

 **2015 TRANSMISSION PLANNING STABILITY ASSESSMENT**

**STUDY SCOPE**

**Version 1.0**

Document Revisions

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**2015 Transmission Planning Stability Assessment**

# Objective

The purpose of this assessment is to ensure that the ERCOT system is planned to satisfy stability-related reliability criteria per “*ERCOT Planning Guide, Section 4: Transmission Planning Criteria”* and NERC standard TPL-001-4. System response with respect to angular, voltage, and oscillatory stability will be assessed for both the near-term and long-term transmission planning horizons. The assessment will include corrective action plans to address analysis results that indicate an inability to meet specified performance requirements. Such corrective action plans will serve as a starting point for developing and implementing remedies and/or alternative operational practices. Additionally, the study report will serve as documentation for compliance with NERC standard TPL-001-4. The assessment will be completed by December 31, 2015.

# Data Inputs

Dynamic simulations required for this assessment will use Dynamics Working Group (DWG) flat start cases (based on the Steady State Working Group 2015 dataset B power flow cases) scheduled to be completed in 2015 as follows:

* Long-term planning horizon – system peak load: DWG 2021 summer peak case
* Near-term planning horizon – system peak load: DWG 2017 summer peak case
* Near-term planning horizon – system off-peak load: DWG 2018 high wind low load case

Steady-state voltage stability analysis will be performed on the cases identified above or other power flow cases as deemed appropriate. Additionally, previous annual assessments and other ERCOT studies (completed within the last five years) may be reviewed to determine if results are still valid and applicable for this 2015 assessment.

# Voltage and Transient Stability Studies

## Voltage Stability

Increasing intra-regional power transfers in the system from remote generation to load centers can cause voltage depression in the receiving region. Extremely high levels of power transfer or extreme contingencies could lead to a voltage collapse in the load center resulting in a blackout due to insufficient reactive power support. Steady state voltage stability analysis (also called PV analysis) will identify the most severe contingencies for each power transfer scenario and transfer limits that may be employed as SOLs/IROLs based on “*System Operating Limit Methodology for Planning and Operations Horizon”*.

## Transient Stability

For the region under study, all network elements that significantly affect dynamic response will be represented with dynamic models (provided by the equipment owner) that accurately reflect the behavior of the element during the pre-disturbance, on-disturbance and post-disturbance time periods.

Undervoltage load shedding (UVLS) dynamic models are included for regional studies as necessary and will be represented with appropriate parameters as determined by the corresponding TSP.

In the ERCOT network, frequency excursions below 59.7 Hz for more than 20 cycles may activate Load Resource (LR) that providing ERCOT Responsive Reserve Service (RRS) support disconnecting or reducing their load consumption. Frequency excursions below 59.3 Hz for more than 20 cycles may activate ERCOT underfrequency load shedding (UFLS) schemes.

# Study Process

## Contingency Definition and Application

Contingency sets will include contingency definitions for the NERC planning events P1 through P7 and extreme events as defined in NERC Standard TPL-001-4.

For the steady-state voltage stability assessment, the full database of contingencies defined, and annually reviewed, by the SSWG will be tested. In addition, all single contingencies (generator, transformer, shunt device, power-flow-case-defined branch and power-flow-case-defined bus) will be tested. It is expected that these contingency sets will satisfy contingency analysis requirements for NERC planning events P1, P2 (with respect to straight bus configurations), and P7.

The most severe/limiting contingencies from the above contingency sets will be combined to produce additional contingency definitions for testing. It is expected that this contingency set will produce the most severe set of multiple element contingencies and satisfy contingency analysis requirements for NERC planning events P2 (with respect to ring or breaker-and-a-half bus configurations), P3, P4, P5, P6, and extreme events.

The most severe/limiting contingencies determined from the steady-state voltage stability assessment will be simulated with time domain analysis to ensure that the most severe contingencies are included in the transient stability assessment. Additional contingencies may be selected based on engineering judgment and/or compliance need.

Fault clearing times will be simulated per TSP recommendations for the location and event (including normal clearing, delayed clearing due to breaker failure, and delayed clearing due to relay failure). The impact of high-speed reclosing will be evaluated per TPL-001-4 R4 4.3.1.1. Assistance will be solicited from the TSPs for determining locations where high-speed reclosing is applied and properly simulating reclosing schemes.

The simulation duration should allow for the proper evaluation of system performance with respect to angular, voltage, and oscillatory stability. Typically, continuing the simulation without any other disturbance for approximately 10 seconds after fault clearing is sufficient.

If the system response to a contingency is deemed to be unacceptable then a corrective action plan will be developed.

## Monitored Elements

For steady-state voltage stability analysis, all 345 kV and 138 kV transmission buses will be monitored for voltage violations. It may be necessary to define transmission interfaces and monitor interface flows to establish power transfer limits.

For transient stability analysis, selected transmission lines, buses and generators within the study region will be monitored for frequency, voltage, power flow and angular separation.

## Load Models

Load model provided by TSPs will be applied to the study case based on the load levels and conditions specific to the region of interest. Sensitivity analysis will be performed with varying motor load levels to obtain an understanding of the impact of load modeling on system response.

## Performance Criteria

The performance criteria are as defined in the NERC Standard TPL-001-4 and ERCOT Planning Guide Section 4.

## Software and Parameters

For the steady-state voltage stability assessment, Siemens PTI’s PSS®E and/or Powertech™ VSAT program will be used. The following solution settings will be employed:

* Area control set to off – ERCOT operates as a single control area, single swing bus.
* Transformer taps (when ULTCs are present) are allowed to move in post-contingency.
* Discrete switchable shunts are allowed to switch.
* Dynamic reactive devices (SVCs, STATCOMs etc.) are held fixed at their pre-contingency states during screening but allowed to participate during re-run of a voltage collapse event.
* Generation limits enforced – export transfers are limited by generation capability.

For the transient assessment Siemens PTI’s PSS®E and/or Powertech™ TSAT will be used as determined by the Dynamic Studies Group.

## Sensitivity Analysis

Additional sensitivity analysis for study cases will be performed for the Near Term Transmission Planning Horizon to vary one or more of the following conditions by a sufficient amount to stress the System within a range of credible conditions that demonstrate a measurable change in performance.

* Load level, Load forecast, or dynamic Load model assumptions.
* Expected transfers.
* Expected in service dates of new or modified Transmission Facilities.
* Reactive resource capability.
* Generation additions, retirements, or other dispatch scenarios.

## Scenarios

Table1 includes the planned study scenarios and estimated study schedules for all three study cases described in section 2 and sensitivity analysis described in section 4.6.

|  |  |
| --- | --- |
| **Region** | **Analysis** |
| Houston | PV - ImportTransient Stability |
| West Texas (including Panhandle region) | PV - ImportPV - ExportTransient Stability |
| DFW  | PV - ImportTransient Stability |
| South Texas (Valley, Laredo, Corpus Christi)  | PV - ImportTransient Stability |
| Central Texas (Austin, San Antonio) | PV - ImportTransient Stability |
| Entire System for Large Plants with Synchronous Generation | Transient Stability |

Table 1: Planned Stability Assessment Study Scenarios

The stability assessment will include analysis of regions within the ERCOT system as noted in Table 1. PV analysis will test the capability to import and/or export power from a specific geographical region. Transient stability analysis will test transient response to disturbances within the study region and may require that more detailed models (e.g. dynamic motor load models) be added to the base case. Large synchronous generators have the greatest potential to impact system operations should an instability event occur. Therefore, large plants (with capacity greater than 1000 MW) will be assessed for transient stability.

The stability assessment will also include sensitivity analysis in accordance with NERC Standard TPL-001-4 R2 2.4.3. Additionally, the impact of protective relay operation pursuant to NERC Standard TPL-001-4 R4 4.1.2 and 4.3.1.3 will be incorporated into the assessment analyses through either modeling relays directly within simulations or comparing simulation results with relay settings. Assistance will be solicited from the TSPs for determining appropriate relay models and/or assumptions.

# Deliverables

An assessment report documenting:

* Scenarios and assumptions
* Contingency definitions
* Study process and case development
* Analysis, results and corrective action plans, if necessary
* Identified SOLs and/or IROLs as defined by the “*System Operating Limit Methodology for Planning and Operations Horizon”*.

The report will document compliance with:

* ERCOT Protocols
* ERCOT Planning Guides
* NERC Standard TPL-001-4