at 138 kV or 230 kV. This includes utility-to-utility (entity) type interconnections used for power interchanges as well as delivery point type connections used to deliver power to end users. Subsections C through J apply mainly to transmission interconnections. The MW and MVAR capacity shall normally be limited to 200 MW and 100 MVAR respectively. Any greater capacity shall require extensive consideration involving a consultant service selected by GRU and totally paid for by the applicant. Detailed, project specific requirements will be developed as part of a System Impact Study, a Facilities Study or are referenced in other documents such as the NERC Planning Standards or the National Electrical Safety Code.

### **III. B. Process**

The connection of non-GRU transmission facilities to the GRU transmission system should follow the Facilities Connection Process outlined in Figure 1. Either GRU or both entities jointly will begin a System Impact Study to determine the effect of the proposed connection on the GRU transmission system. If necessary, a Facilities Study will be initiated to determine the cost of the connection and all GRU equipment improvement needed to accommodate the new connection.

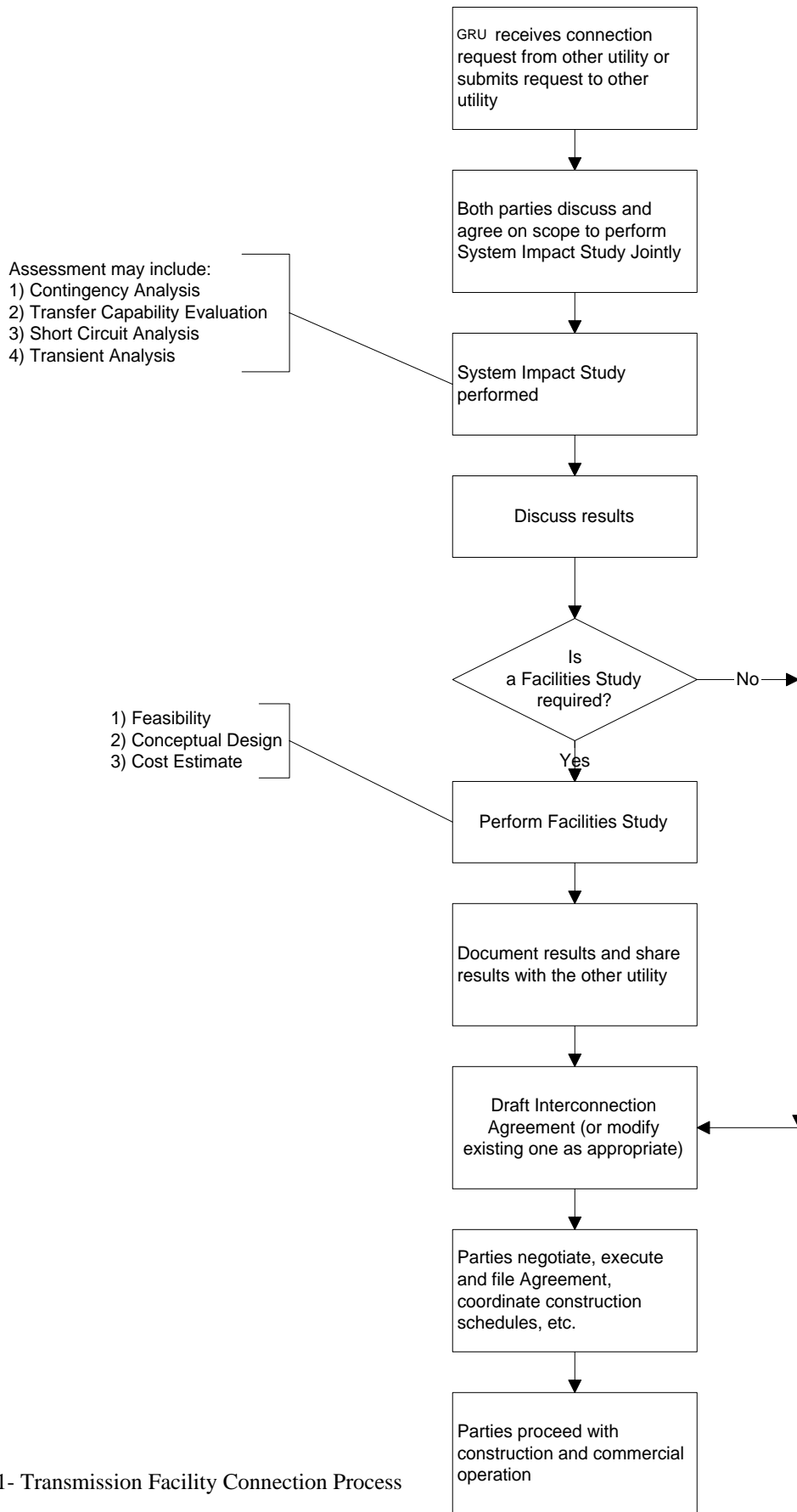


Figure 1- Transmission Facility Connection Process

### **III. C. Configuration**

The interconnection point between utilities is typically through a transmission line or lines. The change of ownership is usually at a transmission line structure. The neighboring utility must have an effectively grounded transmission system. Three terminal lines are to be avoided for interconnections due to problems discussed in Section I.

### **III. D. Operations**

Interconnections between GRU's transmission system and other transmission systems are normally operated in parallel unless otherwise agreed. However, if any operating condition or circumstance creates an undue burden on the GRU Transmission System, GRU shall have the right to open the interconnection(s) to relieve its system of the burden imposed upon it. Prior notice will be given to the extent practical. Each party shall maintain its system and facilities so as to avoid or minimize the likelihood of disturbances that might impair or interrupt service to the customers of the other party.

The GRU System Operator shall be notified prior to any maintenance work on a transmission interconnection. GRU switching and safety procedures shall be strictly adhered to when maintenance is being performed on an interconnection.

### **III. E. Metering**

Metering equipment may be located at either end of the transmission line but should be installed at the station closest to the change of ownership.

If the neighboring utility is within and under the GRU control area, GRU is to own, operate and maintain the metering installation equipment, including the instrument transformers, secondary conductors, cables, meters and transducers. If the interconnection facilities are owned by the neighboring utility, and that utility does not own the instrument transformers or meters, a structure and a location for mounting metering transformers and recording devices is to be provided by the facility owner. The neighboring utility may not connect additional devices such as relays or meters directly to potential or current transformer secondaries used for revenue metering.

It is the facility owner's responsibility to provide GRU approved telecommunication from the metering location to any point desired by GRU up to and including the GRU Operational Service Center(OSC) presently located at NW 53<sup>rd</sup> Ave and NW 43<sup>rd</sup> Street, Gainesville, FL. If the OSC moves prior to the metering installation, GRU will notify the proposed facility owner of the new location.

### **III. F. Protection**

Line Differential Protection is the primary protection for the GRU Transmission System. Permissive Over-Reaching Transfer (PORT) scheme is the secondary backup protection. Any connection to a GRU Transmission line will have to accommodate and coordinate with these protection schemes.

### **III. G. Separations**

There are several controlled islanding special protection systems installed in the Peninsular Florida transmission systems. None are presently owned or operated by GRU. These special protection systems have been coordinated with the utilities involved and with the FRCC underfrequency load shedding program. Depending upon the location of the transmission interconnection, it may be necessary to install special relaying or transfer trip equipment.

Connections to the GRU transmission system which introduce the possibility of GRU load being isolated with non GRU generation must be evaluated to assure safety and quality of service. When there is a potential for GRU load to become islanded with non-GRU generation, a special protective isolation scheme may be required. See Section II. D. for specific guidelines under islanding conditions.

### **III. H. Transmission Reclosing**

Automatic reclosing on interconnected transmission lines between utilities is handled on a case-by-case basis. Transmission interconnections between utilities may be restored from either direction depending upon a reclosing practice agreed to by the utilities involved.

### **III. I. Reactive Power Control**

Entities interconnecting their transmission system with GRU's 138 kV or 230 kV transmission system shall endeavor to supply the reactive power required on their own system, except as otherwise mutually agreed. GRU shall not be obligated to supply or absorb reactive power for the other party when it interferes with operation of the GRU transmission system, limits the use of GRU interconnections, or requires the use of generating equipment that would not otherwise be required.

### **III. J. Unbalance Phases**

Unbalance currents and voltage are to be controlled by each party on their respective side of the interconnection. However, it should be realized that switching devices, such as breakers and switches, are three phase devices and can fail with only one or two poles closed. It is the responsibility of the facility owner to protect their own equipment such as generators or transformers from damaging negative sequence currents or voltage.

## **IV. END USER FACILITIES**

### **IV.A. Process**

The connection of new Network Load to the 138 kV or 230 kV System, including the studying, negotiation and execution of a developed Network Service and Network Operating Agreements between the Parties shall comply with the provisions of the OATT unless other agreements take precedence.

### **IV.B. End User Interconnection Technical Requirements**

The technical requirements for connecting new Network Load to the 138 kV or 230 kV System are defined in the Network Service and Network Operating Agreements executed by the Customer pursuant to the provisions of the OATT. Other general guidelines that shall be followed by the Customer shall include, without limitation, the following minimums:

- Load operating characteristics that comply with the Florida Public Service Commission's standards for power quality.
- The MW load of 100 MW or less as specified in the Network Operating Agreement between the Parties, measured at the Point of Delivery.
- The load power factor as referenced in Section IV.C and specified in the Network Operating Agreement between the Parties, measured at the Point of Delivery.

### **IV.C. Delivery Point Power Factor**

The Peninsular Florida transmission systems can, under some circumstances, be subject to voltage instability and collapse. An essential element in the reliability of the GRU transmission system is the installation of power factor correction capacitor banks that compensate for the reactive power demands of customer loads. GRU designs and operates its load connections so that the load power factor measured at the point where the load connection exits the GRU integrated transmission system is between 95% lagging and 99% leading during summer peak load conditions. In order to avoid transmission system overvoltage, load power factor compensation is controlled so that the load power factor measured at the point where the load

connection exits the GRU integrated transmission system is unity or lagging during minimum spring load conditions. Delivery point connections to the GRU transmission system shall meet the power factor requirements listed above.

In order to assess power factor, the delivery point real (kW) and reactive demands (kVar) shall be recorded at the time of GRU's transmission system summer peak load (June, July, or August) and at the minimum spring load (March, April, or May). For compliance assessment purposes, GRU and the customer can aggregate delivery points that are in close electrical/geographical proximity (by summing kW and kVar values)

GRU occasionally experiences unusually high loads outside of the summer period (e.g. 7 a.m. peak loads associated with winter cold fronts). Load serving entities should cooperate to the extent feasible with requests from the GRU System Operator to help support system voltage.

#### **IV.D. Delivery Point Power Quality**

Generation of harmonics should be limited to values prescribed by IEEE Standard 519 when measured at the interconnection point of ownership. Additionally, the GRU transmission system should not be subjected to harmonic currents in excess of 5% of a transformer's rated current as stated in ANSI/IEEE Standard C57.12.00.

#### **IV.E. Delivery Point Metering**

GRU is to own, operate and maintain the metering installation equipment, including the instrument transformers, secondary conductors, cables, meters and transducers. If the meter location is not part of GRU facilities, then a structure and a location for mounting metering transformers and recording devices are to be provided by the facility owner. End user devices are not to be connected directly to potential or current transformer secondaries used for revenue metering.

It is the facility owner's responsibility to provide GRU approved telecommunication from the metering location to any point desired by GRU up to and including the GRU Operational Service Center(OSC) presently located at NW 53<sup>rd</sup> Ave and NW 43<sup>rd</sup> Street, Gainesville, FL. If the OSC moves prior to the metering installation, GRU will notify the proposed facility owner of the new location.

#### **IV.F. Delivery Point Auto-Restoration**

End user facilities are energized in the direction from GRU to the load. Owners of interconnected load facilities are to be aware of GRU's automatic reclosing practices as stated in Section I. GRU's standard reclosing, 10 seconds after fault clearing, should be taken into

account by end users with sensitive control systems or large motors. Ride-through capability and heavy motor inrush currents should be assessed in the design stages of the facility.

#### **IV.G. Delivery Point Load Shedding Programs**

Entities responsible for load serving delivery points shall implement and maintain an underfrequency load shedding program designed and coordinated with GRU and the FRCC. GRU has installed automatic emergency load shedding schemes at several locations in the GRU transmission system to minimize the potential for instability following severe contingencies. GRU has the right to require entities responsible for load serving delivery points to implement an emergency load shedding program to the extent that such a program is required and utilized by GRU to assure transmission integrity under adverse conditions. The amount of load to be interrupted by emergency load shedding programs will be distributed comparably among GRU's and other entities' customers in the applicable region.

#### **IV.H. Delivery Point Generation**

Delivery point connections usually do not have generating facilities that operate in parallel with the GRU transmission system. Customers wishing to install generating facilities to be operated in parallel with GRU must notify GRU in writing prior to the commencement of any work. The technical requirement for the connection of generation outlined in Section II of this document must be followed. No generation shall be operated in parallel with the GRU transmission system without prior written approval of GRU.

#### **IV.I. Delivery Point Parallel Operation**

The distribution and transmission facilities behind the designated delivery point with GRU's transmission system shall be operated as a radial system only. Operation in a mode which would tie two or more delivery points together in a manner which would cause the system behind the delivery points to be operated as a parallel network to the GRU transmission system is prohibited without the express written permission of GRU. The installation of such protective equipment may be required by GRU to ensure that parallel operation is automatically interrupted within the time frame allowed by GRU's standard.

#### **IV.J. Grounding**

All grounding and grounding of equipment will be per IEEE 80 latest revision. Customer's neutral and ground (if applicable) and GRU's will be bonded at the point of interconnection. The high side connection of generation step-up transformers shall be wye solidly grounded.



**Appendix A**

**Table of Specifications  
For  
Customer's Interconnection Facilities**

## **APPENDIX A**

### **Gainesville Regional Utilities TABLE OF SPECIFICATIONS FOR CUSTOMER'S INTERCONNECTON FACILITIES**

Included in this Specification are the minimum electrical and mechanical design data for substation, transmission line, and distribution line to be followed for interconnection with Gainesville Regional Utilities.

**TABLE 1 - Substation Design Data**

**TABLE 2 - Transmission Line Design Data**

**TABLE 3 - Distribution Line Design Data**

**TABLE 4 - Relay Design Data**

TABLE 1

Substation Design Data

ELECTRICAL DESIGN DATA

Substations shall be designed per the latest editions of the National Electrical Safety Code (ANSI C2), NEMA Standards, and ANSI standards. The typical acceptable electrical design characteristics are listed below.

Nominal Voltage Rating (kV)	12.47	138	230
BIL (kV)	110	650	1050
Typical Fault Duty Design Requirements For Structures and Equipment	20kA	40kA	40kA

**MECHANICAL DESIGN CRITERIA**

**Environmental Loading**

The general loading requirements for substation structures shall be defined by the latest edition of ANSI C2 (NESC) approved by the Florida Public Service Commission's Bureau of Electrical Safety. Substation structures shall be designed to meet the requirements for transmission line structures, NESC light loading district with grade B construction and appropriate safety factors. GRU is not in the area of operation associated with extreme wind conditions, normally within 30 miles of the coast.

**Grounding**

All grounding and grounding of equipment will be per IEEE 80 latest revision. Customer's neutral and ground (if applicable) and GRU's will be bonded at the point of interconnection. The high side connection of generation step-up transformers shall be wye solidly grounded.

**TABLE 2**

**Transmission Line Design Data**

**ELECTRICAL DESIGN CRITERIA**

Transmission facilities shall be designed per the latest edition of the NESC standards. The minimum acceptable electrical design characteristics are listed below:

Nominal Operating Voltage	138 kV	230 kV
Insulator Impulse Level (kV)	650	1050
<b>Conductor Spacing</b>		
Phase to Phase	7'-0"	10'-0"
Clearance Above Grade	Meets NESC Latest Edition	

**Mechanical Design Criteria - Environmental Loading**

The general loading requirements for a structure shall be defined by the latest edition of ANSI C2 (NESC) approved by the Florida Public Service Commission's Bureau of Electric Safety.

- NESC light loading district criteria shall be used with grade B construction and appropriate overload capacity factors.
- GRU does not have any facilities within 30 miles of the coast in either direction from Gainesville, Florida

**Grounding**

Customer's neutral and ground (if applicable) and GRU's will be bonded at the point of interconnection.

Actual impulse level, conductor spacing, and clearances shall be determined for each respective structure and conductor used during line design activities for the interconnection structures. All phases of the line design activities must conform to all current applicable standards.

TABLE 3

**Distribution Line Design Data**

**Electrical Design Criteria**

Distribution facilities shall be designed per the latest edition of the NESC standards. The minimum acceptable electric design characteristics are listed below:

**Nominal Voltage Rating** 15 kV

BIL (Equipment) kV	110
BIL (Line Construction) kV	350

**Conductor Spacing**

Phase to Phase	2'-6"
Phase to Neutral	5'-0"
Clearance above Grade	Meets NESC (latest edition)

**Mechanical Design Criteria - Environmental Loading**

The general loading requirements for a structure shall be defined by the latest edition of ANSI C2 (NESC) approved by the Florida Public Service Commission's Bureau of Electric Safety.

- 1 NESC light loading district criteria shall be used with grade B construction and appropriate overload capacity factors.
- 2 GRU is not in the area of operation associated with extreme wind conditions, normally within 30 miles of the coast.

**Grounding**

Customer's neutral and ground (if applicable) and GRU's ground will be bonded at the point of interconnection.

Note: Where grounding resistors are used, a transformer must isolate the Customer from GRU lines serving other customers.

**Fault Current and Voltage**

The maximum 3-phase fault current will be limited to approximately 10,000 amps symmetrical including both GRU's and the Customer's contributions. Voltage fluctuations will be limited in accordance with PSC/GRU guidelines. The total voltage harmonic distortion must not exceed proposed IEEE 519.

**TABLE 4**

**Relay Design Data**

**Protection Design Data**

Transmission lines shall be designed per acceptable industry practices. The following table lists the acceptable protection requirements for transmission lines.

<b>Scheme or Requirement</b>	<b>138 kV*</b>	<b>230 kV*</b>
Directional Comparison	X	X
Phase & Ground Distance (N/A)		
Line Differential via Fiber Optic	#	#
Permissive Over-Reaching Transfer Trip via Fiber Optic	%	%

\* - 138kV & 230kV lines both require two sets of protective relays

X- Backup Protection when fiber optic communication is lost

# - The preferred protection at this voltage levels

%- Acceptable protection

**Control Data**

1. The customer shall provide an isolated “N” dry contact from all interface breakers.
2. The customer shall provide synchronizing capability and no "Dead-Line" reclosing on all interface breakers.
3. The customer shall provide breaker failure protection on all interface breakers operating at 138kV.

**Drawing and Equipment Data**

1. The customer shall provide one-lines showing their system and generator protective equipment.
2. The customer shall provide impedances of the generator, step-up transformer and associated lines.

**Telemetry Data**

1. The customer shall provide space for mounting a RTU and Fiber Optic equipment whenever the metering point is located at the customer's end of the line.



## **Appendix B**

### **Procedures for Notification of Generating Plant**

#### **Operational Data and Control Status**

## **Appendix B**

### **Procedures for Notification of Generating Plant Operational Data and Control Status**

#### **Introduction**

An essential part of operating a transmission system reliably is the coordination of reactive power sources to maintain an adequate transmission voltage profile both for normal and contingency conditions. Reactive sources must be distributed throughout electric systems due to the large voltage drops associated with transmission of reactive power. Operators of transmission systems follow voltage control strategies to minimize the risk of exceeding equipment voltage limitations and the transmission grid's voltage stability limitations. Generators operating in parallel with the transmission system must operate with the automatic voltage regulator ("AVR") on and follow the established voltage schedule for the voltage control strategy to be effective.

Owners of generators connected to the GRU transmission system must coordinate with Transmission Operations to optimize generating plant transformer tap settings. By carefully selecting transformer tap ratios, it is possible to optimize generating plant voltages and reactive capabilities for the expected range of transmission voltages.

GRU has established these information and notification procedures to facilitate the coordination of reactive power and to comply with the NERC Planning Standards (Sections II.B. Generator Data and III.C. Generator Protection and Control).

#### **Requirements**

1. Notification of AVR status - All synchronous generators with MVA ratings larger than 20.0 MVA connected to the GRU transmission system shall operate with the generator's AVR on and in the voltage control mode to the extent practicable. The operator of the synchronous generator must contact the GRU System Operator when it becomes necessary to operate with the AVR off for more than 15 minutes, state the reason for operating with the AVR off and provide an ETA for returning to normal. In addition to verbal notification of the reason for operating with the AVR off, the AVR status should also be automatically telemetered to the GRU control center.

Owners of generating equipment are responsible for maintaining records that a) provide a summary of the number of hours per month each generator was not in the automatic voltage control mode while operating in parallel with the GRU transmission system and b) provide the date, duration, and reason for each period of occurrence. These records must be available for the preceding 12 months and must be provided within five business days of request.

2. Notification of Deviation from Voltage Schedule - All synchronous generators connected to the GRU transmission system with ratings larger than 20.0 MVA shall maintain a voltage schedule at the point of interconnection as prescribed by the System Operator to the extent allowed by the capabilities and limitations of the generating plant equipment.

Typical voltage schedules for generating plants are listed below.

<u>Switchyard Nominal Voltage</u>	<u>10am-10pm Scheduled Voltage</u>	<u>10pm-10am Scheduled Voltage</u>
138 kV	140.0 kV	136 kV
230 kV	240.0 kV	235 kV

The GRU System Operator or designated agents will advise generating plant operators of the current voltage schedule. This voltage schedule may change on an hourly basis depending on conditions in the power system.

The operator of the synchronous generator must contact the GRU System Operator when the generator can not maintain the voltage at the point of interconnection as prescribed by the GRU System Operator for more than 30 minutes. The operator of the synchronous generator shall state the reason for deviating from the voltage schedule and provide the GRU System Operator with the generator’s reactive limitations that exist at that time. Owners of generating equipment are responsible for maintaining records that a) provide a summary of the number of hours per month each generator was not following the voltage schedule as prescribed by the System Operator and b) provide the date, duration, and reason for each period of occurrence. These records must be available for the preceding 12 months and must be provided within five business days of a request.

3. Notification of Plant Capabilities - Prior to commercial operation, the generating equipment owner shall notify the GRU System Operator of the expected generator capabilities as listed below.

<b>Generator</b>	<b>Summer Continuous Generator Gross Capabilities</b>		
	<b>MW</b>	<b>Lagging MVAR</b>	<b>Leading MVAR</b>
_____	_____	_____	_____

<b>Generator</b>	<b>Winter Continuous Generator Gross Capabilities</b>		
	<b>MW</b>	<b>Lagging MVAR</b>	<b>Leading MVAR</b>
_____	_____	_____	_____

<b>Total Plant Auxiliary Power Usage Summer</b>	<b>MW</b>	<b>MVAR</b>
	_____	_____

## **Winter**

Updated information based on actual test results shall be provided to the GRU System Operator as it becomes available.

4. Notification of Turbine Governor Status - Owners of synchronous generators with ratings larger than 20.0 MVA connected to the GRU transmission system shall notify the GRU System Operator of changes in the status of the speed/load governing controls for the turbine. The GRU System Operator shall be made aware of nonfunctioning, partially functioning or blocked governor controls when these conditions are expected to persist for five days or more.
5. Notification of Available Transformer Ratios and Changes in Transformer Data – Owners of synchronous generators with ratings larger than 20.0 MVA connected to the GRU transmission system shall provide the GRU System Operator with the transformer data. Updated information shall be provided when transformer changes are made. In the event that operating experience indicates that transformer ratio changes are desirable, GRU will provide the generating equipment owner with a detailed study that documents the technical justification for making a transformer tap change. GRU's practice has been to select transformer ratios that will be acceptable for both summer high load conditions and Spring/Fall light load conditions so that seasonal adjustments are not necessary. As required by the NERC Planning Standards in Compliance Template III.C. S2 M6, the generating equipment owners are expected to make these transformer tap changes during the next scheduled maintenance period.
6. Notification of Generator AVR Control and Protection Settings – Most synchronous generator AVRs are equipped with limiting controls that help protect the generator while also allowing the generator to support the grid during temporary excursions in transmission voltage. These limiting controls must be properly coordinated with generator protection and with the generator's short term voltage/reactive capabilities. Two common examples of these controls are the maximum excitation limiter (coordinates with overexcitation protection) and the minimum excitation limiter (coordinates with the loss of field relay).

Prior to commercial operation, the owner of a synchronous generator with a rating larger than 20 MVA shall provide the GRU System Operator with documentation that describes the functional operation and settings for the AVR's control functions. This documentation shall demonstrate the AVR's controls are coordinated with the generator protection and with the generator's short term capabilities. In cases where the AVR has been set to regulate a voltage other than the generator's terminal voltage or it has been set to regulate a compensated terminal voltage, sufficient data shall be provided to allow the AVR to be modeled accurately.

7. Provision of Generator Test Data – One of the standard generator commissioning tests is to introduce a step change in the AVR's reference voltage with the generator running at

synchronous speed but not connected to the transmission system. This is referred to the open circuit, step in voltage test and is used to confirm the AVR is functioning properly.

Prior to commercial operation, the owner of a synchronous generator with a rating larger than 20 MVA shall provide the GRU System Operator with open circuit, step in voltage test results. Recordings of the generator terminal voltage and generator field voltage magnitudes must be provided together with any calibration data necessary to equate the recordings with actual voltages. In situations where it is impractical to measure the generator field voltage (e.g. brushless excitation systems) alternate quantities with equivalent response characteristics can be provided. An estimate of the generator's field winding temperature during this test must be provided.

**GRU should be notified within 5 business days or sooner of any addition or modifications to the generation, transmission, and end-user facilities. GRU will then notify those parties responsible for the reliability of the interconnected transmission system as soon as feasible (R2.1.2).**

## **Appendix C**

**GRU Facility Rating Methodology  
(Separate Document-  
Not included but available upon request)**