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PROJECT NO. 52373

REVIEW OF WHOLESALE ELECTRIC MARKET DESIGN	**§ §**	**PUBLIC UTILITY COMMISSION OF TEXAS**

COMMENTS OF EOLIAN

COMES NOW Eolian and files these recommendations regarding potential market design changes for the ERCOT Region in response to the Commission Staff's request dated September 20, 2021.

INTRODUCTION

Since 2005, Eolian has invested more than $500 million of equity in the development of electricity generation in Texas which has resulted in $7 billion of direct capital investment in the state. Eolian retains an interest in 4,000 MW of operating projects in ERCOT and also owns 100% of 300 MW of standalone energy storage under construction across two sites in the ERCOT market, in addition to another 1,500 MW of standalone energy storage projects in development and targeting commercial operations in 2023 and 2024. Eolian's founders created the predecessor to Eolian as part of natural gas mineral acquisition fund, and the Eolian founders managed a portfolio of Texas mineral interests with a value in excess of $1 billion. Eolian has also partnered with oil and gas majors on the development of the electricity sector in ERCOT – recently having announced a transaction in February 2021 with Total on 2,200 MW of solar and battery energy storage that will start construction in Q4 2021 in the Houston area to help meet the load growth seen in that region. Eolian's largest shareholder is Global Infrastructure Partners (GIP). Together, Eolian and GIP have more than $9 billion of equity capital invested and committed to electricity assets across the globe.

SUMMARY

Over the next 24 months, the topology of ERCOT generators is going to experience a major transformation with approximately 21GW of new solar resources coming online. While much of

this solar is being constructed in the North, South and Houston Zones, and a substantial amount of solar is coupled with time-shifting energy storage to allow discharge into higher-priced hours during the evening peak, this unprecedented growth in the generating fleet will result in a new operating paradigm consisting of an increasing volume of daily ramping requirements of both higher magnitude and shorter duration than has historically been seen in the market. To ensure reliability in this new paradigm and as one of the largest direct investors in the newest technology being added to the ERCOT market, Eolian recommends that the PUC work with ERCOT to (a) expand the suite of ancillary service products to include an Online ECRS product, an Offline ECRS product, and a long duration Multi-Day product; and to (b) ensure that energy storage resources (ESRs) can qualify for participation in any new ECRS product, as well as the Online and Offline Non-Spin markets, with requirements that do not demand arbitrary duration metrics that could act as a barrier to the full market participation of new technologies that are built to meet market needs.

Of particular concern at the present time is the proposed NPRR 1096[1] that would impose a duration requirement of 6 hours for participation in ECRS as well as Non-Spin. ECRS is intended to be a 10-minute ramp product. The first step in the rollout and design of the ECRS product should be focused on the response and ramp time, which is of most critical concern to system reliability and especially for the ERCOT topology that will exist in the coming years. By mandating a 6-hour duration for participation in the ECRS market, all energy storage assets currently under construction or operating in ERCOT, which totals more than 2 GW, would be excluded from participation. Thus, the fastest-ramping, most responsive technology that is already under construction at scale across the ERCOT market would be forcefully barred from or significantly devalued in their participation in a product that ERCOT has adopted and is waiting

[1] NPRR 1096, Require Sustained Six Hour Capability for ECRS and Non-Spin, Posted September 28, 2021.

to implement for the purpose of increasing market reliability. Mandating a duration requirement for fast-response reliability products that is in excess of the current 1-hour-bid market construct, and on a new reliability product that may be used on a daily basis to optimize overall operations and reduce system costs passed on to consumers, directly contravenes the successful history of the ERCOT market's development, which has historically created market products that could agnostically benefit from existing and future technologies. Such action would also impose a discriminatory limitation not required of other potential participants in ECRS (or Non-Spin). For example, under NPRR 1096, it does not appear that a gas-fired generator would be tested to prove firm gas supply deliverability for 100% of its gas volume at peak load, at any and all hours, and under any and all system conditions, for a minimum of 6 hours.

COMMENTS

The ERCOT market structure has allowed for participants to identify market needs and invest in market solutions. As we saw with the growth of wind generation from 2003 to today, participants responded to market signals and moved toward geographic and resource diversity to help balance generation profiles across the system. Despite this move toward wind resource diversity, the market-wide wind profile in ERCOT has often resulted in a "V" shaped power production curve as nighttime wind falls away mid-morning and ramps up again each evening. Solar developers anticipated and responded to this mid-day energy price signal years ago and ERCOT now projects up to an additional 21GW of additional solar capacity may be installed by the end of 2023.[2] Much of this new solar generation is targeting North, Houston and South Zones to stay close to load and higher market price signals. This increasing geographic and resource diversity on the system will reduce energy scarcity events and provide cheap energy during summer peak load for consumers.

[2] ERCOT Capacity by Fuel Type Chart (August 2021) available at http://www.ercot.com/content/wcm/lists/219848/Capacity_Changes_by_Fuel_Type_Charts_August_2021.xlsx.

Importantly, this means that the type of scarcity event seen in June 2021 when thermal units tripped offline in the middle of the day during high temperatures is not the type of event that will be seen in the coming summers. The highest load during hot days is correlated to solar irradiance – thus as temperatures in east Texas rise, substantial solar generation through the midday hours will be directly correlated to this load.

With wind and solar generation providing 50% of electric load carrying capacity during peak shoulder months by 2023, the system will see a new operating paradigm that will demand a revised set of reliability needs that are vastly different from today. Instead of the system seeing prolonged (2-6 hour) scarcity events caused by high summer temperatures and unforeseen thermal generation outages or inaccurate weather forecasts, the market will instead need to manage (a) frequent ramping requirements of high magnitude and short duration as well as (b) lower system inertia as fewer thermal units are operating during shoulder periods of lower load and insufficient price signals to justify thermal dispatch. Under current system conditions as seen in 2021, much of the thermal generation follows a single daily ramp up and ramp down. In today's topology, as wind drops mid-morning, thermal units gradually ramp up, and as wind ramps up in the evening, thermal units ramp down. With as much as 21GW of new solar build in the next two years, dispatchable generation will need to ramp up during early-morning hours as overnight wind production declines, then quickly ramp down during mid-morning hours as solar production ramps up. The midday hours will see substantial solar production that will depress the need for dispatchable and baseload generation and create lower mid-day market pricing. As solar production declines late in the day, dispatchable generation will then ramp back up to follow afternoon and evening load before wind production from West Texas ramps up during the late evening hours, at which time dispatchable resources will ramp down quickly as wind production increases and load drops quickly. We anticipate that by 2023, the average required hourly system ramping from

dispatchable generation (in MW units) will be 40% higher than in current conditions, and some hours will require ramps of dispatchable generation of +/- 60% or more hour-over-hour.

To ensure reliability in this new operating paradigm, multiple ancillary services must work in parallel across different time scales to maintain the ERCOT system. Today, ERCOT has implemented:

Table 1:

Product	Ramp Speed	System Benefit	Duration
Regulation	0s (Follows Signal)	Frequency Maintenance	15min
FFR	250ms	Arresting Frequency (new market construct implemented)	15min
RRS	2s	Arresting Frequency	1hour
Online Non-Spin	<=30min	System Recovery to AVOID a Scarcity Event	1hour
Offline Non-Spin	30min	System Recovery AFTER a Scarcity Event occurs	1hour

We recommend that additional new services as outlined in the following table be implemented across the ancillary service product suite to address daily ramping pinch-points when renewables enter/exit the system and to address reliability requirements during contingency and scarcity events:

Table 2:

Product	Ramp Speed	System Benefit	Duration
Regulation [EXISTING]	0s (Follows Signal)	***Frequency Maintenance***	15min
FFR [EXISTING]	250ms	***Arresting Frequency Fast Frequency Response; Addresses Lower Inertia***	15min
RRS [EXISTING]	2s	***Arresting Frequency***	1hour
Online ECRS (ERCOT Contingency Reserve Service) [NEW, allow ESR to participate]	<=10min	***Bridging Volatility, AVOIDING Scarcity*** Accelerate the creation of a 1hour duration <=10min ramping product to stabilize market volatility and large-scale generation transitions between resources. Create an Online ECRS product to allow ESRs to respond to price signals ***before*** there is physical scarcity on the system and to avoid the deployment of online non-spin.	1hour

Offline ECRS [NEW, allow ESR to participate]	<=10min	***Bridging Volatility, AVOIDING Scarcity***	1hour
Online Non-Spin [EXISTING], but allow ESR to participate [NEW]	<=30min	System Recovery Prior to a physical scarcity Event – ***AVOIDING Scarcity***	1hour
Offline Non-Spin	30min	System Recovery in a physical scarcity Event	1hour
Multi-Day Duration Non-Spin	Hours	Multi-Day enhanced reliability ("Break the Glass Resource") that is technology agnostic.	6+ Hour

With this suite of products working together using complementary response times and durations, ERCOT can ***avoid a crisis-based system***. Instead of relying on RRS and Non-Spin to respond to emergency events, the system will use a collection of services to respond to market signals prior to scarcity events and reserve Offline Non-Spin and Long Duration generation for extreme physical scarcity and contingency events:

- **FFR**: The 250ms response from FFR aids in preserving Load Resources and Generation Resources for RRS participation during more severe events. FFR can arrest a cascading event of frequency drops related to units tripping offline with a very short restoration time in a lower inertia environment.
- **RRS**: RRS is a backstop for FFR rather than the first line of defense if multiple plants have tripped offline and require time to restart and re-synchronize.
- **Online ECRS**: This proposed product would be structured in the same manner as Online Non-Spin, which would allow <=10min ramping resources to bid into the ancillary service day ahead market for reliability and also participate in the real time energy market as economics dictate when real-time price signals exceed known and pre-determined thresholds. ECRS is a much faster product than Non-Spin and can bridge the gap between arresting frequency drops and supporting rapid ramping requirements. By allowing ECRS to operate online with a similar minimum real time offer price like Online Non-Spin, dual

participation in both day ahead ancillary service and real time energy decouples energy price scarcity vs. physical scarcity on the system. This is a key feature of both Online ECRS and the existing Online Non-Spin – it is critical to ***allow the system to self-correct*** during daily pinch points or with the loss of generation units that push real-time prices up. By allowing nearly instant responses from ESRs, the system would self-correct and have a high likelihood of avoiding Non-Spin and RUC unit calls, which should be retained as the last line of defense for system reliability. Ensuring this market construct would allow generators to provide day ahead reliability but also follow real-time market prices as an instantaneous signal for deployment would thereby add resources to the market at precisely the moments the market signals are indicating a need, and would naturally then ***align reliability requirements with real time market prices and all market participants***, instead of relying solely on ERCOT operators and dispatch. Rather than needing to wait for ERCOT to directly deploy ECRS to bridge an hour-long duration ramping event in a case where real-time generation units are unavailable or have chosen to not participate in the day-ahead market, resources in Online Non-Spin and Online ECRS would instead start dispatching as real time prices signal an immediate need.

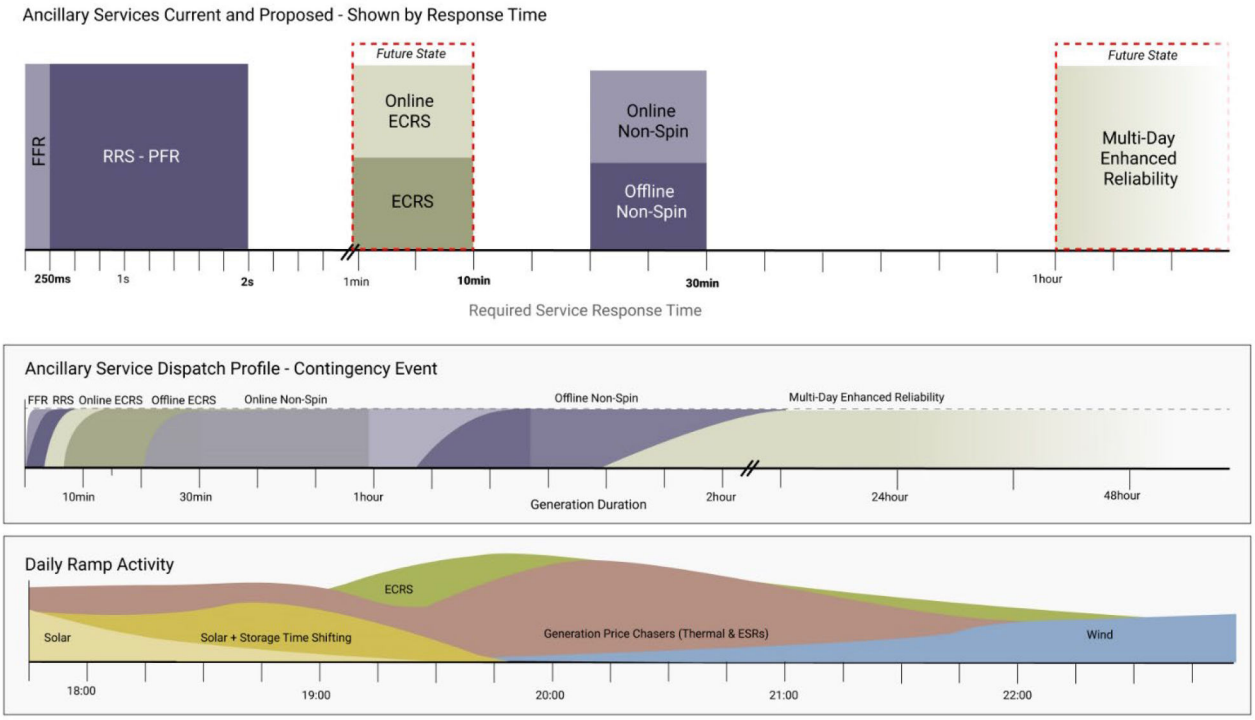
- **Offline ECRS:** This is a previously-approved ERCOT product with a 10min ramping rate and restoration within 3 hours. It mitigates system conditions such as low load with high renewable penetration that produces high ramping potential and hour/sub-hourly volatility as well as large-scale generation transitions between resources. Figure 1 below shows ECRS participation in an environment with a large evening solar ramp down if the market participants have been unable to meet instantaneous requirements from following price signals alone.

- **Online Non-Spin**: This existing 30-min ramping product allows thermal units to bid into the ancillary service day ahead market for reliability and also participate in real time energy as economics dictate. It provides a self-regulating system where day ahead committed reliability generation can follow real time signals ahead of a crisis. With enough Online Non-Spin, the market will not need to RUC resources and can preserve Offline Non-Spin as a true recovery solution. Energy storage resources are currently not able to participate in Online Non-Spin but ensuring their inclusion would provide a substantial amount of additional capacity and resources to Online Non-Spin and is an immediate action that can be taken.
- **Offline Non-Spin**: Recovery solution largely relegated to playing a role in a true scarcity event.
- **Multi-Day Enhanced Reliability / Long Duration**: A 6+ hour solution that ultimately can provide for multi-day products that can provide energy during an extreme prolonged physical scarcity event where generation units are under forced outages and unable to recover. Using a technology-agnostic duration requirement of this magnitude allows for existing technology (dual fuel) and new technologies (long duration ESRs) to participate, provided that all resources are held to the same duration capability testing, measurement requirements and protocols.

Figure 1 on the next page shows the progression of response time and performance in both a contingency event and a daily ramping event. Due to an ESR's ability to ramp faster than any other resources in response to events or needs on the grid, an ESR is ideally suited to provide FFR, RRS-PFR, Online ECRS, ECRS, and Online Non-Spin. Units that require startup times and warm-up are ideally suited for Offline Non-Spin and Multi-Day Enhanced Reliability (6+ hour).

Ultimately, a suite of market tools with varying response times will be able to successfully meet the market needs to ensure reliable service. As Figure 1 shows, in a long contingency event, products are called upon depending upon the nature and magnitude of the event. A resource that provides 1-minute ramping in Online ECRS, for example, may only have 1 or 2 hours of duration capability, at which time if a serious contingency event persists on the system, Offline Non-Spin has been ramped up from a cold start. In extraordinarily extreme events with multiple outages and unrectified failures, the Multi-Day Enhanced Reliability product may be called upon. The Daily Ramp Activity graphic shows how the market participants should be largely meeting the system needs, as they always have, but that in some cases of outages or forecast errors that ECRS and fast-ramping storage can fill the gap, typically for no more than an hour or two.

Figure 1:



Energy storage resources that are currently under construction in ERCOT can provide the flexibility increasingly required by the market and depending on their technical configuration, are also able to provide all of these ancillary services with the exception of a Multi-Day Enhanced Reliability solution. Allowing ESRs to participate in the full suite of current and future ancillary services alongside existing fast-ramping thermal units, hydro, and other participants will provide more reliability, more diversity, and more innovation to the market. If the current market signals persist and are exacerbated by increasing natural gas prices that might stay at an elevated level, ESRs will continue to quickly be deployed to meet the opportunity of reliably operating the ERCOT grid with increased penetration of renewable generation while minimizing consumer costs. By year-end 2021, there will be at least 1,500MW of operating energy storage on the system – versus ~400 MW this past summer. We anticipate that this will double prior to the summer of 2023 with many more GWs in the queue to follow, and with a large amount of energy storage paired with solar assets under construction that are also going to provide time-shifting capability to the market.

Until ECRS is implemented, it is important that Non-Spin qualification be opened to ESRs. If ERCOT and the PUC were to conclude that Offline Non-Spin can act as a bridge to a more detailed set of requirements for Multi-Day Enhanced Reliability, then, until ECRS is implemented, a sub-class of Online Non-Spin with a duration requirement of 1 hour would allow energy storage to bridge volatility and keep Offline Non-Spin resources intact for emergency conditions.

When providing these critical services, location matters. The controllable load resources and thermal generators that provide today's ancillary services exist adjacent to load pockets. Locating standalone ESRs adjacent to load is equally beneficial for reliability during extreme conditions when transmission pathways become compromised. Currently, the market does not differentiate

by location for ancillary services, however this should eventually be considered when implementing a full suite of reliability products.

CONCLUSION

Significant capital has been invested by ERCOT participants in the last 20 years in a consistent cycle of identifying market opportunities and deploying capital and new technologies to solve system needs in a market-based approach. Increased solar penetration in eastern ERCOT will eliminate the incidence of mid-day peak load market generation scarcity events that occur when large generation units trip offline or when load is at its peak of the year. However, the same increasing penetration of solar in eastern ERCOT will generate a new market challenge – exacerbating system ramping requirements over short durations and with lower system inertia. In anticipation of this market dynamic, billions of dollars have already been invested into the ERCOT market by dozens of participants to build the largest market-based deployment of energy storage resources in the world. No other market in the world currently has this level of capital deployment into energy storage based purely on market dynamics and without explicit mandates or supports. To ensure true system reliability, decouple physical scarcity from price scarcity, and to accommodate this new operating paradigm, we recommend that the PUCT:

1. Clarify ERCOT rules such that standalone energy storage can participate in Non-Spin ancillary services with specific attention to ensuring ESR participation in Online Non-Spin.
2. Preserve the current market construct for Online Non-Spin that allows participants to bid into the day-ahead market for ancillary services while also participating in real time energy as economics dictate when real-time price signals exceed known and pre-determined thresholds. Allowing new ESR resources already under construction in ERCOT to participate in this existing market will provide substantial immediate system benefits.

3. Preserve the current market construct around a 1-hour duration for all products being currently bid into the market.
4. Instruct ERCOT to procure a substantial volume of Online Non-Spin ahead of ECRS implementation, with the inclusion of energy storage as a participant.
5. If there is a desire to mandate a longer duration requirement for Offline Non-Spin, then until ECRS is implemented we recommend the PUCT direct ERCOT to add a sub-class of Non-Spin with a duration requirement of 1 hour to provide Online Non-Spin. This will allow energy storage to bridge volatility and keep Offline Non-Spin resources intact for actual physical scarcity events.
6. Direct ERCOT to accelerate the implementation of the ECRS 10-minute (or less) ancillary service product and clarify that a portion of this product should also allow for real time energy participation, structured the same way that Online Non-Spin functions (creation of Online ECRS).
7. Begin work to define a technology-agnostic, Multi-Day Enhanced Reliability product that can meet the very rare occurrences of future events that might require longer than 6 hours of reliability duration after all other system reliability products have been deployed and the market is still physically unable to meet a scarcity event.
8. Support an ancillary service procurement methodology that increases the total ancillary service MW capacity pool as renewable penetration increases and system inertia decreases. If market participants and capital resource see increasing ancillary service procurement signals, they will continue to build new flexible energy storage resources to meet market needs.

Eolian appreciates the opportunity to provide these Market Reform Recommendations and look forward to working with the Commission and other interested parties on these issues.

Respectfully submitted,

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COMMENTS OF EOLIAN

EXECUTIVE SUMMARY

In order to ensure true system reliability, decouple physical scarcity from price scarcity, and to accommodate the changing generation mix on the ERCOT grid, Eolian recommends that the Commission:

1. Clarify ERCOT rules such that standalone energy storage can participate in Non-Spin ancillary services with specific attention to ensuring ESR participation in Online Non-Spin.

2. Preserve the current market construct for Online Non-Spin that allows participants to bid into the day ahead market for ancillary service while also participating in real time energy as economics dictate when real-time price signals exceed known and pre-determined thresholds. Allowing new ESR resources already under construction in ERCOT to participate in this existing market will provide substantial immediate system benefits.

3. Preserve the current market construct around a 1-hour duration for all products being currently bid into the market.

4. Instruct ERCOT to procure a substantial volume of Online Non-Spin ahead of ECRS implementation, with the inclusion of energy storage as a participant.

5. If there is a desire to mandate a longer duration requirement for Offline Non-Spin, then until ECRS is implemented we recommend the Commission direct ERCOT to add a sub-class of Non-Spin with a duration requirement of 1 hour to provide Online Non-Spin. This will allow energy storage to bridge volatility and keep Offline Non-Spin resources intact for actual physical scarcity events.

6. Direct ERCOT to accelerate the implementation of the ECRS 10-minute (or less) ancillary service product and clarify that a portion of this product should also allow for real time energy participation, structured the same way that Online Non-Spin functions (creation of Online ECRS).

7. Begin work to define a technology-agnostic, Multi-Day Enhanced Reliability product that can meet the very rare occurrences of future events that might require longer than 6 hours of reliability duration after all other system reliability products have been deployed and the market is still physically unable to meet a scarcity event.

8. Support an ancillary service procurement methodology that increases the total ancillary service MW capacity pool as renewable penetration increases and system inertia decreases. If market participants and capital resource see increasing ancillary service procurement signals, they will continue to build new flexible energy storage resources to meet market needs.