

SERC
Facility Connection Requirements
Guideline

NERC Reliability Standard FAC-001



Revision History

Revision	Date	Comments
0	April 5, 2000	Developed by the Generation/Load Connection Task Force (GLCTF) and approved by SERC EC
1	June 7, 2000	Updated supplement to include transmission
2	November 20, 2001	Revised by the PSWG to reflect the December 15, 2000 version of the I.C Compliance Template
3	June 4, 2003	Re-certification of supplement by SERC EC
4	May 25, 2005	Revised by PSS to reflect new SERC Supplement format, NERC Version 0 Reliability Standards, and NERC functional model naming convention
5	October 13, 2005	Changed Reliability Authority to Reliability Coordinator and added SERC Power System Stabilizer Guideline as Attachment 2
6	May 28, 2009	Approved by Engineering Committee

Responsible SERC Subgroup & Region Review Group

Planning Standards Subcommittee (PSS)

Review and Re-Certification Requirements

This procedure will be reviewed every three years or as appropriate by the PSS for possible revision. The existing or revised document will be re-certified and distributed to all members by the SERC Engineering Committee (EC).

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I. Introduction

The SERC Guideline, Facility Connection Requirements, was developed by the SERC Planning Standards Subcommittee (PSS) to provide guidance to SERC Transmission Owners in developing their respective Facility Connection Requirements.

This Guideline, once approved by the SERC Engineering Committee, will supersede SERC Supplement – Facility Connection Requirements NERC Reliability Standard FAC-001, dated October 15, 2005.

These guidelines are intended to establish a consistent approach to document formatting and content for the development of SERC Transmission Owners' Facility Connection Requirements documents for Generation Facilities, Transmission Facilities and End-User Facilities as required by NERC Reliability Standard FAC-001 – Facility Connection Requirements. A consistent approach in format and content of Facility Connection Requirements documents will aid prospective facility owners in evaluating connection requirements. Because facility connection needs for Generation Facilities, Transmission Facilities and End-User Facilities may vary, this Guideline contains guidance that may not apply equally to all facility types. Transmission Owners are not limited by this guideline, and may have additional requirements based on the needs of their system.

In addition to these guidelines, the SERC Power System Stabilizer Guideline document should also be reviewed for additional information.

The SERC Facility Connection Requirements Guideline is not a NERC/FERC approved Regional Standard and does not impose additional requirements, above and beyond the requirements of the Reliability Standard, upon the Standard's applicable entities. Nor does adherence to these guidelines ensure compliance with the requirements of the standard.

SERC seeks to ensure that this Facility Connection Requirements Guideline focuses on the reliability aspects of generation, transmission, and load connections. **This guidance document is not intended to serve as a design standard nor as an operating agreement or interconnection agreement.**

II. General Recommendations

NERC Reliability Standard FAC-001 applies to Transmission Owners. It addresses connection requirements for generation facilities, transmission facilities, and end-user facilities.

Reference to Operating Agreements may be made, provided that it is the practice of the Transmission Owner to include specific operational requirements (e.g., permissible operating voltage ranges) in Operating Agreements. Whenever applicable, specific industry standards should be cited. However, whenever specific standards are not appropriate, the facility connection requirements should be based on good utility practices with references to supporting documentation which describe the justifications for the utility practices.

The Transmission Owner should reserve the right to take such actions as deemed necessary to ensure the reliability of the interconnected transmission system.

III. Specific Recommendations Applicable to FAC-001-1, Requirement 2

R2.1. Provide a written summary of its plans to achieve the required system performance as described above throughout the planning horizon:

The Transmission Owner may incorporate system assessments, conducted per the requirements of the TPL Reliability Standards, describing the results of the assessment(s) and any mitigation requirements incorporated into the facilities interconnection requirements to mitigate system performance deficiencies.

R2.1.1. Procedures for coordinated joint studies of new facilities and their impacts on the interconnected transmission systems.

Transmission Owners should include a description of their procedures for study of new facilities and their impacts on the interconnected transmission system. The impact studies that should be considered include but are not limited to:

- fault duty
- stability
- power flow
- transfer capability

The Transmission Owners' procedures should identify the conditions requiring coordinated joint studies with interconnected transmission systems and the processes used in initiating and conducting joint studies.

R2.1.2. Procedures for notification of new or modified facilities to others (those responsible for the reliability of the interconnected transmission systems) as soon as feasible.

Planning requirements that should be addressed include:

- The Transmission Owner should include a description of its procedure for the facility owner to provide notification of any planned modification or changes to facilities that may affect system operations or reliability. In addition, the procedure should address the facility owner's timeframe to implement the planned modifications or changes.
- The Transmission Owner should include a description of its procedure for incorporating facility owner data into system studies. The Transmission Owner should provide the requirements for data relating to planned facility modifications or changes.

R2.1.3. Voltage level and MW and MVAR capacity or demand at point of connection.

Design requirements that should be addressed include:

- Load following capability
- AGC
- Reactive power output
- Minimum operating capability
- Remote control functions
- Coordination of generation control system settings
- Load shedding
- Black start capability
- Dynamic stability and the use of power system stabilizers - SERC recommends that power system stabilizers be utilized for certain conditions identified in the stand alone document SERC Power System Stabilizer Guideline.

- Internal plant systems design (e.g., transformer rating/taps/impedance, cooling systems, generator/exciter rating) should be designed to support continuous reactive capability requirements at the point of transmission interconnection.
- Transmission interconnected equipment should have the tap ranges and self-regulation necessary to accommodate the transmission system's reactive power flow requirements.
- Load power factor
- Generator power factor
- Load equivalent sources of reactive power, if acceptable
- Generator equivalent sources of reactive power, if acceptable
- Transmission interconnections impact on adjacent areas' voltage and reactive power flow requirements

Operational requirements that should be addressed include:

- Operation at 60Hz nominal
- Mode of frequency control
- Operation of generators during frequency decline conditions
- Coordination between generator controls and underfrequency load shedding programs
- Speed droop setting
- Responsibility for coordination with the appropriate operating entity
- Verification of reactive support capability per NERC Reliability Standards and corresponding SERC documents
- Generator step-up transformer (GSU) tap changes as necessary to meet voltage schedule and reactive support requirements

R2.1.4. Breaker duty and surge protection.

Design requirements that should be addressed include:

- Short circuit capabilities of current carrying elements
- Ratings of interrupting devices
- Existing and planned future fault current levels
- Responsibility for required changes in existing facilities due to increased fault currents (Generator and Transmission Projects only)
- Arrester applications

R2.1.5. System protection and coordination.

Design and Operational requirements that should be addressed include:

- Safety of the general public
- Prevention/minimization of equipment damage
- Minimization of equipment outage time
- Minimization of system outage area
- Minimization of system voltage disturbances
- Maintenance of protective system coverage for abnormal conditions
- Performance of all appropriate studies: grounding, short circuit, stability, power quality, and coordination of protective devices
- Specification of RTU protocols and other communication channels
- Coordination of remote trip schemes, underfrequency load shedding schemes, undervoltage load shedding schemes and special protective systems should be required whether in the same Balancing Authority Area or different Balancing Authority Areas.
- Relay and device coordination with existing system protection

Generation-specific facility requirements that should be addressed include:

- Synchronizing with the transmission system
- Parallel operation with the transmission system
- Protection against islanding

R2.1.6. Metering and telecommunications.

Typical metering data requirements could include the following:

- kW
- kWh
- kVAR, leading and lagging
- kVAR-hour
- kV²-hour
- voltage

Design requirements that should be addressed include:

- Loss compensation
- Bi-directionality
- Metering accuracy
- Ancillary equipment specifications (e.g., CT's, PT's)
- Provisions for maintenance and calibration
- Data protocol
- Mode of data transmission (e.g., fiber optic cable, phone line)
- Provisions for maintaining continuity and meeting reliability criteria

Supervisory Control and Data Acquisition (SCADA)

Typical data requirements could include the following:

- Status of interrupting devices
- MW flow
- MVAR flow
- Voltage

Design requirements that should be addressed include:

- Communication protocol
- Mode of data transmission (e.g. fiber optic cable, phone line)
- Control functionality (breakers, switches, etc.)
- Provisions for maintaining continuity and meeting reliability criteria (e.g., dual DC sources, dual port RTUs)

R2.1.7. Grounding and safety issues.

Design requirements that should be addressed include:

- Grounding study
- Compatibility with Transmission Owner's system
- Construction techniques and inspection requirements (if any) of the Transmission Owner
- Testing
- Periodic maintenance
- Personnel safety considerations
- Interconnection of grounding system to Transmission Owner grounding system(s)

- Transmission line shielding provisions
- Cathodic protection

R2.1.8. Insulation and insulation coordination.

Design requirements that should be addressed include:

- Identification of general design parameters and practices of Transmission Owner (e.g., shielding, attachment details, surge protection, current-carrying elements, basic insulation levels, etc.)
- Provision for Transmission Owner review of facility design and specifications

R2.1.9. Voltage, Reactive Power, and power factor control.

Design requirements that should be addressed include:

- Internal plant electrical system design (e.g., transformers, tap settings, motors & other loads, generator/exciter, voltage regulator) should not restrict any mode of project operation within the transmission system's allowable voltage range and regulation.
- Transmission interconnected equipment should have the tap ranges and self- regulation necessary to operate within the transmission system's voltage range and regulation.
- Voltage regulator load compensation, if required, to control voltage at a point beyond the generator terminals
- Voltage regulator droop compensation, if required, for generators whose terminals are directly connected (i.e., cross-compound, hydro)

Operational requirements that should be addressed include:

- Load and/or generation operation within the acceptable voltage range and regulation as specified by the Transmission Owner
- Excitation system/voltage regulator allowable operating modes (e.g., automatic/manual)
- Generator voltage schedules
- Coordination of any reactive compensation devices

R2.1.10. Power quality impacts.

Design requirements that should be addressed include:

- Power quality studies to define acceptable operating ranges and limits. Studies may include, but not be limited to:
 - ◆ Voltage Unbalance
 - ◆ Voltage Flicker
 - ◆ Voltage Fluctuation
 - ◆ Harmonic Distortion
 - ◆ Transient Overvoltage
 - ◆ Temporary Overvoltage
 - ◆ Temporary Undervoltage
 - ◆ Insulation Coordination
 - ◆ Operating Frequency
 - ◆ Power Factor Range
 - ◆ Interruption/Outage Frequency

Studies may identify additional equipment necessary to meet power quality standards.

Operational requirements that should be addressed include:

- Connection of a generator, transmission facility, or end-user load to a Transmission Owner's system should not unacceptably compromise or degrade the power quality of existing customers.
- Installation of power quality monitoring equipment by the Transmission Owner to verify facility owner/operator compliance with power quality performance requirements

R2.1.11. Equipment Ratings.

Equipment ratings shall be established and communicated in accordance with the current approved version of NERC Reliability Standards FAC-008 and FAC-009 or their successor. Additional considerations may include:

- Identification of general design parameters and practices of Transmission Owner (e.g., shielding, attachment details, surge protection, current-carrying elements, basic insulation levels, etc.)
- Provision for Transmission Owner review of facility design and specifications as they impact the reliability and operation of the transmission system.
- Special requirements due to atmospheric, geological, seismic, or environmental conditions
- Responsibility for changes to existing transmission system made necessary by the project

R2.1.12. Synchronizing of facilities.

Design and Operational requirements that should be addressed include:

- The responsibility associated with synchronizing generation and transmission facilities to the power system.
- Required communications necessary between the Transmission Owner/Operator and the generation/transmission facility operator.
- Synchronizing equipment
- Test plans
- Applicable reclosing requirements and prohibitions for generation and transmission facilities

R2.1.13. Maintenance coordination.

Operational requirements that should be addressed include:

- The facility owner/operator responsibility for the regularly scheduled calibration and/or maintenance of its equipment, should include, but is not limited to:
 - ◆ Circuit breakers
 - ◆ Generators
 - ◆ Power transformers
 - ◆ Protective relays
 - ◆ Revenue metering
 - ◆ Communications
 - ◆ Trip circuits
 - ◆ Interrupters
 - ◆ Power DC sources
 - ◆ Grounding system
 - ◆ Transmission facilities

The maintenance practices of the generator and transmission facility Owner/Operator, and end-user on their transmission-connected equipment should be performed at a level that ensures the reliability and continuity of service of the interconnected transmission system. Relevant maintenance records should be maintained.

Other Operational requirements that should be addressed include:

- Definition of maintenance programs, responsibilities and performance objectives
- Authorization, notification and clearances for work
- Generation: such planning should take into account unit commitment obligations, replacement power, and / or contractual obligations that impact the performance of the bulk power system.
- End-Users: the maintenance practices of the end-user on their transmission-connected equipment should be performed at a level that ensures the reliability of the interconnected transmission system.
- Transmission Interconnections: requirements (if any) for advanced publication of maintenance schedules, including any need to observe limitations imposed by generation maintenance and dispatch schedules, maintenance of associated facilities, transmission transaction schedules, area protection or voltage requirements.

R2.1.14. Operational issues (abnormal frequency and voltages).

Design requirements that should be addressed include:

- Consideration for abnormal voltage conditions
- Consideration for abnormal frequency conditions
- Consideration for generators connected through a tapped transmission line (e.g., islanding)
- Relay coordination to maintain stability
- Load shedding implementation

Operational requirements that should be addressed include:

- Provisions for abnormal voltage conditions
- Provisions for abnormal frequency conditions
- Provisions for load shedding
- Special procedures for coordination

R2.1.15. Inspection requirements for existing or new facilities.

Operational requirements that should be addressed include:

- Initial (pre-operational) inspection by the Transmission Owner and/or copies of pre-operational test reports to be provided to the Transmission Owner. Include any requirements by the Transmission Owner prior to commercial operation and options of the Transmission Owner to specify additional testing.
- If applicable, required right of access to the facility by the Transmission Owner for purposes of conducting inspections, observing tests, and auditing records required by NERC standards and established reporting procedures.
- Requirements for facility Owner/Operator to modify operations to reasonably comply with Transmission Owner testing requirements.

R2.1.16. Communications and procedures during normal and emergency operating conditions.

Operational requirements that should be addressed include:

- Provision for a point of contact

Each generation and transmission facility operator and end-user facility should include a provision for establishing a contact person for communications with the appropriate operating entity. This contact person should have the authority and capability to operate the facilities according to the instructions of the appropriate operating entity.

- Provision for reliable communication
All Generator Operators and all Transmission Operators should have a provision for reliable communications with the appropriate operating entity. In addition, all Transmission Operators should have provisions for reliable communications with other Transmission Operators as appropriate.

- The generation and transmission facility operators and end-users should communicate with and should cooperate with the appropriate operating entity to support the recovery efforts during emergency conditions. This may include, but may not be limited to (as appropriate):
 - Switching operations
 - VAR support
 - Adjustments in real or reactive generation net output
 - Tripping of generating unit(s)
 - Starting of generating unit(s) including black start units
 - Implementation of emergency communication procedures
 - Transmission facility restoration efforts