Virtual Power Plant: Role in Power Networks

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***Abstract*-- The concept of a virtual power plant (VPP) refers to the application of communication and information technologies (ICTs) to the power transmission and distribution system. As one part of this new network, in-home displays provide real-time information on energy usage and cost, allowing consumers to adjust their habits to save money and reduce peak load demand. In addition, grid monitoring and control devices are used by utilities to anticipate, detect, and resolve problems quickly, minimizing power disruptions and making the grid more reliable and secure.**

Background & Main Results

Transmission of electricity is one of the foundations of advanced, industrialized economies. Fostering investment in electric transmission infrastructure is among the nation's highest energy priorities as a strong grid facilitates the development of alternative generation resources, is more resistant to storms, lowers electricity costs to consumers, promotes a wholesale power market with minimal congestion and market power, improves reliability and energy security, and advances energy independence overall as shown in Figure 1.

The centralized VPP control mechanism for the energy market is tested by using a 16-busbar, UK generic distribution system (UKGDS) as shown in Figure 3. We supposed that buses 12, 14, and 16 were outfitted with four PVs. While buses 3, 6, 9, and 11 were possible WTs installation places in the distribution network. It is supposed that each candidate bus can have only one PV assigned. PVs with a cumulative capacity of 440 kW have been installed on their designated buses. V_{min} = 0.94 p.u and V_{max} =1.06 p.u, are the min/max voltage limits. The planning horizon used in this study is a day divided into 24 hours. All the necessary data is taken from reference [4] with small modifications to fit our purpose. The obligations of generators at specified buses are fulfilled according to the load requirements and the access of power is injected into the day-ahead electricity market using grid supply points.

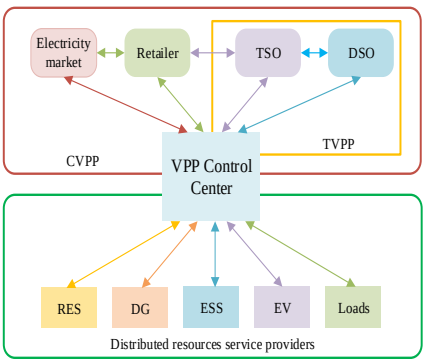

Figure 1: VPP generic structure

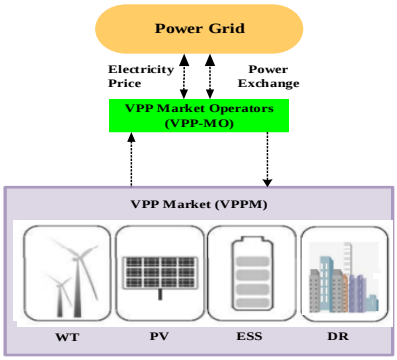

Figure 2: VPP power markets

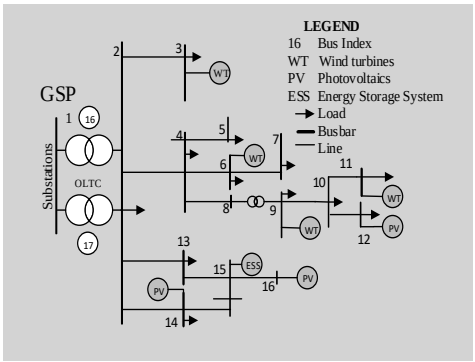

Figure 3: Single line diagram of 16-bus UKGDS

Conclusions

Better VPP controllability will allow utilities to reduce investment in the transmission lines with the application of the Internet of Things (IoTs). The combination of modern control along with real-time information and communication technologies will move them very close to their physical limits. Reduces the operation of complex and inflexible distribution generation and provides better coordination between DSO and TSO

References

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