



Practices and Challenges To Manage Transmission Constraints

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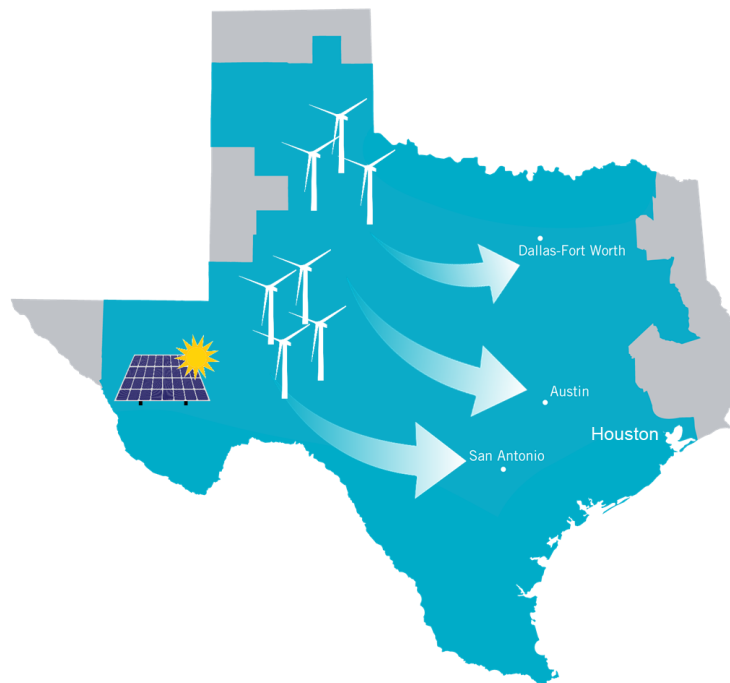
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Inverter-Based Resources in ERCOT

- > 45 GW IBRs are expected to be connected to the ERCOT transmission grid by the end of 2021.
- Most wind and solar generation are in West Texas:
 - Long distance transfer to load centers
 - Limited/no online synchronous generators in West Texas during high IBR output periods
- Similar issues are also manifesting themselves in South Texas.

2021	2023
• >34GW Wind • >10 GW Solar • >1.4 GW Battery	• >39 GW Wind • >30 GW Solar • >4.5 GW Battery

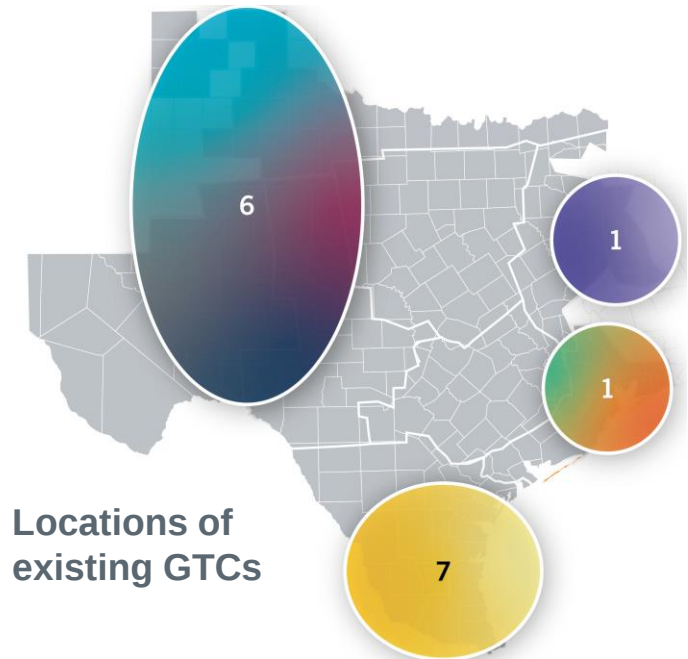
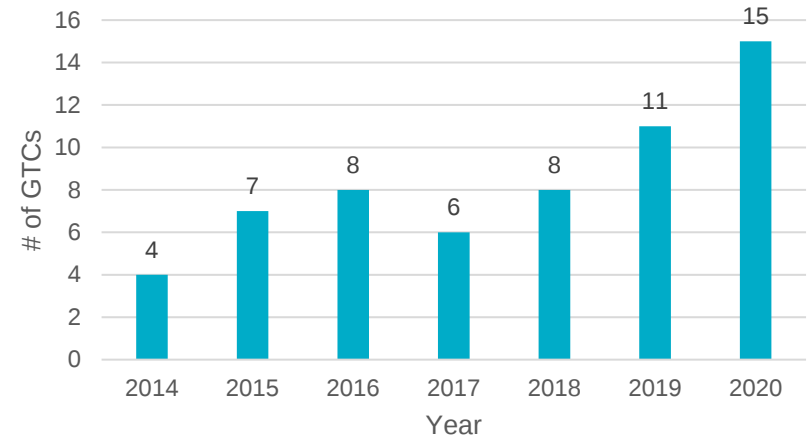
*As of Sept. 2021



Increasing stability constraints

- A Generic Transmission Constraint (GTC) is a tool that ERCOT uses to manage stability limitations in real-time operations.
- ERCOT has seen an increase in stability constraints in recent years, particularly in West Texas and South Texas, which has led to an overall increase in the number of GTCs.
- These stability constraints can limit power transfers below the physical thermal ratings of the individual transmission lines.
- ERCOT needs better real time tools to identify and manage stability constraints.

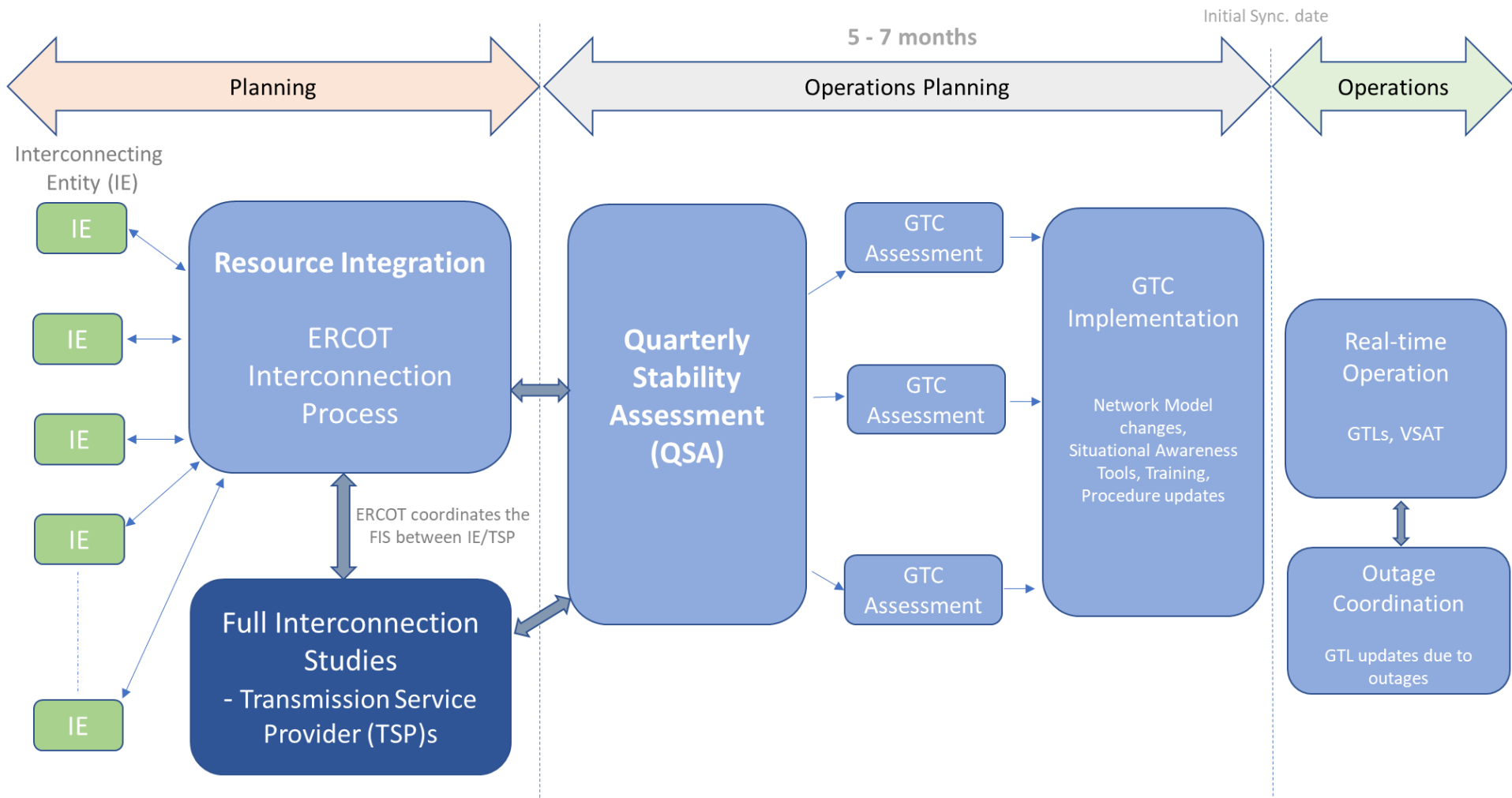
Number of effective GTCs by year



Generic Transmission Constraints (GTCs)

- GTCs are implemented to manage non-thermal System Operating Limits (SOLs) using a market-based dispatch.
- Generic Transmission Limit (GTL) is the value of the SOL for which the constrained area is managed.
- GTC must be reliable, efficient, non-discriminatory, and able to be managed through ERCOT's current operating tools and market mechanisms.
- Generators that will be controlled by GTC should have similar impact on stability issue being managed.
- GTC definition should result in appropriate control of the identified stability issue in all conditions.

GTC Process Overview



Quarterly Stability Assessments (QSA)

- QSA is a stability assessment conducted every three months to assess the impact of planned Generation Resources and Settlement Only Generators (SOGs) connecting to the ERCOT Transmission Grid.
- QSA is a cluster study that includes all Generation Resources and Settlement Only Generators (SOGs) with planned Initial Synchronization for a specific three-month period (operations horizon).
- The assessment derives the conditions to be studied with consideration given to the results of the Full Interconnection Study (FIS) stability studies for Generation Resources or SOGs, also may study conditions other than those identified in the FIS stability studies.
- QSA provides an assessment of both a specific study area and other regional issues, whereas Individual FIS – Stability study focuses on a particular GR or SOG connecting to a specific study area.
- QSA incorporates the latest transmission & generation updates, bridges the gap between FIS study and the GTC implementation.

GTC Assessment

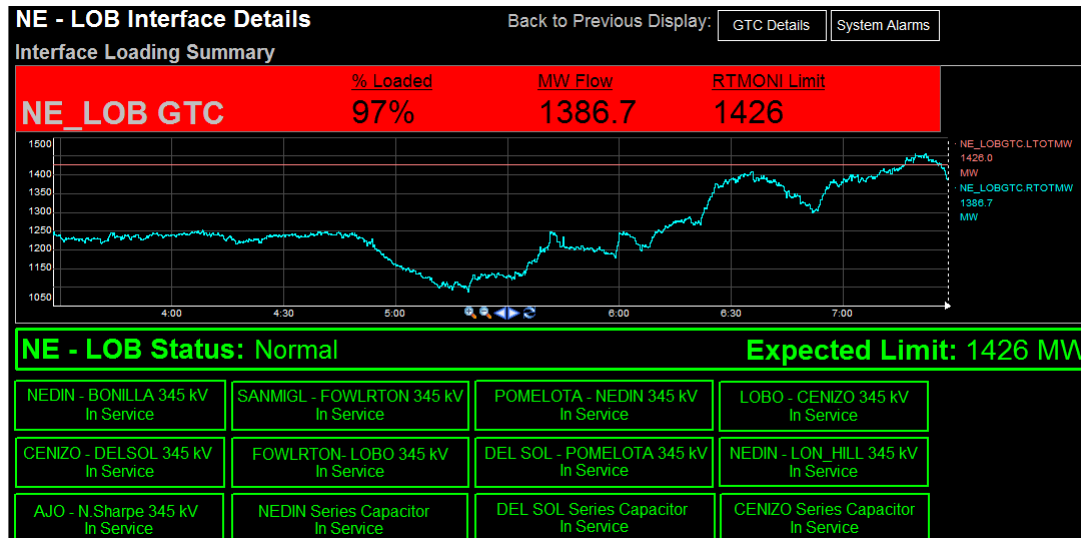
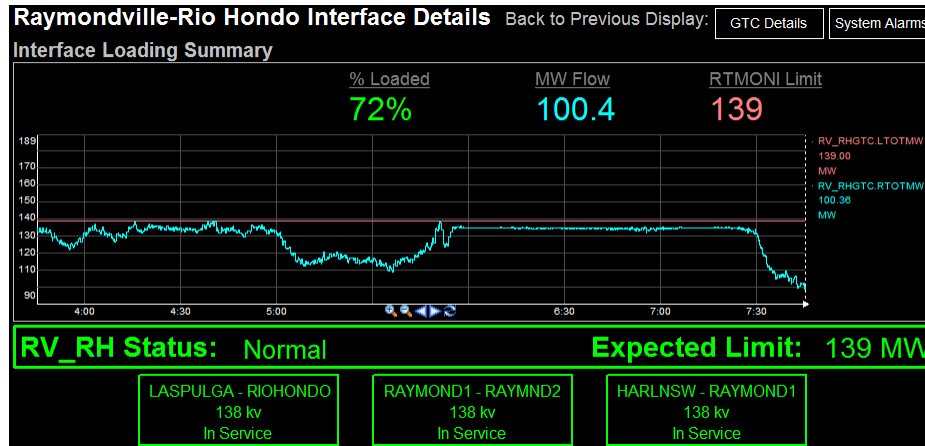
- The GTC assessment will establish the GTC interface to manage the stability issue and set the GTLs for set of operating conditions (including some prior outage conditions).
- For every new/modified GTC area identified in the QSA, ERCOT will perform a GTC assessment to implement/update the GTLs and GTC interface.
- In some cases, the QSA may provide sufficient information to update GTLs without a need for additional study, this will be determined as part of the GTC study/assessment.
- Changes to the Initial Synchronization date may move the GTC assessment to a different time period (that would be based on the latest QSA).

GTC Implementation



- Complexity/Situational Awareness
 - Network Operations Model Change Request (NOMCR)
 - PI displays / ad-hoc operator tools
 - Multi-limit tables for GTLs
 - Monitoring medium (VSAT, EMS, etc.)
 - SCED and constraint visibility
- Operator Training
 - Procedure updates
- Market Impacts
 - Getting GTC modeled in time for Congestion Revenue Right (CRR) auctions
 - GTC considerations in Day-Ahead Market (DAM) prior to implementation in the network model

Situational awareness tool examples



GTC Exit Alternatives Development

- ERCOT, in consultation with Transmission Service Provider, identifies the exit alternatives for all GTCs.
- The listed alternatives may include but are not limited to the implementation or modification of a RAS or a transmission improvement project.
- These GTC exit alternatives serve as references for implementation considerations subject to the reliability and/or economic criteria.

New GTC

- Identify the GTC exit alternatives within 180 days

Existing GTCs

- Review the adequacy of the identified GTC exit alternatives (every 3 years)
- Review if the GTC exit alternatives can be recommended based on the reliability and/or economic criteria

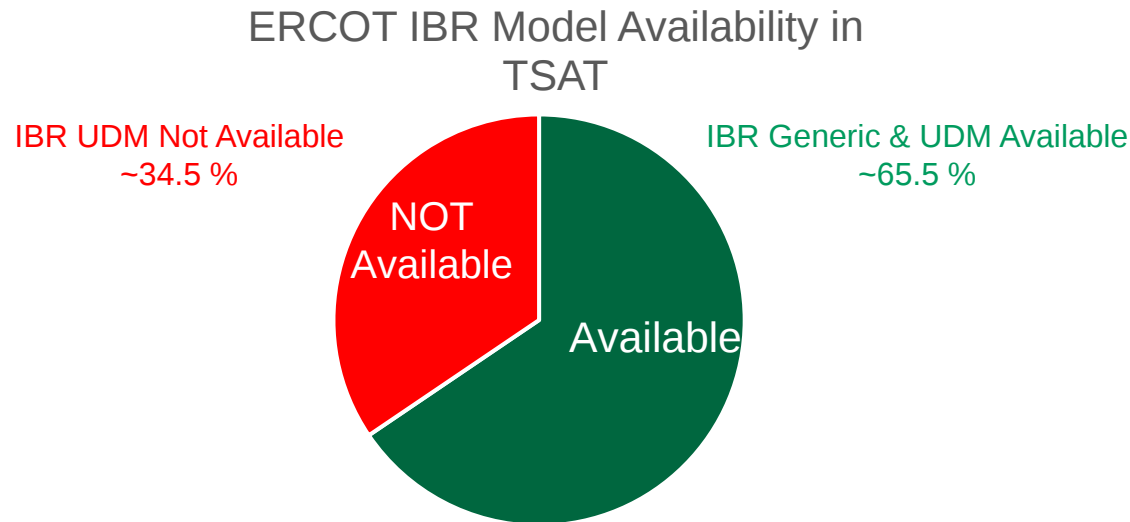
Real-time tool to calculate GTLs

- The recent increase in the number and the complexity of GTCS has made it difficult to manage these GTCs using the current off-line study process.
- The current process for GTL calculation involves off-line studies that are based on system conditions (snapshot) that represent a conservative, stressed-system (worst case) scenario.
- ERCOT is in the process of implementing *DSATools*™-Transient Security Assessment (TSAT) for Real-Time operations, expected to go on-line in 2022.
- TSAT will calculate dynamic stability related GTLs in real-time and make it easier to manage the GTCs based on actual system conditions.

DSATools™ – Dynamic Security Assessment Tool by Powertech Labs Inc.

Dynamic Model challenges

- Models for Inverter-Based Resources (wind, solar, battery) often use user-defined code (those user-defined models submitted for PSSE).
 - Generic equivalent representations in TSAT are not suitable for ERCOT regions with low system strength
 - Total Inverter-Based Resources (IBR) capacity ~ 48.3 GW



- Since 2019, ERCOT is working with various stakeholders (REs, OEMs, Powertech, others) to resolve the UDM models for TSAT.

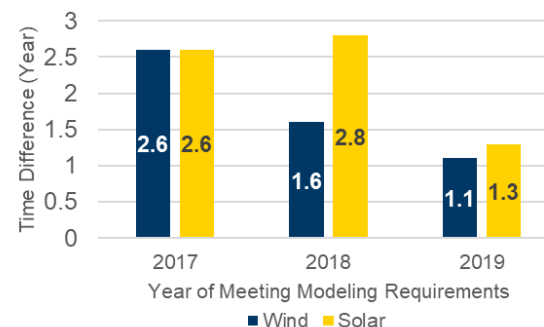
Summary

- Shorter generation interconnection timeline and less time to perform the stability studies.
- Increased interest in development of Energy Storage Resources, Distributed Generation Resources.
- Increasing number of GTCs make it difficult to manage and coordinate outages (that involves multiple outage in and around the GTC area).
- In certain situation, detail EMT models and simulation are needed to study sub-synchronous control interactions (between IRRs, FACT devices).
- Real-time stability assessment tool will address some of the challenges including outage coordination.
- Real-time stability assessment and PMU measurements (event analysis) can be used for dynamic model validation.

**18-24
Months**

Typical time for IBRs from
initial planning to physical
interconnection

Average duration of planned projects
between meeting modeling requirements and
projected commercial operation date



Dynamic models are available only
~8 months prior to COD

GTC- Additional Resources

2020 ERCOT GTC Workshop

<http://www.ercot.com/calendar/2020/2/24/201276>

Transmission Issues Related to Generation Constraints Workshop

<http://www.ercot.com/calendar/2020/8/21/209816>

Use of Generic Transmission Constraints in ERCOT – White paper

http://www.ercot.com/content/wcm/key_documents_lists/209817/The_Use_of_GTCs_in_ERCOT_July_2020.pdf

Thank you! Questions?



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