Facility Interconnection Requirements

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1. LONE STAR TRANSMISSION (LST) FACILITY INTERCONNECTION REQUIREMENTS

This document is published in compliance with NERC Reliability Standard FAC-001-3 Facility Interconnection Requirements, which requires entities responsible for the reliability of the interconnected transmission systems to maintain and make available a Facility Connections Requirements document to ensure compliance with NERC Reliability Standards, applicable Regional Reliability Organization, subregional, and individual Transmission Owner planning criteria and facility connection requirements. These connection requirements will address the following:

1.1 Generation Facilities

Generation facility connection requirements described in this document are general overviews of functional requirements for connecting new generation to the LST transmission system or substantially modifying existing generating facilities connected to the LST transmission system.

1.2 Transmission Facilities

Transmission facility connection requirements described in this document are general overviews of functional requirements for connecting new transmission facilities to the LST transmission system. Detailed, project specific requirements will be developed in accordance with NERC Reliability Standards, applicable Regional Reliability Organization, subregional and individual Transmission Owner planning criteria and facility connection requirements.

1.3 End-User Facilities

End-user facility connection requirements described in this document are general overviews of functional requirements for connecting new and existing delivery points.

2. INTRODUCTION

Lone Star Transmission (LST) is a transmission service provider in ERCOT with tariffs filed at the Public Utility Commission of Texas (PUCT) for Transmission Service. Transmission Service Requirements for Generator and Transmission interconnections are addressed in the Public Utility Commission substantive rules §25.191, §25.195, and §25.198.

This document has been prepared in compliance with NERC FAC-001 and FAC-002 standards and ERCOT Nodal Operating Guides and Protocols (as may be amended from time to time) to identify the technical requirements for connecting new facilities to the LST transmission system. It applies to new connections or substantial modifications of existing transmission interconnections, new interconnections with generators as well as potential 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 LST when installing new LST facilities or modifying existing LST facilities.

All interconnecting facilities, new or existing, requesting interconnection or interconnection upgrades to the LST transmission system shall be planned, designed and operated in accordance with these Facility Interconnection Requirements, Good Utility Practice, the Texas Engineering Practice Act, the Texas Administrative Code, the Texas Health and Safety Code, other applicable laws and regulations, NERC and ERCOT regional reliability standards and planning criteria, LST planning criteria, and any applicable requirements of ANSI, IEEE, NESC, OSHA, and the PUCT, including but not limited to its Substantive Rules. Detailed project specific requirements will be developed and documented as part of coordinated Joint Studies, Interconnection Agreements and the above mentioned NERC and ERCOT Reliability Standards and planning criteria. Generators begin their interconnection request with ERCOT and their request is processed in accordance with the ERCOT Generation Interconnection or Change Request Procedure.

"Good Utility Practice" is defined by the PUCT as "any of the practices, methods, and acts engaged in or approved by a significant portion of the electric utility industry during the relevant time period, or any of the practices, methods, and acts that, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety, and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act, to the exclusion of all others, but rather is intended to include acceptable practices, methods, and acts generally accepted in the region."

2.1 Summary of Plans to Achieve Required Performance

LST performs its transmission planning assessment on an annual cycle to analyze and evaluate all interconnected facilities and where applicable coordinates with other transmission service providers, and ERCOT. Plans that include the interconnection of new generating facilities are coordinated with ERCOT and the applicable generating entities. The transmission planning horizon covers a period of five years and system assessments may extend up to ten years.

New projects necessary to meet electric system reliability obligations in compliance with national (North American Electric Reliability Corporation or NERC), regional (Electric Reliability Council of Texas and Public Utility Commission or ERCOT and PUC), and internal reliability criteria are published where applicable.

Regional load flow base cases are established for a range of generation and load configurations, with summer peak loading conditions being predominant. Simulations are run to determine compliance with the planning criteria throughout the planning horizon. Stability studies are also conducted based on data availability from ERCOT as well as on

an "as needed" basis for generator interconnections. Special stability studies are run to simulate multiple contingencies if extended outages occur, if new generating facilities are to be added to LST transmission system.

On an annual basis, the individual members of the ERCOT Steady State Working Group (SSWG) cooperatively prepare load flow simulations of the interconnected system. Once the base cases are complete, contingency analyses are collectively conducted by the members to demonstrate the reliability of the system.

2.1.1 Procedure for Coordinated Joint Studies

ERCOT published Transmission Planning Criteria and the LST established transmission system planning criteria are used to assess the system reliability impacts for any new facilities connecting to LST. The interconnecting Facility Owner and LST must coordinate on joint studies as appropriate.

As a Transmission Owner (TO) and ERCOT Transmission Service Provider (TSP) within the ERCOT region, LST is obligated to comply with ERCOT, Texas RE and PUCT Tariff, Rules and Procedures regarding coordinating and seeking peer review and ERCOT review and approval of its plans for the interconnection of new generation, transmission or end-user facilities, as applicable. Currently, ERCOT and PUCT Tariff require all applications for connections to LST's transmission facilities, including new generation and transmission interconnections to apply directly to ERCOT for such interconnections. ERCOT then directs and coordinates the conduct of any studies that may be required to accommodate such new interconnections. As such, LST's involvement with assessing the impacts of new interconnections is at the direction of ERCOT which ensures a regionally coordinated effort. ERCOT's practice includes that all such applications and supporting study assumptions and results also reviewed by the ERCOT's Regional Planning Group (RPG) and other ERCOT technical working groups. This peer review and ERCOT approval process is designed to ensure that no adverse impacts to the operability or reliability of the ERCOT transmission system will result from such planned changes to LST's transmission system. This process of coordinating review, assessment and ERCOT approval of the impacts any proposed new interconnections to LST's transmission system may have on the transmission systems within ERCOT ensure LST's compliance with NERC Reliability Standard FAC-002.

Generator Interconnection Process:

The connection of new generating facilities to the LST transmission system or the substantial modification of existing generating facilities shall follow the procedures specified in the ERCOT Generation Interconnection or Change Request Procedure.

Transmission and End-User Request Process:

All requests for transmission service shall be made in accordance with the terms

and conditions of the typical LST Interconnection Agreement template.

The connection of non-LST facilities to the LST transmission system should follow the Facilities Connection Process outlined in the ERCOT protocols, guidelines and PUCT Open Access Transmission Tariff. Either LST or both entities jointly will begin a System Impact Study to determine the effect of the proposed connection on the LST transmission system. If necessary, a Facilities Study will be initiated to determine the cost of the connection and all LST equipment improvements needed to accommodate the new connection.

2.1.2 Procedure for Notification of New or Modified Facilities to Others

Any changes that affect an interconnection must be reviewed in advance as specified in the LST Interconnection Agreement. 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 current levels due to system changes must be provided in a timely manner. Some modifications may require engineering studies and a formal review by LST and/or ERCOT.

LST will, in accordance with ERCOT Nodal Protocols Section 3.10, notify ERCOT of any new or modified transmission facilities.

The aforementioned ERCOT and PUCT Tariff process for cooperation and coordination with ERCOT (the Balancing Authority) on integration of new or materially modified facilities, discussed herein in Section 2.1, serves as the vehicle for confirming that said Facilities are included within the ERCOT Balancing Authority area's metered boundaries.

2.1.3 Voltage Level and MW and MVAR Capacity or Demand at Point of Interconnection (POI)

The POI is to be clearly described. Usually, the change of facility ownership and the POI are the same point.

The transmission system shall be planned consistent with LST Transmission System Planning Criteria. In general, for new interconnection substations voltages shall not exceed 105 percent nor fall below 95 percent of nominal during normal conditions (Category P0) and shall not exceed 105 percent nor fall below 90 percent of nominal for NERC P1-P7 planning events. No single anticipated event shall result in more than a 7 percent voltage deviation for three or more substations (Reference LST Transmission System Planning Criteria).

Generally, LST limits its transmission facilities to 100% of the applicable thermal rating of facilities. LST also provides 15 minute and 2 hour emergency limits in compliance with ERCOT requirements. The voltage level, MW and MVAR capacity or demand at POI shall be compatible to, and coordinated with LST, and shall be in

conformance with ERCOT Nodal Operating Guides and Protocols voltage and reactive requirements. The metering and communication of such metered quantities shall be in accordance with ERCOT Nodal Operating Guides and Protocols Metering and Telemetering requirements.

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

Facilities interconnecting to the LST transmission system must have an isolating device installed at the POI. This isolating device, typically a disconnect switch, must be capable of physically and visibly isolating the facilities from the LST transmission system. This isolating device must be lockable in the open position by LST or its designated operating representative.

2.1.4 Breaker Duty and Surge Protection

Valid studies shall determine the site specific short-circuit current available for the POI and shall be communicated to the appropriate interconnecting entities. Circuit breakers and interrupting devices at the POI shall have ratings that meet or exceed at least 120 percent of the maximum available close-in fault current at the point of application.

LST's standard is to shield substations and transmission lines from direct lightning strokes and to provide line entrance arresters at transmission line terminals. Surge arresters are also applied at major components and systems.

AC high voltage circuit breakers 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.

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 shall be accordance with IEEE 80 Guide. If equipment ratings will be exceeded, the appropriate modifications must be performed prior to the new generation coming on line.

2.1.5 System Protection and Coordination

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 transmission system, substations, 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.

The interconnecting facility owner shall design its system protection facilities to isolate any fault occurring on its system that would negatively affect LST's system at such POI in accordance with applicable ERCOT requirements and NERC Reliability Standards. The protection schemes used by the Parties at the POI shall be determined by both Parties in a cooperative effort to achieve system coordination. Complete calibration test and functional trip tests shall be performed at each respective system protection equipment, including communication circuits between facilities, prior to commissioning of the POI to insure performance and system safety.

LST designs and operates its transmission system to meet all applicable ERCOT Nodal Operating guides and Protocols, Planning Guides and NERC Planning Standards. [1]

System and generator stability is to be maintained for normal clearing of all three phase faults.

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.

LST 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.

A. <u>System Protection and Coordination Requirements for Generation Facilities:</u>

Generators connecting to the LST transmission system are responsible for protecting those facilities from electrical faults and other hazardous conditions. Generator interconnections must be equipped with circuit breakers or other appropriate interrupting devices to protect those facilities.

[1] LST Planning Criteria

The generator owner must provide and own the primary circuit breaker or other interrupting device that protects the facility and disconnects it from the LST 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.

Generators connected to the LST transmission system should be able to withstand certain temporary excursions in voltage, frequency, reactive and real power output without tripping in accordance with the ERCOT Nodal Operating Standards and Planning Guides, Rules, Protocols and Procedures. This is required to support the grid and avoid cascading events.

Generators must be designed to remain on line for normal clearing system faults within the close proximity to the plant switchyard. Control systems, contactors, motors and auxiliary loads that are critical to the operation of the plant must have ride through capability where needed to avoid generator tripping for close-in faults as described above. 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.

It is recognized that certain circumstances may exist that necessitate the imposition of performance criteria that is considered more stringent than the default criteria specified above. Such circumstances shall be identified during the conduct of the System Impact Study or Operational Studies for each particular generator.

B. System Protection and Coordination Requirements for Generation Facilities:

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 and shall be consistent with protective relaying criteria described in ERCOT Requirements and NERC standards. 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. As reasonably requested by LST, the interconnecting entity, at its expense, will provide corrections or additions to existing control and protective equipment required to protect the ERCOT system or to comply with government, industry regulations, or standard changes.

All bulk electric 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 may be required on transmission elements or 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. The battery 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.

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. Power line carrier or microwave is also used.

Automatic reclosing on interconnected transmission lines between utilities is handled based on mutually agreed upon policies and standards. High speed automatic reclosing must be avoided at generation substations.

Entities connecting to the LST transmission system shall investigate and keep a log of all protective relay actions and misoperations as required by Texas RE, NERC Standards, and ERCOT Nodal Operating Guides and Protocols.

Entities connecting to the LST transmission system must have a maintenance program for their protection systems in accordance with NERC Standards and ERCOT requirements. Documentation of the protection maintenance program shall be supplied to LST, Texas RE, ERCOT and NERC upon request. Test reports as outlined in the maintenance program are to be made available for review by LST. 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 as outlined in the NERC standards and ERCOT requirements.

C. System Protection and Coordination Requirements for Transmission Facilities:

End-Users connecting to the LST transmission system are responsible for protecting end-user facilities from electrical faults and other hazardous conditions.

End-User facilities must be equipped with circuit breakers or other appropriate interrupting devices to protect those facilities. End-User facilities must provide, own and maintain the primary circuit breakers or other interrupting devices that protects and disconnects the facilities from the LST transmission system.

2.1.6 Metering and Telecommunications

All metering, telemetering and SCADA design, installations and maintenance shall be performed in accordance with ERCOT Nodal Operating Guides and Protocol requirements: ERCOT Settlement Metering Operating Guide, ERCOT Nodal Operating Guide-Section 7, ERCOT Protocols-Section 10.

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.

Each Party will promptly advise the other Party if it detects or otherwise learns of any metering, telemetry or communications equipment errors or malfunctions that require the attention and/or correction by the other Party. The Party owning such equipment shall correct such error or malfunction as soon as reasonably feasible in accordance with ERCOT Requirements.

Any changes to the meters, telemetry equipment, voltage transformers, current transformers, and associated panels, hardware, conduit and cable, which will affect the data being received by the other Party must be mutually agreed to by the Parties.

A. Metering and Telemetry Requirements for Generation Facilities:

All generating plants connected to the LST transmission system must meet the applicable requirements as prescribed by ERCOT protocols and metering guidelines.

B. Metering and Telemetry Requirements for Transmission Facilities:

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. Metering shall be designed and installed in accordance with Good Utility Practices, applicable ERCOT operating and metering guidelines, and the ERCOT Nodal Protocols.

C. Metering and Telemetry Requirements for End-User Facilities:

All end-user facilities connected to the LST transmission system are required to have meters at the POI. Metering shall be designed, installed and maintained in accordance with Good Utility Practices, applicable ERCOT operating and metering guidelines, and the ERCOT Nodal Protocols.

2.1.7 Grounding and Safety Issues

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. LST must approve any connection to an LST substation ground grid.

A. Grounding Requirements for Transmission Facilities (Source Systems):

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.

Interconnections between LST'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 LST Transmission System, LST 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 which might impair or interrupt service to the customers of the other Party.

The LST System Operations group and ERCOT shall be notified prior to any maintenance work on a transmission interconnection as required by NERC Reliability Standards and ERCOT Nodal Operating Guides and Protocols. LST

switching and safety procedures shall be strictly adhered to when maintenance is being performed on an interconnection.

B. Grounding Requirements for Generation Facilities (Source Systems):

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's 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.

Safety is of utmost importance. Strict adherence to established switching, 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, standards and regulations and in compliance with Occupational Safety and Health Administration (OSHA), National Electric Safety Code (NESC) 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 transmission system operator or designated person as outlined in the ERCOT Nodal Operating Guides and Protocols and in the National Electric Safety Code.

Operators of generating facilities must notify LST and ERCOT, and obtain approval before synchronizing the facility to or disconnecting the facility from the LST 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 deenergized LST transmission circuit unless such actions are directed by LST (or its designee), or ERCOT or are provided for in an interconnection agreement between LST and the interconnection customer.

Each generating facility shall provide a point of contact to LST. This contact person shall have the authority and capability to operate the facility according to the instructions of LST 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 LST's transmission systems must follow all applicable NERC Reliability Standards and ERCOT Nodal Operating and Planning Guides, Rules, Protocols and Procedures.

C. Grounding Requirements for Transmission Facilities (End-User):

End-Users shall, in accordance with all IEEE Standards including but not limited to IEEE Standard 80, ground their transmission voltage equipment at the POI.

2.1.8 Insulation and 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.

The arrester rating must be selected such that the maximum continuous power system voltage applied to the arrester is less or equal to the arrester's continuous voltage capability. An arrester of the minimum practical rating is preferred for its greatest margin of protection of the equipment. The surge arrester must be coordinated with the Basic Insulation Level (BIL) of the protected equipment to be effective.

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.

2.1.9 Voltage, Reactive Power, and Power Factor Control

Entities interconnecting their transmission system with LST's transmission system shall comply with applicable ERCOT protocols, guides, procedures and NERC standards regarding reactive power control.

For generators the facilities shall be designed, operated and controlled to provide reactive power requirements consistent with policies and standards of ERCOT and the Qualified Scheduling Entity (QSE) Requirements. Induction generators shall have static capacitors that provide magnetizing current requirements of the induction generator field consistent with policies and standards of ERCOT and QSE.

2.1.10 Power Quality Impacts

Power quality requirements are applicable to all generation facilities, transmission facilities and end-user facilities connected to the LST system. Generation of harmonics should be limited to values prescribed by IEEE Standard 519 when measured at the interconnection point of ownership. Additionally, the LST 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.

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.

To protect LST equipment, the contribution from the new facilities at the connection point shall not cause a voltage unbalance greater than 1% or a current unbalance greater than 5% may result in curtailment or additional mitigation. Phase unbalance is the percent deviation of one phase from the average of all three phases.

System problems such as an open conductor on a transmission system can result in extended periods of phase unbalance. It is the interconnecting entity's responsibility to protect any of their connected equipment from damage that could result from such an unbalanced condition.

2.1.11 Equipment Ratings

All substation and transmission facility equipment ratings shall be in accordance with LST Transmission System Planning Criteria.

Equipment rating requirements are applicable to all generation facilities, transmission facilities and end-user facilities connected to the LST system. 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. Application of circuit breakers shall be in accordance with ANSI/IEEE C37 standards. For facility and equipment ratings, reference the LST-adopted NextEra Energy Bulk Electric Facility Rating Methodology document. Interconnection facility ratings shall be compatible with those of connected LST facilities.

2.1.12 Synchronizing of Facilities

It is the responsibility of the facility owner 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 facility owner is responsible to know and to follow all applicable standards, regulations, industry guidelines, safety requirements, and accepted Good Utility Practice for the design, operation and maintenance of the facility.

A. <u>Generation Facilities:</u>

a) All generators connected to the LST transmission system are to be equipped with automatic voltage regulators (AVR)[2]. Generators must operate with their excitation system in the automatic voltage control mode unless otherwise approved by LST and / or ERCOT. Generating equipment ownersshall 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 LST system. Generating equipment owners shall make this log available to LST on request.

[2] Items H1, H2, H3, and H4 are requirements of NERC Planning Standards, section III. C.

b) All generators connected to the LST transmission system must maintain a network voltage or reactive power output as specified by ERCOT. 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 LST system. Generating equipment owners shall make this log available to LST on request.

c) The generator step-up and auxiliary transformer tap settings shall be coordinated with ERCOT and this information shall be provided to ERCOT via the Resource Asset Registration Form (RARF) documentation process.

d) 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 LST with the AVR's control and limiter settings as well as the protection settings which coordinate with AVR control and limiting functions.

e) The installation of new generating plants has the potential to aggravate existing modes of oscillation or create new modes. All new synchronous generators connected to the LST transmission system shall be equipped with a Power System Stabilizer (PSS) in accordance with the ERCOT Nodal Operating Guides and Protocols. 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 PSS in service. The determination of the PSS's control settings will be coordinated with LST, associated Qualified Scheduling Entity (QSE) and ERCOT. Typically, this coordination would be to provide LST with preliminary PSS 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 QSE, ERCOT and LST any problems interfering with its proper operation.

All new synchronous generators connected to the LST transmission system shall be equipped with a speed/load governing control that has a speed droop

characteristic in accordance with the ERCOT Nodal Operating Guides and Protocols. The preferred droop characteristic setting is 5% as this is the typical setting for generators. Notification of changes in the status of the speed/load governing controls must be provided to the QSE, ERCOT and LST.

2.1.13 Maintenance and Switching Coordination

The maintenance of facilities is the responsibility of the facility owner of those transmission, generation, or end-user facilities. Adjoining facilities on the interconnected power system are to be maintained in accordance with Good Utility Practice, accepted industry practices and procedures and with all applicable NERC and ERCOT standards, protocols, guides, policies, rules, and procedures. Each Party is to have a documented maintenance program ensuring the proper operation of equipment. LST will have the right to review maintenance reports and calibration records of equipment that could impact the LST system if not properly maintained. LST and ERCOT are to be notified as soon as practicable about any out-of-service equipment that might affect the protection, monitoring, or operation of interconnected facilities.

Maintenance of facilities interconnected to the LST transmission system shall be done in a manner that does not place the reliability and capability of the LST transmission system, or other portions of the ERCOT transmission system at risk. Planned maintenance must be coordinated and scheduled with LST System Operations and must be in accordance with ERCOT Nodal Protocols – Section 3.

Prior to interconnecting to the LST transmission system, each Party will adopt formal switching procedures that govern safety related issues concerning the operation of its switches connected to the POI and will provide a copy of those procedures to the other Party. Each Party will agree to and comply with the aforementioned switching procedures of the other Party and will notify the other Party in writing at least ten days prior to implementation of any changes to its procedures.

2.1.14 Operational Issues (Abnormal Frequency and Voltages)

Operational procedures are to be established in accordance with all applicable NESC, OSHA, ERCOT, and NERC standards and requirements. Each Party shall designate operating representatives to address: lines of 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 and one-line transmission 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 LST transmission system shall not perform any switching that energizes or de-energizes portions of the LST transmission system or that may adversely affect the LST transmission system

without prior notice to LST System Operations or its designated operating representative, and without prior authorization from ERCOT. Operators of facilities interconnecting to the LST transmission system will notify LST System Operations, or its designated operating representative before performing any

switching that would significantly affect voltages, power flows or reliability in the LST transmission system.

The owner and/or operator of facilities interconnecting to the LST transmission system are responsible for installing and maintaining necessary protection to protect its facilities from abnormal voltages or frequencies.

2.1.15 Inspection Requirements for Existing or New Facilities

There are situations where some equipment that is owned by LST is located within the interconnecting facility owner's property. This is often required for data acquisition or metering. In these cases, installed equipment owned by LST 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 LST employees or its other representatives where LST equipment is located within the interconnecting facility owner's property. Inspection requirements for existing or new facilities are applicable to all generation facilities, transmission facilities and end-user facilities connected to the LST system. Interconnecting facilities shall be made available for on-site inspection for the purpose of demonstrating conformance to the requirements set forth in this document. Request for inspection will be provided in writing at least 14 days in advance.

2.1.16 Communication and Procedures during Normal and Emergency Operating Conditions

Communication requirements during normal and emergency operating conditions are applicable to all generation facilities, transmission facilities and end-user facilities connected to the LST system.

All operating entities within the ERCOT region are responsible for maintaining voltage and frequencies within agreed upon limits. All operators of facilities interconnected to the transmission systems in the ERCOT Region are required to communicate and coordinate with ERCOT and neighboring operators to coordinate normal and emergency operating actions. 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 ERCOT in coordination with LST System Operations as required. Within the ERCOT Region, ERCOT has overall responsibility for the secure operation of the interconnected transmission systems. All facility owners are expected to follow all applicable NERC, ERCOT and Texas RE standards, protocols, guides, policies, rules, and procedures.

3. ADDITIONAL FACILITY INTERCONNECTION REQUIREMENTS

3.1 GENERATION

This section addresses the technical requirements for connecting new generation to the

LST transmission system or substantially modifying existing generating facilities connected to the LST 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, System Impact Study or a Facilities Study, or are referenced in other documents such as the NERC Planning Standards, the NERC Operating Standards, and the ERCOT Generation Interconnection or Change Request Procedure.

3.1.1 Applicability

This section applies to all interconnections with the LST system made at 69, 138, or 345 kV where generation is installed behind the interconnection point and is capable of operating in continuous parallel with the LST transmission system.

3.1.2 Configuration

New generating plants that are to be connected to the LST transmission system are to be designed so as to minimize the impacts of the maintenance or unplanned outages on existing facilities by said new generator and any new lines, transformers, circuit breakers, buses or other equipment related to the interconnection of such new generation. The potential adverse effects of maintenance and equipment outages must be considered in the design of the generating plant and its connection to the LST transmission system.

3.1.3 Generator Testing

a) Prior to commercial operation, the generating equipment owner shall provide LST 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[3].

b) 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 the QSE and ERCOT in accordance with all applicable rules and procedures.

c) Generating equipment owners shall test the gross and net reactive capability of their units on intervals as required by ERCOT and QSE rules and procedures. These test results shall be provided to QSE and ERCOT.

Generating equipment owners shall test the AVR control and limit functions of their units on intervals as required by QSE and ERCOT rules and procedures. An initial test result shall be provided to LST prior to commercial operation and every test year thereafter. The initial test results shall include documentation of the settings of AVR control and limit functions. Typical AVR limit functions are maximum and minimum excitation limiters and volts per hertz limiters.

[3] Sections H1, H2, H3, and H4 are required by NERC Planning Standards, section II. B.

Documentation of the generator protection that coordinates with these limit functions shall also be provided. Typical generator protection of this type includes overexcitation protection, loss of field protection.

3.1.4 Generator Data

The generator data, filed by the generator owner to ERCOT must be supplied for all new generators connected to the LST transmission system through the Resource Asset Registration Form (RARF) process and communicate to LST when changes occur to the data in the RARF.

3.2 TRANSMISSION

This section addresses the technical requirements for connecting new transmission lines to the LST transmission system as well as for new and existing delivery points. A utility/customer may elect to connect to LST through a "delivery point" connection or an "interconnection point" connection.

A "delivery point" is an interconnection point between LST'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" is a point of connection between two entities' respective transmission systems. Interconnection points may be operated in parallel with other 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.

3.2.1 Applicability

This section applies to all interconnections with the LST transmission system made at 69, 138 or 345 kV and includes utility-to-utility (entity) type interconnections used for power interchanges. 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. All requests for transmission service shall be made in accordance with the terms and conditions of the ERCOT protocols, guidelines and PUCT.

3.2.2 Configuration

The interconnection point between utilities is typically through a transmission line or lines. The change of ownership is usually at a transmission line or substation structure. The neighboring utility must have an effectively grounded transmission system.

Three source terminal interconnection configurations of transmission lines are to be avoided within the LST 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 or any other non- standard line configuration.

Some new connections to the LST transmission system may require one or more LST 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 LST contractual or tariff transmission service obligations.

Any new interconnection configuration should be designed in such a way so as to minimize the likelihood that LST would be prohibited from taking an LST transmission facility out of service for just cause. LST shall not be forced to open a transmission facility for an adjacent interconnected generator or transmission line to obtain an outage, other than during approved scheduled outage periods as such are coordinated with LST and ERCOT, and approved by ERCOT or in the case of an emergency. Manual switching or clearing electrical faults within the non-LST facility shall not curtail the ability of LST to transmit power or provide transmission service to ERCOT customers.

Reliable station and breaker arrangements will be used when there are new or substantial modifications to existing LST substation(s). In general, transmission substations must be 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.

All substation and transmission facility equipment ratings shall be in accordance with LST Transmission System Planning Criteria.

3.2.3 Structures

Transmission and substation structures for facilities connected to the LST 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.

In addition, for both transmission and substation, structural load criteria shall meet all requirements as specified by "Minimum Design Loads for Buildings and Other Structures", ANSI 7-02, published by American Society of Civil Engineers (ASCE). Proper structural category shall be determined based on ANSI 7-02, Table 1-1.

Structural strength criteria shall comply with applicable industrial standards such as "Design of Latticed Steel Transmission Structures" (ANSI 10, published by ASCE), "Manual of Steel Construction" (published by American Institute of Steel Construction Inc.), or Building Code Requirements for Structural Concrete (ACI-318, published by American Concrete Institute).

3.3 END-USER FACILITIES

This section addresses the technical requirements and information required to be provided to connect end-user facilities to the LST transmission system.

3.3.1 Customer Data

The Customer must provide the following information to LST:

- Requested In-Service Date
- Location of proposed POI
- Voltage at which interconnection is requested
- Load projections
- Peak load power factor
- Proposed transformer ratings
- Description of tie-line including characteristics such as impedance, length
- Relay functionality for Customer's proposal
- Special service requirements

3.3.2 Applicability

This section applies to all interconnections with the LST transmission system made at 69, 138 or 345 kV. 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. All requests for transmission service shall be made in accordance with the terms and conditions of the ERCOT protocols, guidelines and PUCT.

3.3.3 Configuration

Some new connections to the LST transmission system may require one or more LST 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 LST contractual or tariff transmission service obligations.

Any new interconnection configuration should be designed in such a way so as to minimize the likelihood that LST would be prohibited from taking an LST transmission facility out of service for just cause. LST shall not be forced to open a transmission facility, other than during approved scheduled outage periods as such are coordinated with LST and ERCOT, and approved by ERCOT or in the case of an emergency. Manual switching or clearing electrical faults within the non-LST facility shall not curtail the ability of LST to transmit power or provide transmission service to ERCOT customers.

Reliable station and breaker arrangements will be used when there are new or substantial modifications to existing LST substation(s). In general, transmission substations must be 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.

All substation and transmission facility equipment ratings shall be in accordance with LST Transmission System Planning Criteria.

3.3.4 Structures

Transmission and substation structures for facilities connected to the LST 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.

In addition, for both transmission and substation, structural load criteria shall meet all requirements as specified by “Minimum Design Loads for Buildings and Other Structures”, ANSI 7-02, published by American Society of Civil Engineers (ASCE). Proper structural category shall be determined based on ANSI 7-02, Table 1-1.

Structural strength criteria shall comply with applicable industrial standards such as “Design of Latticed Steel Transmission Structures” (ANSI 10, published by ASCE), “Manual of Steel Construction” (published by American Institute of Steel Construction Inc.), or Building Code Requirements for Structural Concrete (ACI-318, published by American Concrete Institute).

4. COMMON REQUIREMENTS

This section addresses the technical requirements that are common to the connection of generation, transmission and end-user delivery point facilities to the LST transmission system. General overviews of functional requirements are given in this section. This

document is not intended to be a comprehensive design specification. This document references, and therefore is supported by other current, applicable industry standards. Specific design and construction of the electrical facilities are to be in accordance with Good Utility Practice and these standards which include, but are not limited to the following:

NFPA 70 – NEC - National Electrical Code
NESC – National Electrical Safety Code
NEMA SG-6 – Power Switching Equipment
ASTM – American Society of Testing Material
AISC – American Institute of Steel Construction
ACI – American Concrete Institute
IEEE – Institute of Electrical and Electronic Engineers, Inc.
UL – Underwriters Laboratories, Inc.
EPA – Environmental Protective Agency
ASME – American Society of Mechanical Engineers
ASCE – American Society of Civil Engineers
NFPA – National Fire Protective Association
NRMCA – National Ready Mixed Concrete Association
CRSI – Concrete SI – Concrete Reinforcing Steel Institute
ANSI – American National Standards Institute
ICEA – Insulated Cable Engineers Association
OSHA - Occupational Safety & Health Administration
ERCOT –Electric Reliability Council of Texas NERC- North American Electric Reliability Corporation

The facility designs shall comply with all applicable federal, state and local laws and regulations. Final design of facility connections to the LST transmission system will be subject to LST review and approval on a case-by-case basis.

4.1 Ferroresonance

Ferroresonance occurs on the power system under certain system configurations that may damage high voltage equipment. This phenomenon is usually caused when power transformers (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. Where such configurations cannot be avoided, detailed studies must be performed prior to installation to ensure ferroresonance will not occur.

4.2 Balancing Authority

All loads, generation, and transmission facilities must be part of the ERCOT Balancing Authority area**.**