RISE OF THE 'DSO' – A NEW CONSTRUCT FOR NEW POWER MARKETS - Stratton Report

Written By: Stratton Report

September 15, 2016

As distributed generation grows in both numbers and MWs, utilities are looking at a disruptive loss of load (read: market share) and a mismatch between traditional utility top-down business models and the new realities of power generation, distribution and consumption.

Speaking at the IEEE Innovative Smart Grid Technologies Conference (ISGT) in Minneapolis, Erik Takayesu, Director of Electric System Planning at SoCal Edison painted the picture in no uncertain terms: "Utility distribution planning and operations people are preparing for the most transformational change ever seen in our industry."

Multiple distributed energy resources ("DERs") operating at the grid-edge open up new capabilities but also carry operational risk to the power system. Challenges range from real-time reliability to long-term resource planning and load forecasting, not to mention shaking up utility business models.

The signs of this transition are everywhere. Third party aggregators are playing an ever larger role in the power business, while technology innovation (like the ever-dropping cost of solar and energy storage) remains a "known unknown," its impacts looming ever larger. Utilities, regulators and grid operators are responding in a

variety of ways. In the case of regulators in California and New York, aggressive policies are proactively driving the transition to a new model.

One proposed construct for dealing with the increasing complexity of distribution system planning grid operations, and providing mutual access between consumers and wholesale power markets is the "distribution system operator" or "DSO". This basic idea is also known in the parlance of the New York REV process as a "distribution system platform provider" or a "DSP." Yet another related acronym, used by the California ISO, is "DERP" for a distributed energy resource provider, an entity that aggregates individual distributed energy resources for wholesale market participation. Related technology platforms in development in California are known as "distributed energy resource management systems," or "DERMS".
This proliferation of terms reflects the as yet largely conceptual nature of a DSO.

As Dr. Lorenzo Kristov, Principal for Market & Infrastructure Policy at CAISO, noted at ISGT2016: "DSO is now common currency within our community, but no such thing as yet exists."

In energy system charts presented by Dr. Farrokh Rahimi, Senior VP of Open Access Technology International, the DSO sits below the ISO/RTO or balancing area with one or more transmission substations as their interface. Subsumed under the DSO may be many transactive agents and aggregators of DER services. Dr. Rahimi wrote an early treatment of the vision in 2014, "From ISO to DSO"

Dr. Mohammad Shahidehpour, Director of the Galvin Electric Center for Electricity Innovation at Illinois Institute of Technology, explained: "The DSO is essentially a new level of control – between bulk power markets and substations. The DSO acts as a balancing authority – it can bundle together aggregator operations, microgrid, variable generation, demand response, storage, EV, smart grid metering." Looked at from the perspective (and needs) of the ISO level, a DSO offers the prospect of flexible, controllable loads, critical for the further uptake of wind and solar energy.

Who will own and operate these novel entities on the grid?

Speculatively, a DSO could be run by a third party provider, or by an independent subsidiary of the local utility. Perhaps the larger demand response aggregators or microgrids could evolve into taking on the role of the DSO. In deregulated states, retail energy providers might take on those functions.
At the extreme – given that DSOs will be required to manage very dynamic, complex information networks and extremely large amounts of real time data –IT giants like Google, Apple or Intel might enter this game. Google, for example, paid $2 billion for Nest. And Apple aims to play in wholesale power markets.
To that point, another of the drivers behind the DSO is not just the ever-growing number of DERs popping up in utility distribution systems but the attendant uncertainties they impose on grid reliability and resiliency. In comparison to bulk transmission models for wholesale market analytics, measured in thousands of nodes, distribution system models are measured in the hundreds of thousands of nodes, adding scales of complexity to management of potential distribution markets.

Currently, according to Tom Mimnagh, who works in Distributed Planning & Operations at Con Edison: "The New York transmission system has knowledge of real-time power-flows across its whole system, whereas New York's distribution system has sparse monitoring of those hundreds of thousands of nodes where new DER may

interact at the grid-edge. To implement a DSP in New York, additional monitoring and control functionality will be required to effect new load balancing needs."

In other words, up to this point, the wholesale power markets have not needed to understand the local power-flows happening in distribution systems in order to run their marketplace. This would not be the case for a new DSO entity.

According to SCE's Takayesu, "We've never studied certain types of distributed resources on different circuits to respond collectively to signals all at once in aggregate. A reliability coordination role starts to emerge here. This is where the DSO entity comes in – who decides priority of control when resources are getting compensated to provide multiple services at once."

This topic was also addressed by SCE in a just released a related whitepaper, "The Emerging Clean Energy Economy"

By aggregating many controllable devices, including behind-the-meter batteries and EV batteries, a DSO would be able to absorb excess power from the grid, on top of injecting power when needed. In addition, the DSO could also play into ancillary markets such as frequency response. CAISO has recently received FERC approval to allow aggregations of behind-the-meter resources to bid into the wholesale market.
From a utility point of view, the DSO could help to facilitate the implementation of "non-wires investment". For example, Con Edison avoided $1.2B in wire upgrades by contracting for DR services in a particularly congested neighborhood of Brooklyn / Queens. More broadly, if New York State continues to utilize the traditional central generation/transmission/distribution model, it is looking at $30 billion in 10 years for infrastructure upgrades; avoiding the cost of "business as usual" was one of the main factors behind the adoption by state planners of the REV process to facilitate the use distributed resources.

The REV process seeks to restructure the entire state energy system into a customer-centric, low carbon, distributed model. (According to ConEd's Mimnagh, NY utilities are expected to deliver a "joint response" to the DSP model in November 2016. Regulators want to see a common definition of the DSP roles and responsibilities, and a structure that would enable third parties to help manage the energy transition.)

Dr. Rahimi presented one of the more in-depth breakdowns of DSO archetypes, offering a series of different models that range from conservative to extremely ambitious proposals. According to Rahimi, the NY Public Service Commission initially was envisioning his maximal #4 model, "but subsequently slowed down and is now moving somewhere between Models #1 and #2."Rahimi's most comprehensive DSO archetype #4 is perhaps equivalent to Kristov's "Total DSO", which would provide services including: "operations of distribution-level markets; DER aggregation for wholesale market participation; optimizing local DERs to provide transmission grid services; balancing supply and demand locally; managing DER to minimize impacts at the Transmission/Distribution interface; and lastly facilitating a transactive retail market."

Kristov and co-authors recently published an article illustrating the range of possible models, contrasting the Total DSO with its opposite bookend, a "Minimal DSO."

In Dr. Rahimi's view, "there are little to no technical barriers to adapting and extending wholesale market tools to retail and grid-edge transaction management." At its outer development, the DSO augurs a fully bi-directional, "Transactive Energy" peer-to-peer paradigm.

Strategic questions arise: Beyond ownership models, will DSOs be under FERC jurisdiction? Will they need to be licensed by regional ISOs? And what is the scope of the value streams they can capture and monetize?

Unfortunately, few presenters at ISGT attached dollar ranges to these scenarios. Dr. Donald Hammerstrom, Senior Research Engineer at Pacific Northwest National Labs, presented on "DSO Valuation" and warned that no single value can be roped around a DSO in the abstract. Its value can only be drawn from an analysis of highly localized revenue streams and costs (in short, it would be a similar process to the real estate industry's three key valuation factors: "Location, location and location").

For now, the DSO remains a promising but as yet theoretical entity in the Grid 2.0 innovation landscape. For Rahimi, "it may take 5 years in some states, maybe 25 years in others." However, given the furious pace of change, DSO-type pilots and testbeds may be just around the corner—and a great deal of money and future profits are clearly at stake.

Stay tuned to the Stratton Report for future coverage of the DSO construct.