POTOMAC ECONOMICS

MEMORANDUM

TO: ERCOT Board of Directors

FROM: Dan Jones
Director, Independent Market Monitor

DATE: September 13, 2010

RE: IMM Review of the Nodal Assessment Performed by Market Reform

At the August 17, 2010 meeting of the ERCOT Board of Directors, Potomac Economics in its role as the Independent Market Monitor for the ERCOT wholesale electricity markets was requested to review the Nodal Protocols risk assessment that was prepared by Market Reform ("MR") and presented to the Board on August 16, 2010.

The MR assessment identified eight issues, categorized as follows:

Category 1: Needs Fixing Now (before market start)

- PTP Options in DAM

Category 2: Likely to Need Fixing Soon (after market start)

- Load Zone Modeling/Pricing
- Ancillary Services Deliverability
- CRR Derating

Category 3: Must Be Fixed Over Time (within a few years

- Scarcity Pricing

Category 4: Watch and Be Ready (if/when fix is needed)

- Settlement at Shadow Prices
- RUC and RUC Clawback
- SCED and 2-Step Mitigation

In this review, we use the same four categories defined in the MR assessment.

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COMMENTS

Category 1 Issues

The most critical issue identified in the MR assessment is related to Day-Ahead Market ("DAM") performance issues associated with the volume of Point-to-Point ("PTP") Option Congestion Revenue Rights ("CRRs") in the DAM. This DAM design element involves very complex modeling and does not exist in any other electricity market. Thus, it is not surprising that at some volumetric threshold the computational issues rise to the level of preventing the DAM to solve in the required timeframes. We agree that this is a Category 1 issue.

However, our understanding is that further testing indicates that a sufficient volume of PTP Options can be allowed in the DAM to accommodate their intended purpose without compromising the performance of the DAM, although some limits and rationing may be required to ensure that the total volumes remain within the identified feasibility limits.

Category 2 Issues

The Category 2 issues identified in the MR assessment were (1) Load Zone Modeling/Pricing; (2) Ancillary Services Deliverability; and (3) CRR Derating.

With respect to the Load Zone Modeling/Pricing issue, we agree with the conclusion in the MR assessment that more/smaller load zones are preferable to fewer/larger load zones from the perspectives of pricing efficiency and minimizing the effect of potential modeling errors.

In comparison to other nodal markets, some of the ERCOT load zones are relatively large. For example, the ERCOT North load zone is comparable in electrical size to the entire footprint of the ISO-New England, which is divided into eight load zones. However, some of the PJM load zones are comparable in electrical size to the ERCOT North load zone (*e.g.*, the AEP and Commonwealth Edison load zones).

The primary issue raised in the MR assessment related to load zone modeling concerns the fidelity of the load distribution factors ("LDFs") that are used in the DAM to allocate bids and offers at the load zone level to each individual load bus within the load zone. Our opinion is that the larger load zones defined in the Nodal Protocols are feasible to the extent that reasonably accurate LDFs are applied to each load zone in each hour of the DAM. Therefore, the focus at this time should be to ensure high quality LDFs rather than an assessment of creating smaller load zones. We rank the load zone modeling/LDF issue as a Category 1 issue at this time with the recognition that efforts are currently underway to ensure high quality LDFs. If the LDF issue is adequately resolved, the load zone pricing issue is a longer-term policy consideration that we rank as Category 4.

Regarding Ancillary Services Deliverability, the MR assessment identifies the ancillary service self-arrangement provisions and the lack of locational reserve markets as

presenting potential market and reliability issues. We agree that these are important issues to monitor following the implementation of the nodal market. Further, the term "undeliverable ancillary services" is not well-defined in the Nodal Protocols, so a clear definition of the specific circumstances in which ERCOT would deem ancillary services as undeliverable is required prior to addressing potential solutions to ancillary service deliverability.

The MR assessment also observes in the section related to SCED that, unlike the DAM, real-time nodal operations do not include co-optimization of energy and reserves, nor does SCED include a "look-ahead" capability that will enable more efficient commitment, dispatch and pricing of resources such as off-line gas turbines and the duct firing capacity of combined-cycle units. Both of these functionalities have been successfully implemented in other nodal markets. Finally, the implementation of both of these design elements should include demand curves for operating reserves (which has also been implemented in other nodal markets) to address the shortcomings identified in the MR assessment for the sole Category 3 issue (scarcity pricing). Because these are inter-related issues that will require considerable protocol and system changes, we place the issues of ancillary service deliverability, real-time co-optimization of energy and reserves, SCED look-ahead, and operating reserve demand curves in Category 3.

The final Category 2 issue identified in the MR Assessment is CRR Derating. We agree that the CRR Derating provisions in the Nodal Protocols are unique among nodal markets and place increased, difficult to quantify risk on CRR holders that will come at the expense of loads through reduced – perhaps significantly reduced – CRR auction revenues. We also classify CRR Derating as a Category 2 issue.

Category 3 Issues

Scarcity pricing was the sole Category 3 issue identified in the MR assessment. This issue is addressed in our response to Category 2 Issues.

Category 4 Issues

The Category 3 issues identified in the MR assessment were (1) Settlement at Shadow Prices; (2) RUC and RUC Clawback; and (3) SCED and 2-Step Mitigation.

The SCED issue is addressed in our response to Category 2 Issues. We agree with the classification of the remaining issues as Category 4.

Other Issues Not Addressed in the MR Assessment

In addition to the computational issues associated with PTP Options in the DAM identified in the MR assessment, the existence of these instruments in the DAM may affect the quality of day-ahead and real-time energy price convergence. Good price convergence between day-ahead and real-time prices facilitates efficient day-ahead generating unit commitments that reflect actual real-time operating needs. In general,

good day-ahead and real-time price convergence depends on (1) consistent topology and modeling assumptions between the day-ahead and real-time; and (2) price sensitive bids and offers in the day-ahead market, including active virtual supply and demand participation.

Unlike PTP Obligations and energy bids and offers, the manner in which PTP Options must be modeled in the DAM creates flows on the transmission system in the DAM that are inconsistent with the modeling of the flows of the underlying transactions in real-time. This modeling inconsistency may degrade the quality of day-ahead and real-time price convergence and the efficiency of generator unit commitments in the DAM, particularly if the volume of PTP Options in the DAM is significant. At this time, because the computational issues identified in the MR assessment will result in limitations on the volume of PTP Options in the DAM, we rank this additional concern as a Category 4 issue.

Another modeling issue relates to inconsistencies in the shadow price limit values assigned to transmission constraints in the DAM and real-time markets. Different transmission shadow price limits can result in different allowable transmission flows on a transmission element that is rated the same in the DAM and real-time markets. As noted above, good day-ahead and real-time price convergence depends on consistent topology and modeling assumptions between the day-ahead and real-time, and different transmission shadow price limits does not provide this consistency. Having said that, a well-functioning DAM with price sensitive bids and offers, including active virtual supply and demand participation, should generally make the transmission shadow price limits in the DAM less consequential than in the real-time markets when the system is less flexible. Therefore, we rank this issue as a Category 4.

The final issue relates to the manner in which intermittent renewable resources ("IRRs") identify SCED intervals in which they are required to curtail their output. Under the current approach, to ensure that an IRR has knowledge of the High Sustainable Limit ("HSL") used by SCED that it can compare to the base point issued by SCED to determine if curtailment has occurred, the HSL value telemetered to ERCOT by the IRR is artificially "frozen" for up to five minutes prior to each SCED execution. Under this approach, unlike for all other resources, SCED is unable to use the most current information regarding the actual production (or the production potential if curtailed) of an IRR.

With the five minute lag, these output changes (up and down) not captured by SCED will have to be compensated through regulating reserve deployments. Even though the majority of intervals do not experience significant changes in wind output, regulation procurement quantities are driven primarily by the tails of the regulation deployment frequency distribution. Thus, these less frequent but significant 5-minute wind output changes that cannot be captured by SCED because of the "frozen" HSL will ultimately result in increased regulation procurement quantities.

These 5-minute output changes not captured by SCED will also present congestion management challenges for ERCOT, particularly during times when wind output is rapidly increasing. These challenges will likely manifest as efficiency impairments as ERCOT operators resort to reducing transmission limits to account for the discrepancies between actual IRR output levels and the stale values used in SCED because of the five minute lag. Both of these results will occur to some degree in any event; however, the five minute lag will unnecessarily exacerbate the effect of both.

The solution to these issues involves ERCOT sending a flag to each IRR indicating curtailment status along with its base point for each SCED cycle. The communication of a curtailment flag would eliminate the need for the IRR to telemeter a "frozen" HSL and allow SCED to use the most current information available from the IRR, thereby enhancing the efficiency of congestion management and regulation procurement and deployment. We rank this issue as a Category 2.

The table on the following page includes a side-by-side comparison of the identified issues and categorization by MR and Potomac Economics.

We appreciate the opportunity to provide a review of the MR assessment and hope that it provides additional value to the Board in its assessment of the nodal project implementation.

I will be available to discuss this review at the September 20, 2010 ERCOT Board of Directors meeting, and can be reached by telephone at (512) 225-7139 or by email at djones@potomaceconomics.com.

	Market Reform	Potomac Economics
Category 1 *Needs Fixing Now (before market start)*	PTP Options in the DAM (computational)	PTP Options in the DAM (computational) Load Zone Modeling (DAM LDFs)
Category 2 *Likely to Need Fixing Soon (after market start)*	Load Zone Modeling/Pricing Ancillary Service Deliverability CRR Derating	CRR Derating Intermittent Renewable Resource SCED Curtailment Flag
Category 3 *Must be Fixed Over Time (within a few years)*	Scarcity Pricing	SCED: (1) Real-time Co-optimization of Energy and Reserves (2) Operating Reserve Demand Curves (3) SCED Look-Ahead Ancillary Service Deliverability
Category 4 *Watch and Be Ready (if/when fix is needed)*	Settlement at Shadow Prices RUC and RUC Clawback SCED and 2-Step Mitigation	Settlement at Shadow Prices RUC and RUC Clawback 2-Step Mitigation Load Zone Pricing PTP Options in the DAM (price convergence) DAM Transmission Constraint Shadow Price Caps