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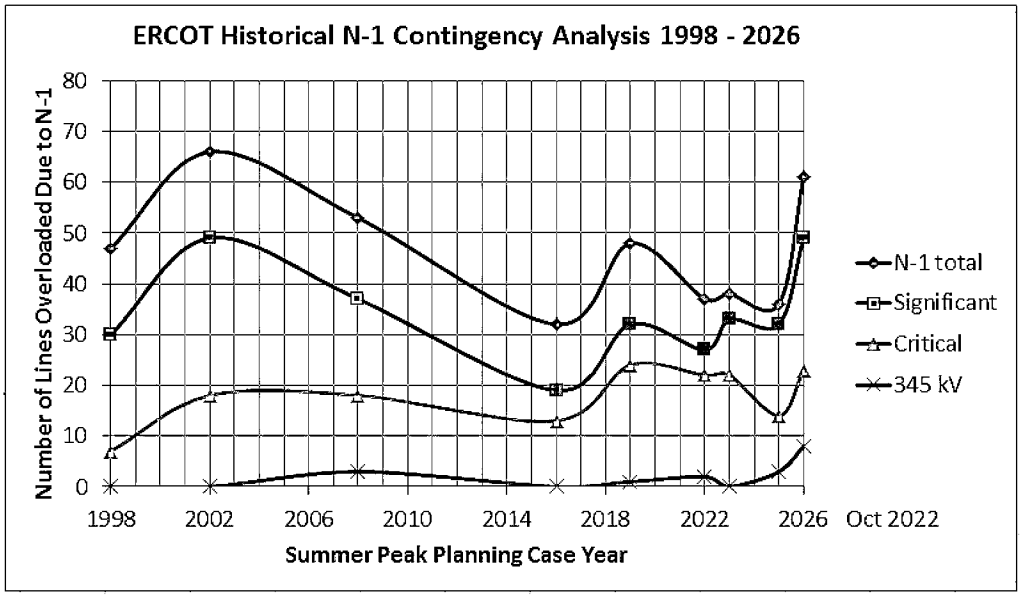
Transmission System Constraints Decrease Generation Reliability

Facts: The transmission system delivers power from generators to loads. If the transmission system has constraints, the full generation capacity is unavailable to serve all the loads at peak demand load times. The impact of the transmission system on overall reliability LOLE (loss of load expectation) has not been studied in the consultant's E3 analysis. ERCOT's own electrical network studies show a decline in the transmission system adequacy which the impacts on generation were not included in the E3 analysis.

Two strong indicators for the decline in transmission adequacy are: 1) the number of GTCs[1] are rising, and 2) the number of N-1[2] overloads has an upward turn in the 2026 case dated Oct 2022 (see below).



1) GTCs are generic transmission constraints due to stability oscillation problems when transmitting too much power from one region to another. Above a maximum power transfer limit the oscillations do not dampen out. GTCs may show up as **large blue areas** on the real time ERCOT map.

2) N-1 analysis means testing all single line outages for causing other lines to overload. If lines start tripping out on overload, the worst case scenario is a blackout the entire system. The above graph shows numbers of N-1 line overloads each year. Look for localized red areas on the real time map.

The real time security system sends price signals to dispatch generation avoiding this possibility. If the avoidance dispatch cannot be realized, the system is put at risk of breaking up. 345 kV N-1 events are critical. Some 138 kV N-1's are critical and some are simply significant. Least important N-1 caused overloads neither critical nor significant to ERCOT's overall reliability are included in the N-1 totals.

Siting Generation: GTC constraints make the siting of all new generators in the constrained area less economic and will ultimately halt supply side growth. N-1 constraints covering a smaller area than GTC constraints can stop a single generation project from moving forward. Building new transmission lines can correct the GTC and N-1 deficiencies allowing new generation projects to happen. A continuation of GTCs and N-1 overloads without building enough transmission might cause a type of planning gridlock leading to both insufficient generation and insufficient transmission throughout ERCOT.

Transmission Planning: Before deregulation, generation and new lines were planned together, in a forward looking planning process. The acquiring of new transmission ROW could take as long as the time needed to build a new power plant, so both would be completed at about the same time.

With deregulation, the forward looking transmission planning process disappeared as did generation planning. Now the need for new lines is reactionary; a retrospect procedure of lines needed after the fact. This means that lines are always imposing generation constraints during peak load periods. The energy market theory is that generation will be sited inside areas to serve load locally. However only smaller gas fired units like the Enchanted Rock LLC generators are easily sited. They are about two orders of magnitude too small to actually relieve the larger GTC and N-1 constraints now appearing.

ATC Studies: ATC is the available transfer capability in megawatts (MW). Power is injected at a point in the network and sent to load buses (i.e. substations). N-1 tests are performed and overloaded lines are identified. The most limiting overloaded line usually sets the ATC maximum MW size of the project unless new transmission is added. Doing an economic re-dispatch of gas generation might allow the ATCs to improve for a new project. It's important to understand that adding new generation in ERCOT can cause a degradation of the ATCs of existing gas generators. This is a subtle but important result of the ERCOT market. Beefing up the transmission system is needed to maintain the existing set of gas generators if this is desired. Otherwise, they may have to retire early due to insufficient revenue.

Recommendation: ERCOT performs regional transmission planning studies and creates a set of new lines needed to remove N-1 and GTC transmission deficiencies. The PUC approves the transmission improvements plan as a single reliability package for an area. The new line costs should be uplifted. I would not recommend over analyzing the economics of each line addition if the entire set of lines is needed for overall transmission adequacy for an area.

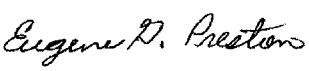
Capacity Value of Renewables: The ERCOT generation CDR (capability demand reserve) tabulation uses an averaging procedure in a spreadsheet format for estimating the capacity credits for wind and solar. Averaging variable resources at peak demand periods introduces some error into the spreadsheet tabulation as well as into the LOLE studies because it throws away low probability events information that can cause LOLE spikes. Errors can creep into studies https://egpreston.com/EGPpresentation.pdf. On page 13 of this presentation ERCOT performs all the items except the second item in its studies. ERCOT has the data but chooses to use longer sets of uncorrelated demand, wind, and solar data. One way we can tell if the CDR is biased is to look for a declining reliability of wind and solar as more is added. This sounds counter intuitive however it is fact that not all hours can be served by wind and solar no matter how much wind and solar is added to the system. Look for this effect in studies.

Designing A Zero CO_2 Emission System: When and if we ever want to phase out fossil fuels we may be stuck with needing about 28 GW of gas generation in standby mode for extreme weather events as shown in this simulation: https://egpreston.com/ERCOT22B.xlsx. Since the standby gas generates no energy in a normal weather year, the cost to maintain these gas generators would need to be uplifted.

The above spreadsheet has 40 GW of base loaded nuclear in it as well as 34 GW wind and 58 GW of grid connected solar. The reason there is less wind than in ERCOT studies is because the wind and nuclear are less compatible than solar and nuclear. The lowest cost system has wind not expanding beyond what is currently in ERCOT whereas solar 58 GW is economic in serving summer peak load periods.

If the above spreadsheet were adjusted to have 100% wind and solar, the storage cost would not be affordable, and the number of new transmission lines needed would be excessive. If we continue with our current practice of letting the market make all the decisions, we are not likely to have a low cost, reliable, and low CO_2 emissions system by 2050.

Why not let ERCOT propose a future 10 year plan for both generation and transmission projects and then bid out all the components? Generation capital investments could be protected from predatory practices. CO_2 reduction investments such as storage and nuclear could be worked into the plan. Specific locations of wind, solar, gas, and nuclear could be left up to the companies submitting bids.



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