ERCOT Trending Topics

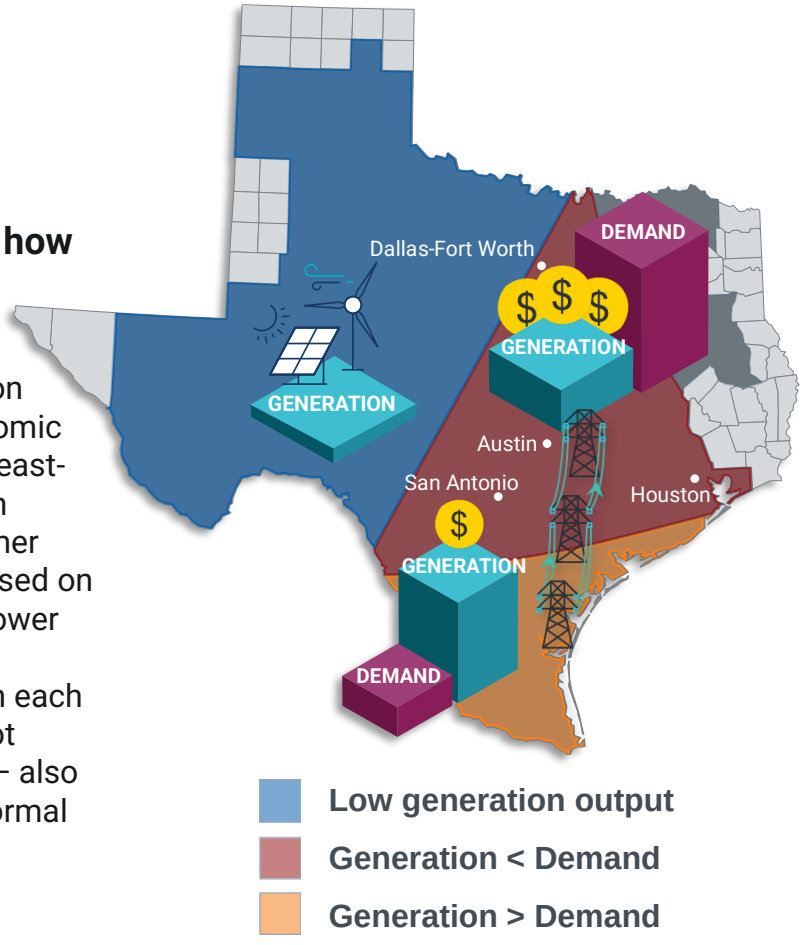
TOPIC: GENERIC TRANSMISSION CONSTRAINTS (GTCs)

In this ERCOT Trending Topic, we explain how ERCOT uses Generic Transmission Constraints (GTCs) to reduce reliability risks, including recently identified risks associated with exports and imports of power from South Texas.

FACTS:

How does ERCOT dispatch (or instruct) generation, and how is that dispatch impacted by transmission limits?

ERCOT uses a software application called Security-Constrained Economic Dispatch (SCED) to optimize the least-cost dispatch of online generation resources needed to meet customer demand across the Texas grid based on each resource's offer to supply power at a given price. SCED's dispatch solution ensures that the flows on each transmission line in the grid do not exceed that line's thermal rating — also called its thermal limit — under normal condition as well as credible contingency conditions.



A transmission line's thermal limit is the maximum amount of power that can flow on the line without creating a level of heat that causes damage to the line. This value can vary from transmission line to transmission line based on its rating.

What are Generic Transmission Constraints (GTCs), and why does ERCOT need them?

While SCED considers thermal limits of transmission lines in determining generator dispatch, it cannot consider other kinds of limits that may also impact the maximum power flow that can be transferred reliably on certain lines. For example, on very long lines, power flows above a certain level may cause a reduction in the voltage (electric pressure) on the transmission line sufficient to cause certain grid equipment to automatically disconnect from the rest of the grid. SCED cannot directly determine the power flows that would respect this non-thermal voltage stability limit. Generic Transmission Constraints (GTCs) provide a solution that enables SCED to use these stability limits in calculating generator dispatch. GTCs are defined groups of transmission lines connecting two areas of the grid. ERCOT can assign a GTC a limit that reflects the value of the stability transfer limit. SCED can then use the GTC's limit just like a thermal limit in determining the optimal generator dispatch. ERCOT currently has 22 active GTCs.

What are the new South Texas Export and Import GTCs?

As described in a recent filing with the Public Utility Commission of Texas, ERCOT has established four new GTCs that will limit power flows over certain 345-kV transmission lines from South Texas during certain conditions involving high system-wide power demand when power must either be exported from South Texas to the rest of the grid or imported from the rest of the grid into South Texas. The South Texas Export GTCs are necessary to mitigate a system-wide cascading risk, such as a risk that certain transmission line overloads during these export conditions could present a risk to the entire grid. The South Texas Import GTCs are necessary to mitigate a regional cascading risk. The GTCs will enable SCED to manage generation dispatch within these limits the majority of the time if sufficient generation is not available to be dispatched. ERCOT is required to ensure that SCED does not allow an overload of these transmission lines, because they constitute an Interconnection Reliability Operating Limit (IROL) under federal law.

What is an Interconnection Reliability Operating Limit (IROL)?

As defined by the North American Electric Reliability Corporation (NERC), an IROL is a system operating limit that, if exceeded, could lead to instability, uncontrolled separation, or cascading transmission outages, which are major risks to the reliability of the system.

NERC reliability standards require ERCOT to take preemptive actions to keep these limits from being exceeded. The federal law called the Federal Power Act requires ERCOT to comply with NERC reliability standards.

How many IROLs exist across the Texas power grid?

ERCOT currently has nine IROLs. Three of these IROLs are in West Texas; one IROL is in the Houston region; one IROL is in the Lower Rio Grande Valley; and on March 1, 2024, ERCOT designated four new IROLs related to the South Texas Export/Import constraint around the San Antonio region.

How do South Texas Export GTCs affect power flows from South Texas?

SCED would normally be able to keep the South Texas Export GTCs from being exceeded by lowering the output of generation in South Texas and raising the output of generation in the North as a part of its optimization every five minutes. The South Texas Export GTCs would only become a reliability issue during conditions involving high system-wide power demand and an insufficiency of generation to serve demand in the part of the grid outside of South Texas. Under these conditions, SCED would need to attempt to export power from South Texas to the rest of the grid, which could result in these transmission lines becoming overloaded.

Was the Energy Emergency Alert (EEA) ERCOT declared on September 6, 2023, related to the South Texas Export/Import GTCs?

Yes, this condition was related to the need for the new GTCs. On September 6, 2023, ERCOT issued an Energy Emergency Alert Level 2 (EEA 2) and entered emergency operations to address declining system frequency on the grid. This condition was due to a variety of factors that included continued high temperatures, high system-wide demand, low wind output north of the constraint, higher wind output in South Texas, declining solar generation, and a transmission limitation in the South Texas region that restricted the flow of generation out of South Texas to the rest of the grid.

Further, the demand for electricity north of the constraint exceeded the available generation, and SCED began to use generation in the south, which began to overload the transmission lines to a level that would have caused cascading outages if no corrective actions had been taken. ERCOT operators took manual actions to reduce these potential

transmission overloads by curtailing generation that had the greatest impact on the overloads. Because this was not sufficient to resolve the concern, ERCOT declared an EEA 2, which allowed the deployment of Load Resources — industrial customers who are compensated for agreeing to reduce consumption when needed for reliability — in order to reduce overall demand. This action alleviated the frequency condition on the grid.

What plan does ERCOT have to improve reliability in the South Texas region?

In August 2023, the ERCOT Board of Directors (ERCOT Board) endorsed the San Antonio South Reliability Project to provide additional transfer capability between South Texas and the rest of the Texas grid. Less than a year later, in April 2024, the ERCOT Board endorsed another transmission project, the San Antonio South Reliability II Project. These projects are expected to reduce or eliminate the need for the South Texas Export/Import GTCs. Starting in Summer 2027, and continuing through 2029, transmission utility companies in the area will begin energizing new transmission lines that will help to significantly reduce these risks. ERCOT is working with these utilities to evaluate the need for additional long-term solutions for the area.

In the near term, ERCOT has worked with these utilities to maximize the capability of the existing transmission system to deliver power from South Texas by allowing for updates to flow limits based on real-time conditions. ERCOT and the utilities have also jointly developed a plan to temporarily reconfigure the transmission system to reroute power when flows approach the identified limits. In addition, ERCOT has developed a plan to release additional generation reserves to reduce the impact of any transmission overloads. However, even with these mitigating actions, it is still possible that under certain export or import scenarios, a limited amount of customer demand may have to be curtailed (or reduced) by transmission operators to avoid transmission overloads and protect the overall reliability of the grid.

How would ERCOT direct curtailment or reduction of demand to protect the grid?

Importantly, it depends on which GTC is involved. If the South Texas *Import* GTC limit is at risk of being exceeded, ERCOT would direct transmission operators to curtail or reduce customer demand only in the South Texas region – this would be a localized or regional load shed event. If the South Texas *Export* GTC limit is at risk of being exceeded, ERCOT would direct transmission operators to curtail or reduce customer demand across the entire grid – this would be a system-wide load shed event. System-wide curtailment is

appropriate in the export situation because most of the Texas grid is located north of the South Texas Export GTC, and an exceedance of that GTC's limit would only tend to happen when the supply of generation across the grid is very nearly insufficient to serve the entire grid's demand. As a general principle, when the generation supply is not adequate to serve system-wide customer demand, ERCOT is required to direct system-wide curtailment, or reduction of demand; so, employing that same practice when the export limit is exceeded is reasonable. For more information on load shed, please see ERCOT's Trending Topic, "Using Load Shed to Address Shortages in the Generation Supply."