Calpine Proposed Changes to the Operating Reserve Demand Curve (ORDC)

# Executive Summary

On October 8, 2015, the Public Utility Commission of Texas (PUCT) agreed it is time to review the ORDC and determine if any changes are necessary to ensure the ORDC is working as intended. Calpine supports the use of the ORDC in conjunction with the PUCT mandated energy-only market. However, the history of pricing outcomes since the implementation of ORDC on June 1, 2014, point to a significant flaw in the current value of one of the three ORDC parameters. Commissioner Anderson raised some valid concerns about the performance of the ORDC on days like August 13, 2015 when the ORDC adder did not appropriately reflect the reduction in Physical Responsive Capacity (PRC), while ERCOT operators were taking out-of-market actions.

In order to address this shortcoming of the current ORDC described above, maintain consistency with NERC reliability standards, allow market mechanisms to function properly, and avoid unnecessary out-of-market price-suppressing actions by ERCOT, Calpine recommends the following changes to the ORDC design and the Responsive Reserve ancillary service requirement:

1. **Set the value of the Minimum Contingency Level ("X") equal to the sum of Responsive Reserve Service (RRS) and Regulation-Up Service (RUS) requirements;**
2. **Set the minimum RRS requirement at 2,750 MW.**

# Correcting the Minimum Contingency Level ("X")

As noted by Commissioner Anderson in his October 7, 2015, memo, footnote 1:

For example, on August 13, 2015, the ORDC adder did not seem to reflect appropriately the reduction in physical responsive capacity (PRC) that occurred. A low level of PRC can drive ERCOT grid operators to take out-of-market actions, including implementing Energy Emergency Alerts (EEA) and related procedures.

In fact, on August 13, 2015, PRC went below 2,500 MW and ERCOT did take out-of-market action in deploying off-line Non-Spinning Reserve Service (NSRS) and was close to declaring EEA Step #1 as PRC fell close to 2,300 MW. Yet the ORDC online price adder (RTORPA) was only $444/MWh when PRC was 2,374 MW at 15:55. This market outcome points to an obvious shortcoming in the current setting of the value of “X” of the ORDC.

The contributing factors in this flaw in the current setting of “X” of the ORDC are summarized as follows:

1. The value of "X", currently set at 2,000 MWs, is too low to send meaningful signals timely for load and generation action and is set much lower than PRC when it is equal to 2,300 MW, when ERCOT declares EEA, and even lower by a greater amount than PRC equal to 2,500 MW, when ERCOT starts taking out-of-market action.
   1. As pointed out by ERCOT in their presentation[[1]](#footnote-1) analyzing the events of August 13, 2015:

* EEA1 is called based on PRC <2300 to enable the use of Resource that are only available in emergency in a series of steps to avoid load shedding**. PRC only considers frequency responsive capacity (max 20%HSL)**
* ORDC is based on LOLP of reserves falling below 2000. ORDC reserve (RTOLCAP) includes capacity that is considered in PRC up to 100% HSL and it also includes QSGR, capacity from WGRs which are curtailed and NFRC. i.e. **ORDC reserves include all the remaining reserves in the system.**
* PRC drops much faster than ORDC because PRC only considers a fraction of the available online capacity.
* Since EEA is based on PRC, ORDC reserves could be high and price adder could be low when we are near EEA unless ORDC converges to PRC.
* As we approach scarcity PRC will be around 2500 and ORDC will gradually approach PRC as prices increase causing QSGRs to come online, resources to put their duct firing online and SCED to move resources to the top making the remaining capacity within 20%HSL. However, since minimum RRS level is 2300MW there could be situations where PRC stays just above 2300MW for a long time and could drop below 2300 when we still have lot of quick starts physically offline but available to SCED.
  1. During hot summer days, PRC calculation discounts HSL of resources by 2%. Thus PRC = 2,300 MW implies that there is about 2,500 MW of responsive capacity on the system and in RTOLCAP. On top of that, RTOLCAP has additional QSGR, capacity from WGRs which are curtailed for transmission congestion purposes and non-frequency responsive capacity (NFRC). On August 13, 2015, it was observed that there's a difference of more than 1,200 MW between PRC and RTOLCAP. Thus, a Value of “X” of 2,000 MW roughly translates to a PRC value of 1,000 MW or less - well below PRC threshold of 2,300 MW at which declaration of EEA Step #1 is triggered. Hence, the current Value of "X" does not reflect true scarcity when ERCOT declares EEA. In fact, on August 13, 2015, when PRC was 2,374 MW (close to EEA), RTOLCAP was 3,774 MW, the probability of falling below the Minimum Contingency Reserve (or LOLP) was less than 4% and the ORDC online reserve price adder was only $444/MWh.

1. As its name implies, the Operating Reserve Demand Curve should reflect the ERCOT system's willingness to pay for various operating reserves. Since the current ORDC has only one curve to represent the demand for all of the operating reserves, it must reflect ERCOT's willingness to pay for Regulation Up Service (RUS), Responsive Reserve Service (RRS), and Non-Spinning Reserve Service (NSRS) - in that order down the demand curve. And, since this demand curve is supposed to represent ERCOT's willing to pay for these reserves, ERCOT should have no concerns with using the same curve in the Day-Ahead Market (DAM) to actually procure these reserves. However, that is not the case today since the current ORDC was not designed taking into account ERCOT's willingness to pay or "demand" for each of these reserves. As described below, procuring reserves based on the current ORDC could raise serious reliability issues therefor the current ORDC does not reflect ERCOT's willingness to pay for those reserves. Consequently, the operating reserve prices resulting from the current ORDC are also not consistent with ERCOT's willingness to pay or demand for those reserve and thus do not accurately reflect true market scarcity.

Responsive Reserve Service (RRS) Must Be Included in the Value of “X”.

The objective of Responsive Reserve Service (RRS) is to ensure Frequency is arrested above the Under-frequency Load Shedding (UFLS) threshold of 59.30 Hz and to meet NERC Frequency Response Obligation (FRO) Standard (BAL-003-1). FRO for ERCOT is determined based on instantaneous loss of the two largest nuclear units (2,750 MW). ERCOT has determined that the ERCOT system must maintain specified MW amounts of RRS in order to comply with BAL-003-1 requirements. These RRS requirements would be used to set the demand curves for RRS in Real-Time Co-optimization (RTC) and, as such, should also form the basis of designing the ORDC.

ERCOT, on behalf of load, is willing to pay up to the System-Wide Offer Cap (SWOC)  
 to meet RRS capacity requirement in order to meet NERC FRO Standard (BAL-003-1). In other words, as long as there is capacity available on the system beyond what's required to meet load, ERCOT will acquire the required amount of RRS even if the capacity offer is at the SWOC. The current ORDC (Value of X set at 2,000 MW) does not produce a price signal that reflects the new NERC requirement.

As an example, assume ERCOT determines that the system requires 500 MW of RUS and 2,800 MW of RRS for certain hours to comply with NERC requirements. The price signal sent by the current ORDC is that ERCOT is willing to pay up to the SWOC for the first 2,000 MW of RUS plus RRS, but after that point ERCOT’s willingness to pay drops drastically. For the last MW of the total 3,300 MW of RUS plus RRS required by the system, ERCOT is willing to pay only up to $281/MW during the early afternoon hours in the summer months (Mu=-696 and Sigma=1,251). Thus, even if there are plenty of RRS offers at, for example, $400/MW, the current ORDC translates to ERCOT not being willing to "procure" that RRS at that offer price. Consequently, system reliability could be jeopardized and ERCOT would be non-compliant with NERC standards. This would be the outcome if the current ORDC curve was used as the demand curve to procure RRS in today's DAM or under RTC. However, currently RRS is not procured using the ORDC in DAM or in real-time (as it would be under RTC) and so ERCOT does not face this reliability dilemma, but ERCOT is sending the *wrong* price signal using the current ORDC’s value of “X”.

Regulation Up Service (RUS) Must Be Included in the Value of “X”

The power imbalance that develops between each SCED interval causes frequency deviations that require regulating reserves be deployed to correct frequency to 60.0 Hz. Resources providing regulating reserve should be able to closely follow ERCOT Load Frequency Control (LFC) signal for regulating reserves to be effective. ERCOT on an annual basis determines the MW amounts of Regulation-Up Service (Reg-Up) and Regulation-Down Service (Reg-Down) required to provide adequate regulating service for the system. These Reg-Up requirements would be used to set the demand curves for Reg-Up in Real-Time Co-optimization (RTC) and, as such, should also form the basis of designing the ORDC. ERCOT, on behalf of load, is willing to pay up to the SWOC to meet Reg-Up capacity requirement in order to meet its regulating requirements. In other words, as long as there is capacity available on the system beyond what's required to meet load, ERCOT will acquire the required amount of Reg-Up even if the capacity offer is at the SWOC.

Non-Spinning Reserve Service (NSRS) is a form of Supplemental Operating Reserve and Need Not Be Included in the Value of “X”

In contrast to the RRS and Reg-Up demand curves, Non-Spinning Reserve Service (NSRS) may be viewed as capacity reserve available to provide energy at its corresponding energy offer price to be deployed by Security Constrained Economic Dispatch (SCED) in order to meet uncertainties in demand. Since the Value of Lost Load (VOLL) represents the maximum price load is willing to pay for energy, the demand curve for NSRS should reflect the value of expected unserved energy (VEUE) avoided by the purchase of incremental amounts of NSRS capacity. This is the basis for the design of the ORDC. Unless there is scarcity on the system, ERCOT, on behalf of load, is willing to pay substantially below SWOC for NSRS and diminishing prices with increased supply of NSRS.

The translation of these separate demand curves for each AS in RTC into the current ORDC design that has only one "operating reserve" demand curve is that the value of the Minimum Contingency Level ("X") must be set equal to the sum of the RRS MW requirement plus the Reg-Up requirement in order to reflect NERC reliability requirements.

# Setting Appropriate Minimum RRS Requirement - Ensures Proper Market Functioning & Price Formation during Scarcity

RRS requirements are not set appropriately to allow market mechanisms to work and for PRC levels to reflect true scarcity. The minimum RRS requirement should be set at 2,750 MW for the following reasons:

1. Due to the 2% HSL Reserve Discount Factor (RDF) applied in calculating PRC, a PRC value of 2,500 MW when ERCOT starts taking out-of-market action translates to RRS capacity of at least 2,750 MW.
2. SCED will dispatch non-frequency responsive capacity (including from expensive QSGR providing on-line NSRS) in order to follow load and try to protect 2,750 MW of RRS.
3. If SCED is unable to maintain 2,750 MW RRS (PRC < 2,500 MW), then it’s appropriate to deploy off-line NSRS – ORDC prices should be very high at this stage.
4. Also, it is then very appropriate to declare EEA Step#1 if SCED is unable to maintain PRC at 2,300 MW (about 2,500-2,600MW responsive capacity) and the system is not projected to be recovered above PRC equal to 2,300 MW within 30 minutes.

There's also a reliability reason for setting the minimum RRS at 2,750 MW. The current NSRS can be provided by QSGR offering into SCED that can be dispatched by SCED and not reserved as NERC Contingency Reserve. By setting minimum RRS at 2,750 MW, even if all NSRS is already dispatched by SCED and 1,375 MW of generation trips off (ERCOT's interpretation of BAL-002 Most Severe Single Contingency), ERCOT should still be able to meet BAL-002 and BAL-003 requirements for arresting and returning frequency within given time limits and BAL-002 requirement of having at least 1,375 MW of NERC Contingency Reserves (in the form of RRS) within 90 minutes.

At 15:55 on August 13, 2015, if minimum RRS were set to 2,750 MW, SCED would have dispatched energy from the approximately 1,000 MW of QSGR and other NFRC in order to maintain 2,750 MW of RRS and 344 MW of Reg-Up capacity behind the respective units’ High Ancillary Service Level (HASL) and still had an additional 718 MW of QSGR capacity remaining (3,812 MW total capacity[[2]](#footnote-2) - 2,750 MW RRS capacity - 344 MW Reg-Up capacity). Setting minimum RRS at 2,750 MW would maintain PRC at or above 2,500 MW during this time - thus negating the unnecessary deployment of offline NSRS (an out-of-market action that causes price depression) since sufficient on-line and QSGR capacity was available even without the 300-400 MW of deployed offline NSRS.

Some are suggesting that making NSRS an offline capacity service or requiring QSGR providing NSRS while offering into SCED to commit whenever NSRS is deployed would somehow resolve this issue. The fact is that it would make this issue worse. With RRS requirement still at 2,300 MW, the system would have triggered the deployment of NSRS as it did on August 13, 2015, and even more resources providing NSRS (over 1,300 MW) would be unnecessarily committed with even greater market price suppression. To the contrary, having QSGR providing NSRS offering into SCED can actually help with price formation as long as SCED is instructed to maintain a consistent amount of RRS to not trigger unnecessary out-of-market actions by ERCOT.

# Recommended ORDC CHANGES

In order to address the shortcomings in the current ORDC parameters described above, remain consistent with the new NERC reliability standards, allow scarcity pricing mechanisms to function properly, and avoid unnecessary out-of-market price-suppressing action, Calpine recommends the following changes to the ORDC design and Ancillary Service requirement for RRS:

1. **Set the value of the Minimum Contingency Level ("X") equal to the sum of RRS and Reg-Up requirements;**
2. **Set the minimum RRS requirement at 2,750 MW.**

# PNM Impact of Recommended ORDC Changes

The estimated additional Peaker Net Margin (PNM) resulting from the ORDC with the recommended changes described above using the spreadsheet model provided by ERCOT is $42,675 for the entire period of June 1, 2014, to October 31, 2015. That is approximately $30,124 per year. The market behavioral response that this estimate takes into account is the commitment of available offline units and units providing NSRS when System Lambda plus ORDC price adder is above $75/MWh. Of course, as we have learned from previous backcast estimates of PNM impacts of ORDC, it's difficult to capture market behavioral response to such changes to ORDC design.

According to the Brattle Group, under the current parameters of the energy-only market design in the ERCOT region, equilibrium planning reserve margins are estimated to range from 9 to 13 percent, with an additional year-to-year planning reserve margin variation of approximately 3 percentage points around that equilibrium.[[3]](#footnote-3) The recommended changes to the ORDC would not guarantee or require the maintenance of a minimum planning reserve margin value; however, the changes would be expected to significantly reduce the probability of occurrence of outcomes at the lower end of the range of outcomes estimated by Brattle under the current design.

1. *Review of August 13, 2015*, ERCOT Presentation to TAC 10/29/15, Slide 3 [↑](#footnote-ref-1)
2. 3,774 MW of RTOLCAP divided by 0.99 to account for 1% resource discount factor [↑](#footnote-ref-2)
3. *Estimating the Economically Optimal Reserve Margin in ERCOT*, The Brattle Group, at 65 (January 31, 2014) (filed in PUCT Project No. 40000, Item No. 649). [↑](#footnote-ref-3)