

Siemens Comments and Suggestions regarding the CERC draft for Power Market Regulations dated 18th July 2020

We commend and congratulate the CERC team for creating this thoughtful, thorough and robust notification of regulations to implement the country's policy directives, and for inviting comments.

Based on our experience in global engagements in development and delivery of Market Management and Energy Management systems for different countries and their grid operators, we wanted to provide the following comments in the professional spirit of sharing some key experience and best practices for the common good of the Industry in ensuring the targeted social and economic welfare is achieved by the Country.

1. Ref. (5) (1) (a) (iv) Price Discovery and 28 (4) Information Technology infrastructure and Trading system of Power Exchange

The draft regulation mandates the zonal congestion management and market splitting. Our recommendation is in clarifying and implementing the mandate by the needed infrastructure by methods that account for the grid's physical aspects and renewable growth. Current (pre-existing) methods of Congestion management (reference: https://www.ixindia.com/Uploads/Presentation/26_03_2020IEX-Electricity-Presentation-2020.pdf) makes use of generation stack used with in each region, and limits the zonal energy exchange at the couplings. The downside of continuing the same method of congestion management is its inability to monitor flows inside a region by design. The upside comes in implementation of a dispatch that adjusts different generators in an economic manner instead of stack, as this is a non-linear problem of accounting for transmission. Linear methods of generation-stack-based analysis makes the price discovery in a misalignment with the physical or realistic behavior of the grid in the regions. There is existing best practice (e.g., California ISO and Philippines Market Operator) and use of full network model to perform price discovery itself accounting for such non-linearity of transmission system. This method makes the price discovery a realistic accounting of transmission and generation constraints. Such methods avoid a real time operational dispatch from having a large deviation from the initial price/schedule basis.

California experience (2000-2008) of Realtime congestion management deviations are from a combination of economic factors and the fact that the earlier deficient method managed only the zonal congestion in the Day Ahead and Hour Ahead Markets. Subsequent California experience in moving from zonal congestion in price discovery (2000-2008) to that of the current method (2009 - till-date) that accounts for full network model and intra-zonal congestion management is sometimes mistaken as an issue with the Power Exchange model. In practice, it is the price discovery method (using full network model) that makes a great difference by enabling and influencing the first level of zonal and intra-zonal congestion management upfront. This pricing consideration is: (a) a realistic plan and (b) avoiding the price escalation in real time by accounting for transmission (electrical distance

of generators from load centers). It is also mistaken sometimes as the nodal practice instead of zonal practice. In reality, the pool dispatch model of a country (Philippines) uses such full network model based day ahead and hour ahead processing, and essentially the same method for price discovery & dispatch in real time (5 minutes) due to the power of such modeling to achieve realistic price discovery and importantly realistic generation schedules.

Based on our understanding and experience, an electricity market becomes successful based on the feasibility of the schedule and stability of the price signal during the market trade time-interval. The feasibility of the schedule is possible if the market schedule of a participating generator can be generated, transmitted and consumed. A full network model-based congestion management ensures that the flows determined by the market is feasible considering the generator and transmission contingencies for the market trading and operation period. The current market splitting based mechanism is an important step in this direction, but the future of India that wants ensure cheaper, reliable and environmentally responsible power for all will explore these type of options that ensures reliability and determines a electric price that truly represents the cost of generation and delivery.

2. Ref. 32 (5) Market Surveillance by Power Exchange: Aspects of Volatility, Dominant position by Market Participants and Monitoring of Circular Trading:

In order to make the monitoring successful, there are preventive methods of identifying circular trading and market power (dominant position) mitigation at the time of price discovery instead of the cumbersome after-the-fact arbitration with the market participants who exhibit such practices. Such method of market power mitigation requiring full network model use for bid-mitigation also provides the market operator with the convincing evidence to inform the Participant of the reasons behind the mitigation. Reference <http://www.caiso.com/Documents/WhitePaper-SystemMarketPowerMitigation-Sep20-2019.pdf> provides the background of market power mitigation. The important fact of practice at California ISO is to perform Market Power Mitigation first and to replace mitigated bids with reference bids, and then perform the Day Ahead or Hour Ahead market clearing and price discovery. Such method avoids cumbersome arbitration associated with after-the-fact determination of detecting a consistent behavior after the market having to undergo the negative repercussions.

3. General: Renewable penetration risks (intermittency and curtailed surplus energy) converted to tremendous opportunity for the entire country.
Though it directly does not relate to what is explicitly in the regulations, there are some aspects of highly powerful cost saving methods that are worthwhile for CERC and Ministry of Power to consider including in the regulations. These are ideally suited for a large footprint of India's power grid and the vision of "one nation, one grid". The aspects of imbalance management (reference: <https://www.westerneim.com/pages/default.aspx>) is a novel method and is growing in the US to other regions in the South and the Southeast of the US besides the West. This novel method creates the System Operator method to

monetize the fluctuations of regional renewable energy (RE) across a diverse and large geographical footprint. It converts the renewable penetration (surplus) risks of a region to that of a larger-region-joint-opportunity instead of its wasteful curtailment. Such curtailments easily add up to a very large sum of money being lost over a year for the society. Any region's short-term surplus is consumed by a different region to replace its more expensive energy that would complement a momentary deficit in its RE. Fifteen minutes RE forecast accuracy has considerably improved now. Such methods were not possible seven years back due to technology limitations. But they are now running Energy Imbalance Market for the Western US with commercially and easily available computers and not super computers. The combined money saving by seven US states over a six-year period by the Energy Imbalance Market amounts to a staggering \$1 Billion USD. The parallel between US and India in this context is very appropriate due to the similarity in the size of the footprint and the diversity of RE sources in a large geographic area. This is our comment for your consideration, as we find India with a unique opportunity that is already there, while the country is rapidly gearing towards the 100 GW of solar/wind energy vision, thereby increasing the stakes of such powerful cost saving socio economic benefit for the Country.

Such methods also indirectly account for the most effective congestion management for regional level (intra zonal) while also being a mechanism towards large foot-print imbalance dispatch to monetize the negative aspects (intermittency) of RE. The premise of such novel method is arising from what is known as Look Ahead Security Economic Dispatch (SCED), instead of a single time interval dispatch. With renewable forecast in next hour (four 15-minute intervals) goes up and down, during which time some scheduled outages are also coming up, such a Look Ahead methods prepare the generators ahead of time. As the Country is now performing Automatic Generation Control (AGC) of all large generators, this novel method makes possible this new avenue to monetize the AGC implementation in a large and grand scale.

India has tremendous potential for solar based generation and thus the need for the storage system. Pumped hydro, Battery, and compressed air are some of the mechanisms that are used in many parts of the world to store the excess and use in the off solar period instead of using expensive gas units. New generation of AGC using advance control methods can use these resources to manage system regulation together with a market and reliability criteria-based look ahead economic dispatch.

Large amount of renewables and Distributed Energy Resources with its inherent volatile nature causes extreme ramp deficit condition in the system (aka CAISO duck curve, MISO Alligator curve), that cannot be corrected by the AGC, being a very short term application that looks at mitigating the system frequency regulation issues. A proper system ramping capacity management for a minimum of one hour look-ahead exploiting the ramping capacity of diverse resource sources such as hydro, gas, fast switching inverters is necessary to manage the system ramping capacities to avoid the reliability issues arising out of the ramp deficit condition. Consuming all the generated renewable energy without any

curtailment is a challenge that is addressed by these powerful methods for your consideration.

4. We wish the CREC all the best in your efforts in the commendable progress of moving the Country's socioeconomic progress rapidly forward, and we assure that Siemens Digital Grid and Executive Management is behind you if you need any best practice information or assistance.