BEFORE THE
UNITED STATE OF AMERICA
ENERGY REGULATORY COMMISSION

Reactive Supply Compensation	**)**
in Markets Operated by	**) Docket No. AD16-17**
Regional Transmission Organizations	**)**
and Independent System Operators	**)**

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TOPIC: INTRODUCTORY REMARKS
PANEL 3 ADDRESSING "COSTS INCURRED BY NONSYNCHRONOUS GENERATORS FOR REACTIVE SUPPLY"

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Good afternoon. I want to thank the Commission for inviting me to speak today.

My name is Ravi Bantu. I am the Sr. Transmission Strategist for Renewable Energy Systems ("RES"). I manage all the interconnection aspects of RES' development portfolio in the USA, Canada, and Chile. RES offers integrated solutions to centralized and distributed energy markets applying renewable energy, energy storage, transmission, and demand side management technologies. RES has developed and/or built over 10 GW of renewable energy and energy storage capacity worldwide, constructed more than 1,000 miles of transmission lines, and manages a portfolio of assets exceeding 1 GW.

In the Americas, RES has developed and constructed over 8 GW of generation. RES owns two wind assets in ERCOT, owns and operates 49.6 MW of energy storage assets in PJM. RES provides operations and maintenance service for a total of 309 MW of wind, solar, and energy storage generation. RES has significant experience in developing utility-sclae wind, solar, energy storage projects in addition to distributed solar projects.

The costs for a non-synchronous generator to install and maintain Reactive supply is higher than a synchronous generator.

RES develops and constructs wind projects throughout the United States and has noticed the costs related to maintain reactive supply and capability vary from region to region, and are somewhat project and grid specific. Historically reactive power capability of the wind turbines has improved. We have observed that the newer turbines have better reactive power capability than older turbines.

Synchronous generators by design have better reactive power capability than non-synchronous generators. The reactive capability curve best explains the reactive power capability of a generator. The X-axis of the curve shows the active power while the Y-axis shows the reactive power. A generator typically produces lowest reactive power during its maximum active power capability. The reactive power produced by a generator typically increases with reduction in active power.

Synchronous generators reactive power capability curve ("D Curve") can easily meet 0.95 lead/lag at the point of interconnection (POI). Synchronous generators typically do not deal with collection losses as they are more rather centrally located.

For a wind turbine, when compared to synchronous generator, its reactive power capability is limited as it is an induction generator with a full scale converter.

Wind farms by design have lot of losses in the collection system that need to be compensated by additional equipment (static capacitor banks, reactors, etc.). Reactive power losses are higher due to the long collection system. Even with better capability turbines, the reactive power capability curve of a wind turbine generator is inferior to a synchronous generator. Not all wind generators will be able to meet the 0.95 lead/lag dynamic reactive capability at the POI without assistance from additional equipment.

There is a cost associated with increased reactive power capability that is not associated with producing and delivering real power.

The costs incurred by a non-synchronous generator to maintain reactive supply depend mainly on the turbine design. Type 4 turbines have better reactive capability range than a Type 3 turbine. Type 1 and Type 2 turbines have inferior capability than Type 3 or 4 turbines. There is an additional cost associated with better reactive power capability range. For a same MW turbine rating, a Type 3 turbine with DVAR can be equivalent to a Type 4 turbine. Roughly a +/-10MVAr DVAr device can range somewhere around $3MM additional cost to a project.

Non-Synchronous generators will be designed and operated differently based on the current compensation mechanisms, GIA requirements or/and reliability requirements.

Current "Schedule 2" Rates for Wind Generators are not sufficient to compensate the additional costs incurred by the wind generators for supply of reactive power. As explained earlier, wind generators have to sacrifice real power to generate reactive power which does not make any economic sense for wind generators. Hence, the wind farms reactive power design is typically based on the technical criteria set by the RTO/ISO/TO in the GIA. As there is a cost associated with increased reactive power capability that is not associated with producing and delivering real power, the commission should address the compensation due to added capex for additional reactive power capability. If proper compensation mechanism is in place, the wind generators may design their farms beyond the requirement of the IA.

Lost opportunity cost is the biggest challenge for Non-Synchronous generators to supply reactive power during real time.

Wind generators are typically compensated for producing real power. As real power is dependent on the wind at the moment, the reactive power capability of the plant is also dependent on the wind at the moment as well. Depending on the MW operating point of the wind farm, there will be a lost opportunity cost for producing more reactive power in which case wind farms would prefer to produce real power. For wind farms typically producing dynamic reactive power is more expensive than producing static reactive power. If wind farms are designed with additional dynamic reactive power devices, those are mostly sitting idle unless a contingency happens. These devices can be utilized well if the compensation mechanism is properly designed.

There is no proper reactive power cost recovery mechanism for non-synchronous generators.

The cost recovery mechanism varies widely from region to region. In WECC, several TO's for example, APS, Idaho Power etc., don't have any compensation mechanism as they consider “meeting reactive power criteria” is a good utility practice. Few ISO’s such as PJM, and MISO consider AEP methodology for compensation.

The lost opportunity cost is much greater than the current compensation mechanisms. It will be very difficult for a wind generator to reduce their active power and operate out of the dead band 0.95 lead/lag pf requirements. Since producing dynamic reactive power is more expensive than producing static reactive power, the compensation method should take that into consideration.

We think that current AEP methodology should be extended to wind generators and include any externally added equipment to support dynamic reactive power.

Thank you, again, for inviting me to speak to you. I look forward to your questions.