**Summary of Multi-Interval Real Time Market (MIRTM) Feasibility Study**

**BACKGROUND**

* Most other North American Independent System Operators have implemented and used for several years a form of MIRTM, in which the real-time market analyzes a time period consisting of multiple consecutive five minute future intervals. {do most other ISOs operate as a quasi-power pool and commit and de-commit all generation at all times?}
* However, the current ERCOT real-time market software dispatches and prices energy in single five minute intervals. It does not commit resources and does not consider potential changes in conditions more than five minutes into the future. {it may be useful to explain the current rules for generation owners regarding self-commitment/self-decommittment. Today any generator not providing Ancillary Services may self-commit at any time simply by coming into service. Same is true for price responsive loads not providing AS. This also requires the QSE to update the COP for hours in the future. Likewise, any generator may self-decommitt by showing such in the COP or if in the operating period ask ERCOT operators for permission. Such actions only effect SCED when the resource status changes. Correct?}
* This construct has limitations in that it is unable to coordinate the economic commitment of resources across all generation owners such as combustion turbines and Load Resources providing demand response that are available within 10-30 minutes but unable to respond within five minutes. Additionally, these resources may be less flexible than online resources due to operational constraints (*e.g.*, start-up times, minimum loading requirements, minimum or maximum run times, etc.). {Would all Load Resources participating in MIRTM be required to comply fully with all the requirements of a Load Resources such as telemetry, COP updates, RT status updates, etc.; comply with PUC rules regarding market participation}
* The Nodal Protocols were modified to provide a “work-around” solution to commit and dispatch Quick Start Generation Resources (QSGRs) in the Real Time market:
	+ QSGRs capable of coming online within 10 minutes are allowed to telemeter a status of online although physically offline, and also to telemeter a low sustainable limit (LSL) of zero MW even though their physical LSL is greater than zero.
	+ Under this approach, QSGRs are dispatched by SCED as if already online even though they are physically unable to respond for the first 10 minutes. As a result, regulation reserves are deployed to balance the system.
	+ Many operators of combustion turbines cannot meet the QSGR requirements and therefore have no other option than to self-commit. Most QSGR-qualified combustion turbines choose not to participate as QSGRs in SCED and instead self-commit.
* A MIRTM could potentially improve the efficiency of the commitment, dispatch and pricing of resources such as combustion turbines and demand response resources by (1) coordinating the commitment as a power pool across all QSEs and honoring the resources’ temporal constraints; (2) expanding the scope of participation (Not sure what this means. If QSEs do not currently participate and prices are higher than their costs, then they may be violation of PUC rules so how is this expanding scope of participation); and (3) reflecting the physical realities of the system.

**WHAT WOULD CHANGE WITH THE IMPLEMENTATION OF MIRTM?**

* In contrast to the current design which evaluates single five minute intervals, in the MIRTM construct the real-time market software will analyze multiple consecutive five-minute intervals (the “MIRTM horizon”) to determine the most economical commitment and dispatch of resources in each of several intervals longer than 5 minutes.
* The MIRTM horizon enables the coordination of a more efficient commitment and dispatch of the current fleet of resources, and also could be expected to enhance competition by attracting more resources, especially demand response, to the real-time market. {what does a Load Resource get when it would participate in MIRTM? Is there an extra payment? ORDEC reserves? If dispatched off, all that happens is the Load is not consuming as pays nothing. A price responsive load can shut off anytime it so desires. Are you going to guarantee that the cost the load will pay will not exceed its dispatched price for the MIRTM horizon? Do they get the lower of the 5 min LMP or must they pay the MIRTM price? How is this calculated?}
* For MIRTM to be effective, accurate forecasting of system conditions over the MIRTM horizon is critical. Important inputs to MIRTM include:
	+ Short-term load forecast
	+ Current actual load (GTBD){seams issue in RT Pricing and future prices; does MIRTM replace SCED or is it an add on. Does MIRTM produce real time LMPs for settlement?}
	+ Intermittent (wind, solar) resource capacity short-term forecasts
	+ Resource status;
	+ projected Resource Status?
* Commitment instructions issued by MIRTM would be binding, but Locational Marginal Prices (LMPs) would be binding for only the next (current) five-minute interval.
* To ensure that combustion turbines and demand response resources committed by MIRTM contribute to system wide price formation when they are marginal to meet system demand, a SCED pricing run using the mechanics in NPRR 626 would be applied.
* Resources committed by MIRTM would be eligible for “make-whole” payments if real-time LMPs are insufficient to recover the offer costs. Increased accuracy in the forecast of system conditions and effective price setting by marginal resources should both work to minimize the frequency and magnitude of “make-whole” payments. {what if they do not due to the inability to forecast consumers load in the short term. Will there be a maximum uplift consumers would have to bear? If the maximum uplift is exceeded, then the program would stop?}
* MIRTM could replace the existing approach for the dispatch of QSGRs. {should this existing approach be eliminated even without MIRTM to keep QSEs more involved in self-commitment and self-decommittments and not rely on ERCOT to commit generation; Seems like even a QSGR must predict its total run time to estimate if it will recover its start-up costs?}
* Resources would retain the ability to self-commit if they so choose. {this seems extremely problematic. If you are going to have make whole payments, and the cause of the make whole may be due to self-commitments of generation that was not considered in MIRTM, then prices will be lower. This can never work consistently even with large generation coming on-line at any time. What if a big steam unit comes into service slightly sooner than it was expected? Large units cannot predict exactly when they will come into service. Why should loads pay for any make whole? It may be even the same generation company. Maybe the MIRTM should only be “advisory commitments” and the risk be managed by the generation/load that gains from its advice.}

**FINDINGS FROM MIRTM STUDY**

* ERCOT developed a software platform in-house to perform MIRTM simulations for selected operating days in 2015 and 2016 for purposes of assessing MIRTM feasibility and evaluating MIRTM’s potential production cost savings (a measure of economic efficiency).
* The simulations demonstrate that the MIRTM approach is feasible for both Fast Responding Generation Resources (FRGRs) and Load Resources (LRs) that have temporal constraints.
	+ With centralized power pool commitment and dispatch, the scope of potential participation in the real-time market is expanded to include FRGRs and LRs that currently can only participate in the real-time market through voluntary self-commitment.
	+ Increased participation in the real-time market by FRGRs and LRs would provide ERCOT with improved system visibility and operational flexibility. {would QSEs have to provide forecasted COP type information for every 5 minutes in Operating Period for all its resources?}
* For now, the MIRTM simulation study window of 30 minutes appears to strike a reasonable balance between net load forecast accuracy and the scope of potential participation by FRGRs and LRs in MIRTM.
	+ A shortened window of 15 minutes would significantly limit the scope of potential participation by FRGRs and LRs. {How did you make this determination?}
	+ A lengthened window to 45 minutes to one hour may increase the scope of participation by FRGRs and LRs, but would increase the net load forecast error and potential make whole payments.
	+ If implemented, the MIRTM window would be configurable such that it may be expanded or contracted based on operating experience to achieve the optimal balance between participation and net load forecast accuracy.
	+ Can studies be done that would only provide MIRM advisory commitments without any make whole payments to loads}
	+ {In the Power Point presentation, slide 3 you give the “Mean Absolute Error of Net Load Forecast in 2016”. Could you provide a graph of the Load forecast error that shows all errors showing the full range of outcomes both positive and negative? Is this highly variable by season?}
* On average, the MIRTM simulations did not indicate significant production cost savings for the operating days studied in 2015 and 2016.
	+ This result is influenced by the fact that system conditions and the balance of supply and demand during the period studied did not present a significant need for the types of resources that would participate in MIRTM.
	+ Changes in the future resource mix, the balance of supply and demand or system conditions could demonstrate more significant value to MIRTM. {it also could not. What basis or information do you have to support this statement}
	+ {What is the cost for QSEs and ERCOT in software and computer hardware needed to support MIRTM? Is it cost justified}
* Generally, the MIRTM simulation produces a tighter commitment pattern for FRGRs and LRs compared to the current system.
	+ A tighter commitment pattern indicates a desirable outcome where the FRGRs’ and LRs’ capacity utilization is maximized (e.g., if a FRGR is committed, its dispatch level is above its LSL). {Not sure this is true. Is it better to use FRGRs at a higher price than a base load generator at a lower price for more hours? Did you study such?}
	+ In some cases, the MIRTM simulations resulted in more price spikes than Sequential SCED. If MIRTM were to be implemented, the improvements noted below could mitigate the number and severity of price spikes.
* For the days studied in the MIRTM simulation, significant make-whole payments were not required for FRGRs or LRs committed by MIRTM.
* Potential improvements to the forecasted inputs to MIRTM could include:
	+ Resource status forecasts (e.g., Start Up, Shut Down, On Test)
	+ Accuracy of short-term Intermittent Renewable Resource forecasts
	+ Accuracy of the short-term load forecast
	+ Changes in Ancillary Service (AS) requirements across the hour boundary and associated Resource AS responsibility changes and Non Frequency Responsive Capability (NFRC) that impacts a Resources High Dispatch Limit (HDL)
	+ DC Tie schedule changes on a five-minute boundary (the MIRTM study used DC tie schedule changes on a 15 minute boundary)
	+ Local price formation for FRGRs and LRs committed by MIRTM (i.e., improvements to NPRR626 RT Deployment Price Adder)
	+ Inclusion of higher configurations for online combined-cycle generators as eligible for commitment by MIRTM (e.g., 1x1 to 2x1, or 2x1 to 2x1 + duct burner)
	+ Consideration of impacts from upcoming planned Resource status changes including outages and Transmission outages in the MIRTM study horizon